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A CONSERVATION PROGRAMME FOR THE PARTULID TREE SNAILS OF THE PACIFIC REGION

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Abstract

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Throughout the Pacific numerous endemic molluse species have either become extinct in the wild or are currently facing the threat of extinction as a result of introduction of the predatory snail *Euglandina rosea* and the New Guinea flatworm *Platydemus manokwari*. Without determined conservation efforts, including the establishment of *ex situ* breeding programmes, much of the region's endemic snail fauna will be lost. Since 1986 a collaborative international conservation programme has been in place for partulid tree snails. The participating institutions currently maintain a total of 33 taxa in culture (comprising > 12 000 snails). The conservation status of all 117 partulid species has been assessed using the *Conservation Action Management Plan* (CAMP) process. Target *ex situ* population sizes required to maintain 90% of starting heterozygosity over 100 years have been calculated using the analytical model programme CAPACITY (Pearce-Kelly et al., 1994) The genetic management requirements of the breeding programme have necessitated the development of a colony management computer database enabling demographic management and analysis of the populations. The ability of long term captive-bred snails to readapt to natural field conditions was investigated using a trial release and monitoring experiment at Kew Gardens. Field introduction trials via the construction of predator-proof forest reserves, were commenced in 1994.

Introduction

An ill-conceived attempt at biological control of the African land snail *Achatina fulica* (using the snail predator *Euglandina rosea* and the New Guinea flatworm *Platydemus manokwari*) has resulted in large numbers of endemic mollusc species becoming extinct, or facing the threat of extinction, throughout the Pacific region. Without the establishment of *ex situ* breeding programmes many of these endemic species will face extinction.

The 117 species of Polynesian tree snails of the family Partulidae once spread over a wide group of volcanic islands of the west, central and south Pacific. Each island had its own endemic species, which were often further restricted to individual valleys. The product of extraordinary selective pressures, *Partula* (the largest and most studied genus of the Partulidae) has provided researchers with an invaluable insight to the mechanisms behind speciation (Johnson et al., 1995). In addition to their scientific importance many species of Partulidae are valued elements of the region's rich cultural heritage.

The introduction of *Euglandina* has had a disastrous effect on the region's species of Partulidae. *Euglandina* paid scant attention to its intended *Achatina* target preferring to prey on the smaller endemic snails. Extensive field surveys have determined that many partulid species have been preyed to extinction throughout their natural range (Murray and Clarke, 1984; Pearce-Kelly et al., 1994).

In 1986 the international zoo community, in association with IUCN's Captive Breeding Specialist Group, devised an international conservation programme to establish viable *ex situ* populations of as many endangered partulid species as possible. The programme is currently maintaining in culture 33 taxa (totalling >12 000 individuals) in 18 collections in Europe and North America.

A workshop in 1994 used the *Conservation Action Management Plan* (CAMP) process (Seal et al., 1994) to assess the conservation status of every species within the Partulidae. This review determined that no species could be considered as being less than endangered and identified 53 species as being in need of urgent captive-breeding assistance (Pearce-Kelly et al., 1994). Because of the intensive culture requirements associated with the Partulidae, together with the large number of species requiring captive-

breeding assistance, the workshop calculated the target population sizes required to maintain 90% of starting heterozygosity over 100 years using the analytical model programme CAPACITY (Flesness and Mace, 1988; Soule et al., 1986) The results of this exercise suggested that a minimum of 250 adults, together with their associated young, need to be maintained for each species in the breeding programme.

The demographic labyrinth

Maintaining healthy genetic populations of any species over successive generations requires a management protocol that takes account of the major factors that lead to loss of genetic diversity. These factors are genetic drift (the random process which results when a limited sample of genes from one generation is transmitted to the next), inbreeding depression (mating between relatives which can result in reduced characters such as fertility and growth rate), artificial selection (the disproportionate survival of individuals adapted to the prevailing environmental conditions — in captivity selective pressures may differ from those in the wild) and disease. In order to balance these considerations the snail cultures are maintained along inbred and outbred lines with genetic drift and inbreeding depression being minimised in the outbred lines while the inbred lines best reduce the risks of selection pressures and disease.

The taxa in the Partulidae programme derive not only from different islands but from different valleys and collection sites within valleys. Each of the >100 collection sites represents a genetically unique population which needs to be maintained as a separate breeding line. The need for generation separation and monitoring of the four developmental stages (defined as new born, juvenile, subadult and adult) are further management complications. These considerations are compounded by the need to maintain populations as colonies of up to 200 snails, of mixed age structure. The development of a computerized colony database (CERCI) has, for the first time, enabled the detailed monitoring and analysis of demographic trends, and environmental and genealogical data in colony populations.

Re-establishment

The effectiveness of the breeding programme in maintaining viable populations was tested in 1994 when a group of zoo-bred *Partula taeniata* was released on to Polynesian plants growing at Kew Gardens. This 16 month trial suggested that long term captive-bred *Partula* populations have retained their ability to readapt to a natural environment and diet (Pearce-Kelly et al., 1995). The latest development has been the commencement of reestablishment on the French Polynesian island of Moorea (Murray, 1995). Because of continued predator threat, this aspect of the programme has involved the construction of a predator-proof reserve, 20 m × 20 m, built with cheap locally available materials, and containing three species of captive-bred *Partula* snails (Murray, 1995).

For the foreseeable future, it is not possible to progress beyond the predator-proof reserve strategy due to the high numbers of surviving *Euglandina* in the habitat. These *Euglandina* are feeding on native micro-snails in the leaf litter and will continue to prevent the full re-establishment of *Partula* into the wild until effective predator control measures are developed.

To ensure that the captive snails do not become diseased, lose their natural resilience to endemic micro-organisms, or introduce alien microbes when returned to their native habitat, an extensive screening exercise is in place to determine the nature and levels of enteric gut fauna and flora in both the wild and captive *Partula* populations.

Other conservation initiatives

Educational material is being produced to help raise public awareness of the ecological disaster facing the indigenous snail fauna throughout the Pacific and, to illustrate how Polynesians can help prevent further extinctions of endemic molluscs, legislation is being formulated to prohibit further introduction of alien species into French Polynesia. These two initiatives are the most effective conservation action that can be taken to reduce the likelihood of alien predators being introduced to islands that have thus far escaped such disastrous importations.

Conclusion

The extinction of endemic species of mollusc throughout the Pacific is continuing. Without concerted *in situ* and *ex situ* action, of the nature outlined above, it can only escalate. The significance for conservation of such action is highlighted by the number of species currently afforded a second chance of survival through captive-breeding programmes. In addition to benefiting the individual target species, such programmes are potential conservation models

for many of the more than1000 IUCN-listed threatened mollusc species.

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