Captive Breeding Protocol of Mauritius endemic snails

1 INTRODUCTION

Snails form a significant part of the ecosystem, performing a variety of roles. Many feed on living and dead vegetable material, thus aiding the process of breakdown, decay, and recycling of nutrients. Most snails are prey to a variety of vertebrate and invertebrate animals, thus are also an important component of many food chains. In Mauritius, there are a total of 125 known indigenous snail species: 81 endemics, 32 Mascarene endemics and 12 native species.

Since the arrival of humans, 44% of endemic snails have got extinct (36/81). The main reasons for these extinctions are habitat alteration and destruction and the introduction of alien invasive species, namely the Rosy Wolf Snail (*Euglandina rosea*), toads (*Bufo gutturalis*), rats (*Rattus rattus*), tenrecs (*Tenrec ecaudatus*) and pigs (*Sus scrofa*). Many of the remnant snail species today exist in fragmented populations at low abundance and are at serious risk of extinction if action is not taken to address these threats. Captive breeding of Mauritius endemic snails can be implemented at La Vanille which offers all the requirements for the breeding of the snails. This captive breeding protocol is based on decades of experience of Owen Griffiths and Dr Vincent Florens of working with Mauritian endemic snails, including field observations, husbandry and diet trials. *S*nails are by no means easy animals to keep and require particular care.

2 Focal species

The species the project will focus on initially are listed below. None of the species are formerly listed by IUCN, but according to the IUCN criteria, an IUCN status was given to each species by local experts Owen Griffiths and Dr Vincent Florens in 2006:

i. *Pachystyla bicolor* (Vulnerable)
ii. *Gonidomus concamerata* (Vulnerable)
iii. *Tropidophora eugeniae* (Endangered)
iv. *Erepta odontina* (Endangered)
v. *Ctenophila caldwelli* (Critically Endangered)
vi. *Erepta stylodon* (Critically Endangered)
vii. *Plicodomus sulcatus* (Critically Endangered)

3 Captive breeding

3.1 Source of snails

The snails will be harvested from known sub-populations mainly on mountains and preferably outside the National Park. For *Tropidophora eugeniae,* it will be collected in Malabar in Rodrigues, pending approval and permission from Rodrigues Regional assembly.

3.2 Breeding of snails

The breeding of the snails will be done at La Vanille and supervised by snail expert Owen Griffiths. The snails will be reared in outdoor enclosures, already present at La Vanille. The enclosures are fitted with suitable substrate for egg laying and appropriate enrichment – leaf litter; palm fronds; rocks etc where the snails can select suitable resting places with the appropriate humidity. Snails are left to breed, reproduce and grow though out the season until harvested. The current agreed target population level is 250 adults and associated younger life stages for each taxa.

The snails will be bred year round. The snails are fed a formulated mixture prepared by commercial feed producers that include all the nutritional requirements needed for each stage of the snail development. The young will be reared in groups and once adult, separated into smaller breeding colonies. Owen Griffiths will train staff at La Vanille and NPCS staff will be encouraged to join the training.

3.3 Environmental Factors

Humidity and temperature control needs to be constantly monitored. These factors and the correct environment are crucial for the reproductive process of the snail. They also play a very important role in the hatchability of the snails eggs.

3.3.1 Humidity

The snails must maintain a constant equilibrium between the water in its tissues and the relative humidity of the environment for optimum reproduction activities as well as growth.Snails are capable of absorbing or excreting water through their skin pores. The failure or success in raising snails depends on this factor and must be regulated accordingly.

3.3.2 Temperature

Temperature control is also a critical factor that will determine the activity of the snail. The snails prefers and functions very well at around and above 20 C. Thus appropriate shade is important.

4 Intense breeding

If given the proper conditions and the snails are not breeding, then we would choose to create intensive breeding conditions. Larger snails would be selected for breeding and placed in a 40 x 30 x 25 cm plastic or glass container fill with a 3 to 9 cm depth of soil where they will stay for approximately three weeks to copulate and lay eggs. Most of the snails mate during the night and this process can take between 3 to 15 hours. Once fertilisation is complete the snail will proceed to seek a suitable spot in which to deposit its eggs. Plastic pots, old egg carton and palm leaves are provided for this purpose. The snail should not be touched or disturbed while carrying out this activity. The snails would be left in the container for 2 or 3 days then the soil checked for eggs. After egg laying, the parent snails are removed from the container. Regular cleaning programs would be implemented, along with any other management practices that are conducted during the breeding season.

5 Maintenance

If we are carrying out intensive breeding, the enclosures cleaned at least twice a week. For smaller plastic boxes, this will be done three times weekly. The procedure is basically cleaning the enclosures, and replacing the food, then letting the containers naturally dry out before using again – this mimics periods of rain and dry the snails would experience in the wild. It is important hands are thoroughly cleaned and rinsed before maintenance and to avoid potential cross-contamination between containers. The snails are delicate and newborns small, therefore using bare hands rather than gloves is preferred.

6 Feeding

The snails are provided with a variety of food items including commercial cat diet pellets; bran flakes and vegetable peels; banana and papaya and live exotic snails for the carnivorous snails. The diet is designed as a complete food. Other potential sources of food are:

Aquarium fish food 1.5 tsp

Bone meal 3 tsp

Quaker rolled oats 3 tsp

The crushed shells of Achatina snails are also provided, to enable the snails to obtain additional calcium if needed. Generally, this is readily taken by the snails.

Water can be provided in flat recipient like saucepan. However, water used should not be chlorinated.

7 Basic Social Structure

In captivity, snails will live in groups ranging from a few animals to over 100 individuals of mixed-age classes. No aggression has ever been observed although overcrowding stress cannot be discounted.

In addition to birth, death and growth-related fluctuations in the resident populations, immigration and emigration can be regular features of the optimum population management protocol. Mixing populations can introduce fresh breeding opportunities but also risk introduction of disease.

Development and Care of Young

In pure and spanning generation populations, the young need to be removed from their parents before they reach the adult stage. In mixed generation populations, young are allowed to develop through to adult and combine with the parent population. No direct post-natal parental care has been observed to date, although it is possible young benefit from staying with adults by sharing gut flora.

Note mortality is usually highest in the newborn stage, as it is the most delicate and most prone to desiccation. Normally dead newborns can easily be identified when the soft body dries up, by holding the shell up to light (candling). It can be difficult to confirm straight away if an older animal is dead, as they can retract into the shell. However it is obviously important to try and remove any dead animals as soon as possible.

8 Monitoring

Following introduction to the enclosure, the snails will be monitored daily. Information on feeding ecology, habitat use and movement will be collected as well as on population dynamics such as recruitment, survival, mortality, and breeding ecology. Group-based management needs necessitate tracking at the life stage level rather than at the individual level. However, if required several marking options are possible. Individual marking methods used to date have included indelible ink marks on the shell, and most effectively for wild releases in recent years, water-based enamel paint. Different coloured paints can be used for each year of releases or breeding, adults marked with a spot on the whorl, and young stages on the tip of the spire. Other non-individual marking methods have included the attachment of beta lights for night tracking, as well as sticking micro pit tags on the shell.

9 General handling and restraint

Care must be taken when handling the snails to prevent shell damage, especially the young stages where the shell is not fully formed, especially at the growing edge. Most adult snails are remarkably tough once the shell is fully developed, and the thickened lip formed at the shell opening. Care must always be taken to avoid rupturing the delicate foot and body when removing any snail from any surface it is adhered to. Snails

should be gently slid off surfaces rather than pulled directly, using extra moisture if required. They tend to retract into the shell when disturbed but can become active very quickly afterwards.

Although gloves can be used, they can inhibit safe manipulation of small snails. Therefore, bare hands should be washed with an anti-bacterial soap (Hibiscrub is commonly used) and thoroughly rinsed afterwards before commencing working with the snails. This exercise should also be repeated after dealing with any dead snails and at the end of the working session. Snails have a delicate soft body, therefore it is important not to put the snails on surfaces which may have chemicals present. For this reason, it is recommended that if snails are temporarily removed from tanks they are placed on a piece of tissue or box rather than directly on a worktop.

For transportation, other than very brief journeys (e.g. within La Vanille grounds) snails are best transported in a temporary aestivation-like state. This is achieved by wrapping small numbers of snails in several layers of tissue to both protect the snails and encourage them to rest, then putting them in a rigid container with minimal ventilation.