



Global Re-introduction Perspectives: 2010

Additional case-studies from around the globe
Edited by Pritpal S. Soorae



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Changing taxonomy and the need for supplementation in the management of re-introductions of Brothers Island tuatara in Cook Strait, New Zealand

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Introduction

Tuatara (*Sphenodon*) are medium-sized reptiles and the sole extant representatives of the order Rhynchocephalia. Once widespread in New Zealand, tuatara were extirpated from the mainland after the introduction of mammalian predators ~700 years ago. Thirty-one small natural populations are currently found on isolated off-shore islands. Although the taxonomic history of tuatara is complex, two species have been recognized since 1990: the population on North Brother Island (*S. guntheri*, Brothers Island tuatara) and all other natural populations (*S. punctatus*, Cook Strait and northern tuatara). The New Zealand Department of Conservation lists *S. guntheri* as “Nationally Endangered”, and the IUCN lists it as vulnerable (D1 + D2). However, recent genetic data indicate that the species distinction of *S. guntheri* is unwarranted, and that all tuatara are best described as



Female tuatara outside burrow

a single species (Hay *et al.*, 2010). Here we provide an update on two re-introductions of *S. guntheri* in Cook Strait, New Zealand: Titi (1995, Nelson *et al.*, 2002) and Matiu/Somes Islands (1998, Merrifield 2001). We also report a third re-introduction to Long Island (2007). North Brother Island, which is within the same ecological region, was used as the source population, and mammalian predators were eradicated prior to each re-introduction.

Goals

- Goal 1: Secure the population viability and genetic diversity of tuatara (Gaze, 2001).
- Goal 2: Ensure survival of a unique species (*Sphenodon guntheri*) through re-introductions. This goal changed in 2009 as a result of changing taxonomy (see below). The revised goal is to represent the diversity of extant populations and key geographic variants.
- Goal 3: Increase public access to tuatara and education on tuatara conservation.

Success Indicators

- Indicator 1: The release of Brothers Island tuatara onto three predator-free island sanctuaries.
- Indicator 2: Survival and growth of founders within five years of release.
- Indicator 3: Evidence of reproduction within 10 years of release.
- Indicator 4: Increased conservation advocacy.

Project Summary

Feasibility: Titi (32 ha) and Long Islands (142 ha) are protected nature and scenic reserves; Matiu/Somes (24.9 ha) is a scientific and historic reserve that is accessible by public ferry and recreational boats. Matiu/Somes Island receives about 15,000 visitors annually, posing a significant threat of reinvasion by rodents from the mainland. Upon arrival, all visitors must pass through a quarantine station administered by the Department of Conservation rangers on the island. The quarantine procedure provides an opportunity to educate visitors on the threat of introduced mammals to tuatara and other New Zealand wildlife. The mammal eradications and tuatara re-introductions required support from local Māori (indigenous peoples of New Zealand) for each island.

Implementation: The populations on Titi and Matiu/Somes Islands were founded by wild adults and captive-reared juveniles (Titi: 18 adults and 50 juveniles, Matiu/Somes: 20 adults and 35 juveniles). The Long Island population was founded entirely by captive-reared juveniles (n=53). Tuatara were sourced directly from the wild and from eggs collected from females by induction of oviposition and directly from nests on North Brother Island in 1989-1991 and 2000-2001. Eggs were hatched at Victoria University of Wellington, and juveniles were reared in semi-natural conditions in captivity at Nga Manu Nature Reserve (Titi and Matiu/Somes Islands) and the Wellington Zoo (Long Island) until release at 3-6 years of age. Tuatara were marked with unique toe-clips for identification, individually packaged in aerated poster tubes, and transported by helicopter and boat to the islands. Artificial burrows (~50cm long under vegetation) were constructed prior to re-

introduction to provide a safe place to release animals. Burrows were installed on Titi and Matiu/Somes Islands by excavating soil and installing a ~1m drainage pipe; on Titi Island, this drainage pipe connected to a wooden box with a lid to facilitate monitoring. On Long Island, burrows were excavated, but the plastic drainage pipe was not used.

Post-release monitoring: The population on Long Island has not yet been formally monitored, but several individuals have been seen during informal visits. The populations on Titi and Matiu/Somes Islands were both monitored intensely in the two years following re-introduction. Titi Island was also monitored 3, 5, and 11 years after re-introduction, and Matiu/Somes was also monitored 6, 7, and 9 years after re-introduction. The most recent monitoring event was in 2007 for both populations; 185 and 195 person hours were spent searching for tuatara on these trips (Titi and Matiu/Somes Islands, respectively). On each monitoring trip, the habitat was searched thoroughly and all tuatara encountered were caught by hand. All captured tuatara were measured for body size (snout-vent length, SVL in mm) and mass (g). Over all monitoring trips, 43 of 68 founders (63%) were captured on Titi Island, and 33 of 55 founders (60%) were captured on Matiu/Somes Island. Four of the animals on Titi Island and three on Matiu/Somes Island captured in 2007 had not been captured since release, indicating that more tuatara are likely to have survived the re-introductions but have not been located. Their cryptic appearance and difficulty searching the habitat (forest, fern thickets, penguin and seabird burrows, and cliffs) make it difficult to thoroughly search all habitat. Tuatara have dispersed from release sites to other areas of the islands, but many of the juveniles were located close to their release areas.

All founders have increased in size (SVL and mass) since re-introduction. Adults which were observed to show no growth in the eight years prior to re-introduction on North Brother Island, increased in size and continued to grow for at least 9-11 years after release ($p < 0.001$ for all SVL comparisons of individuals pre- and post-translocation, repeated measures ANOVA). Tuatara are generally in very good body condition. Animals released as juveniles on Titi and Matiu/Somes Islands have shown growth comparable with captive juveniles; some have reached a comparable size to adults in the source population, although it is unclear if this reflects sexual maturity. Reproduction was confirmed in 2007 on Titi Island with the capture of an unmarked juvenile adjacent to the adult release area, and on Matiu/Somes with the discovery of a nest. The nest location was close to a public-access track, so the two viable eggs were taken off the island and incubated at Victoria University of Wellington. Hatchlings were released back onto the island within 3.5 months of hatching.

Major difficulties faced

- Monitoring was challenging, because recapturing animals (particularly small and cryptic juveniles) in dense scrub habitat limited the ability to detect survival and growth of all founders on any single monitoring trip.
- Three factors make it difficult to assess the long-term viability of the re-introduced populations. First, the extreme longevity (100+ years) and large generation interval of tuatara (~40 years) make it difficult to interpret short-term

successes and gauge long-term success. Founding populations with only juveniles creates an additional 'lag time', as it will take several years for the founders to reach sexual maturity (maturity at ~14 years). Second, we are unable to evaluate the effects of small population sizes and losses of genetic diversity (e.g. inbreeding depression) in the source and re-introduced populations because of difficulties in capturing animals (particularly juveniles) and their longevity. If populations are founded with only juveniles, higher pre-reproductive mortality rates could reduce the number of genetic founders. Third, recent data suggest that reproductive skew in tuatara is high (up to 70% of males do not mate across multiple seasons, Moore *et al.*, 2009). Models show that in these cases, at least 70 adult tuatara (or more juveniles) should be released in the founder group to ensure that genetic targets for management are met over 10 generations (Miller *et al.*, 2009). Based on this recent information, the long-term maintenance of genetic diversity (both relative to North Brother Island and other natural tuatara populations) has become an indicator of success for re-introductions.

- We have had to re-evaluate the re-introductions of Brothers Island tuatara in light of more recent data. Historically high levels of inbreeding and kinship on North Brother Island are likely exacerbated by the re-introductions. Further, recent genetic research indicated that all tuatara are best described as a single species (Hay *et al.*, 2010). This changing taxonomy, combined with small founder groups and low genetic diversity on North Brother Island, calls into question the validity of North Brother Island as a source population for re-introductions (whereas previous knowledge indicated that it was a desired source to secure a separate species).

Major lessons learned

- When re-introduced to predator-free island sanctuaries, founder survival and growth provide an indication of short-term demographic success.
- Each monitoring event results in the capture of founders that have not been seen since re-introduction. Therefore, data from multiple monitoring events are likely to provide the best indication of short-term successes.
- Changes to taxonomy may alter priorities for conserving populations and our evaluation of single populations as ideal or poor choices as source populations for re-introductions. Based on the most recent genetic information, North Brother Island is likely a poor choice of source population. Supplementation of released populations with tuatara from a wild population with high levels of genetic diversity and within the same ecological region would be desirable for long-term management.
- Goals for a re-introduction program and the indicators of success may change as new information becomes available.
- Long-term (e.g. 10 generations) goals for genetic diversity are important to consider at the time of release, based on species biology.

Success of project

Highly Successful	Successful	Partially Successful	Failure
		√	

Reason(s) for success/failure:

- Three re-introduced populations were founded from North Brother Island, all of which are secure from introduced predators in protected reserves. One of these populations (Matiu/Somes Island) is readily accessible to the public without a permit. This re-introduced population is a successful tool for conservation advocacy, as thousands of visitors are educated annually on threats to tuatara annually.
- Growth and survival of individuals and reproduction were detected in the two populations that have been monitored for ~10 years.
- The survival of recruits and whether the re-introduced populations have a positive growth rate is unknown. The founder contributions cannot be evaluated until a large number of island-born animals are detected. It is possible that a high degree of reproductive skew in the founder groups will lead to rapid increases in inbreeding and losses of genetic diversity. Further, the effects of inbreeding cannot be determined, as it is not currently possible to evaluate individual reproductive success in the wild.
- The criteria for and indicators of success needed to be re-evaluated in light of the most recent taxonomic information. Whilst the re-introduced populations appear successful in the short-term, these populations now seem to be of lower conservation value. Success in the long-term is constrained, as re-introduction constitutes a demographic and genetic bottleneck in a historically small population.

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