

REPORT

10 year post release survey of tuatara

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Executive summary

In October 2003, sixty adult Northern tuatara (*Sphenodon punctatus*) sourced from Middle Island (Mercury Islands Group) were reintroduced to four separate sites on Tiritiri Matangi Island (Tiritiri).

This report outlines the results of the survey of the released population 11 years after the 2003 release.

The objective of the survey was to re-capture as many of the founder tuatara and their Tiritiri island-born progeny as possible within the survey period, in order to:

1. Assess the health of individuals and the population as whole,
2. Assess changes in range/distribution, population size and population structure,
3. Comment on the likely future sustainability of the population, and
4. Make recommendations regarding future management of the Tiritiri tuatara population.

Prior to the survey, a questionnaire was undertaken of regular users of Tiritiri to map recent sightings of tuatara. The questionnaire provided locations of approximately 35 individuals (excluding obvious duplicate sightings), and proved an extremely valuable tool for narrowing search areas and generating efficient captures to augment island-wide searches.

We then undertook two 5-day surveys, one from 2-6th November 2014 and one from 23-27th November 2014. Survey methods included day and night searching to detect active tuatara, active burrows, faecal pellets, sloughs and other sign that tuatara may be present.

Survey approaches included:

- Targeted searching of known individuals,
- Day searches of tracks to detect faecal pellets,
- Day searches by grid-searching off-track areas to detect tuatara burrows and basking individuals, and
- Night searching off and on tracks to detect active individuals.

Summary of results:

In total 102.5 daytime and 132.5 night-time person hours were spent searching for tuatara (actual search time minus travel and rest periods, multiplied by the number of persons undertaking the search). Weather conditions in the first search week were less than ideal for tuatara activity. However, by the second survey week night-time air temperatures were warmer and more favourable for tuatara activity.

Approximately 15 % of the island was searched by day and/or night. Searched areas were known to be most likely to support founder tuatara and/or island-born young not detected during this survey. The 85 % of the island not searched during this survey was considered less likely to support founder tuatara and/or island-born young not detected during this survey.

Thirty-one individuals (i.e. excluding re-captures during the survey) were caught. Of these, 22 were founders and 9 were individuals that had been born on Tiritiri subsequent to release in 2003. During the 5-year post-release survey (undertaken in 2009), 24 founders were caught. Overall, 30 of the founders have been re-captured during the 5-year and 10-year post-release surveys, of which 16 were caught on both surveys.

Six individuals that were caught during this survey were not caught in the previous survey. This indicates that there are likely to be founders alive on Tiritiri that have not yet been re-captured and that are potentially contributing to the breeding population.

The founder tuatara caught during this survey were, with the exception of one individual, in good health. Body weights compared to release (2003) had increased on average 36 % (range -21 % to +163 %). One individual has lost weight by 21 %. The same individual had lost 3 % of release weight by 2009, indicating a likely gradual decline over time. Most animals have increased in condition substantially (between 20 % and 50 %) since the same time of year during their release in 2003. One individual has decreased in body condition (by 20 %), and two have increased condition by a very large degree (79 % and 101 %).

The island-born tuatara that were caught ranged in snout-vent length from 144 mm to 220 mm and likely represented individuals from at least three different breeding events between years. Age of island-born young caught were estimated (based on known growth rates of tuatara young elsewhere) at 4 years up to 9 years.

Population Health

The Tuatara Recovery Group has set indicative guidelines for assessing the health of released tuatara populations. The guidelines state that:

“After 10 years, from a sample of 30-35 animals, the ratio of tuatara 120-180 mm (snout-vent length) SVL to total animals caught would be considered to indicate:

- *20% population had established,*
- *10-19% population has not established, but prospects for establishment appear good,*
- *<10% cause for concern”*

The Tuatara Recovery Plan guidelines were written before information from island translocations was available and can be interpreted in several ways.

If the strict proportion of individuals less than 180 mm SVL is taken as the guide, then of the 31 individuals were caught during this survey, three of the 9 island-born young are less than 180 mm SVL, equating to 9.7 % of the captured individuals. This suggests that *the Tiritiri population has not yet established and that there may be cause for concern about its future self-sustainability.*

Alternatively, if the measure of success is instead taken as the proportion of island-born individuals caught during the survey (i.e. juveniles and those of breeding age), the result could indicate a healthier population with recruitment occurring across age classes. The 9 island-born individuals represent 29 % of the 31 total captures and could be interpreted as showing that the Tiritiri population has established.

Future Management of the Tiritiri Matangi Island population

Irrespective of how the guidelines are interpreted or revised in the future, there remains a key management question relating to the long-term viability of the Tiritiri tuatara population, which is:

“Is breeding occurring at a rate sufficient to guarantee long-term population persistence and increase, and what can be done, if something is deemed necessary, to improve the rate of increase?”

Several options for the future management of the tuatara population are presented and briefly discussed. These include:

1. Do nothing. Monitor the population to better assess longer-term viability on the assumption that the results of this survey indicate that the population is indeed establishing and that breeding is occurring at a level sufficient to grow the founding population. There is a risk that if the population is not established that lack of intervention now may exacerbate issues further down the track and require substantially greater or more intrusive management in the future (e.g. captive rearing and egg incubation programme).
2. Use isolates to reinforce breeding nodes. Move animals which are well away from the known clusters to reinforce the clusters and increase the likely contribution of these individuals to the overall Tiritiri population. This option makes assumptions about the reproductive isolation of individuals, and relies upon the ability to successfully relocate individuals and to establish territories at sites desired by managers, and the ability of those individuals to contribute even if successfully relocated to within the node. This option can be used as a research opportunity to trial localised relocation, hard versus soft release and potential impacts of such management on resident individuals. Risks of this option are that it may be costly with negligible benefit to the overall population (if individuals move away or breeding clusters are disrupted). Potential benefits are a greater understanding of how to successfully utilise all founders in a translocated population, increased breeding within clusters and increased rates of recruitment and population growth.
3. Augment the Tiritiri population with new founders from elsewhere. The logical source is Middle Island, the source of the original founders. Alternatively, new founders could be sourced from other islands in the Mercury Group or elsewhere if genetic mixing of such island stocks is deemed appropriate. The risk with this approach is gaining the approvals necessary to undertake another translocation to Tiritiri. Middle Island supports a small number of tuatara and there may not be support scientifically or politically for another harvest of animals for Tiritiri. The willingness of DOC (and other stakeholders such as iwi) has not been tested with regards to mixing island tuatara stocks for translocations already undertaken.

Supporters of Tiritiri may wish to consider a hybrid of the above options with DOC (and other stakeholders if necessary) with components including:

1. A 15-year post-release survey that focuses on breeding and census within the identified clusters of tuatara on Tiritiri. Gaining a better understanding of the rate of recruitment and the location (if possible) of nesting sites, and numbers of founders present will provide a more robust means to make decisions about the need for future management interventions.
2. A programme of investigation into intra-island relocation of individuals, including testing of the assumptions of reproductive isolation of individuals remote from known clusters, and monitoring of movements of relocated individuals (and methods of constraining excessive post-relocation dispersal should that be deemed necessary).

3. A long-term management plan for tuatara on Tiritiri, including the potential for augmentation from other sources, even if using small numbers of additional founders, to bolster genetic diversity on Tiritiri.

Acknowledgements

This survey was commissioned by the Supporters of Tiritiri Matangi Inc and undertaken under translocation permit WK-13700-FAU¹ which provides for post-release monitoring of tuatara on Tiritiri Matangi.

We are grateful to the participants of the questionnaire who provided their personal observations on the whereabouts of tuatara on the island.

This survey would not have been possible without the enthusiastic and dedicated volunteers who willingly endured late nights, long days and scrambling over steep and densely vegetated areas of the island.

A huge thanks to the volunteers, who were:

Alison Bray	Christine Friis
Roger Bray	Mikey Watson
Hester Cooper	Gerry Brackenbury
Margie Luby	Jennifer Teo
Morag Fordham	Aaron de Raat
Rachel Goddard	

¹And the associated translocation application for Tiritiri Matangi Island entitled 'Proposal to translocate tuatara from Middle Island to Tiritiri Matangi Island' (Ussher 2003).

1 Introduction

1.1 Purpose and scope

Northern tuatara were reintroduced to Tiritiri Matangi Island (Tiritiri) in October 2003. Sixty adult tuatara were sourced from Middle Island (Mercury Islands Group) and released at four separate sites (Bush 1, Bush 2, Bush 21 and Bush 22) on Tiritiri.

This report outlines the results of the survey of the released population 11 years after the 2003 release.

The objective of the survey was to re-capture as many of the founder tuatara and their Tiritiri island-born progeny as possible within the survey period, in order to:

1. An assessment of the health of the tuatara population on Tiritiri by assessing individual animal condition, and an assessment of the level at which breeding has occurred since tuatara were re-introduced to Tiritiri in 2003, and
2. An assessment of the likely future population improvement of tuatara across Tiritiri, including identification of 'hot-spot' areas that are becoming sites where tuatara are established, breeding and increasing in density, and
3. Recommendations on the need for augmentation of the Tiritiri tuatara population based on the results of the 2014 re-survey.

The survey was undertaken in accordance with our letter of engagement dated 16 July 2014.

1.2 Background

Reintroductions of tuatara to their former range have been undertaken since the mid-1990s with most occurring since the early 2000s. The Tuatara Recovery Group recognised the need for guidelines to assess the apparent success of such reintroductions. Provisional guidelines prepared by the Recovery Group in this regard are listed below.

"After 5 years, over a 12 month period, 50% of the adults released should be recaptured and evidence of breeding on the island obtained (capture of at least 2-3 unmarked, young animals). This would not indicate that a population has established, but that prospects for its establishment appeared good.

After 10 years, from a sample of 30-35 animals, the ratio of tuatara 120-180 mm (snout-vent length) SVL to total animals caught would be considered to indicate:

20% population had established

10-19% population has not established, but prospects for establishment appear good

<10% cause for concern"

(Newman 1998)

Research and observations of tuatara on the island since release in October 2003 has provided some information on the distribution, breeding and status of the population. Sources of information include:

1. Two nests observed in January 2004 and February 2004 (as recorded in the photos by Graham Ussher dated 2005),
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2. Research undertaken two years after the tuatara release (Ruffell, 2005²) indicated that most tuatara had left the immediate surrounds of their respective forest interior release sites and had moved to road-side margins, cliff edges or seabird colonies. Several appeared to have become site attached and established territories.
3. Hatchling observed in December 2006 (Teneal Cope *pers. comm.*),
4. The results of the 5-year post-release survey undertaken in March 2009³ which re-caught 27 founders, found three island-born young and identified two 'breeding nodes' where individuals were concentrated and young found,
5. Nest and hatchlings observed in August 2009 by Massey University staff (as outlined in the summary by Dylan van Winkel, September 2009), and
6. Sightings recorded by visitors to the island in the 'tuatara sightings' book in the bunkhouse, and latterly through conversations with rangers, researchers and off-track volunteers to the island.

The 5-year survey concluded that, as judged against the Recovery Group's guidelines, there was evidence for the tentative establishment of the tuatara population on Tiritiri.

The results of the 10-year survey outlined in this report will provide an updated assessment of the establishment of the population since 2009 and indicate future management needs to provide assurance of its establishment in the future.

² Ruffell J. (2005). The use of translocation in tuatara (*Sphenodon punctatus punctatus*) conservation and relationships between the tuatara and the tick *Aponomma sphenodonti* (Acari: Ixodidae). Unpublished MSc Thesis. The University of Auckland, New Zealand.

³ van Winkel, D. and Habgood, M. (2009). Tuatara survey on Tiritiri Matangi Island: Five years post-translocation. Unpublished report to the Auckland Department of Conservation, New Zealand. 29 pages.

2 Methodology

The approach taken included a review of distribution records and a population re-survey.

2.1 Review of distribution records

To assist with identifying site-attached animals and to focus initial search efforts, a survey of regular users of the island was undertaken to collate sightings of tuatara. The questionnaire (Appendix A) was distributed to several SOTM guides, DOC staff, researchers (past and present) and regular volunteers. Participants were asked to mark on a map of the island recent tuatara sightings and to provide descriptions of the locations seen.

The results were collated into a single sightings map to assist with targeted searches of the island during the on-the-ground population re-survey phase.

2.2 Population re-survey

Two 4-day surveys were undertaken, one from 2-6th November 2014 and one from 23-27th November 2014. Survey methods included day and night searching to detect active tuatara, active burrows, faecal pellets, sloughs and other sign that tuatara may be present.

Survey teams comprised 4-5 people, including one experienced tuatara surveyor (Graham Ussher) and volunteers familiar with off-track areas of Tiritiri.

Day searches involved walking tracks and grid-searching sites of known tuatara presence, past records of sightings and grid-searching sites that supported good quality tuatara habitat. For day searches, a focus was on detecting individuals basking outside burrows, burrows likely to have been constructed by tuatara, tuatara faecal pellets and sloughs.

Night searches involved searching for active tuatara using head-mounted spotlights to grid-search areas searched during the day and along tracks.

Location of individuals caught, those suspected to be present and historic sightings were mapped to provide a spatial representation of the population.

2.3 Tuatara body measures

Records of body measurements followed the morphometrics recorded during the 2009 survey (repeated below in full; source: van Winkel, D. and Habgood, M. (2009)).

All tuatara captured during the survey period were scanned with a PIT tag reader, weighed (g), measured (snout to vent length, SVL; and vent to tail length, VTL; mm), sexed, and marked before being released at the site of capture.

Weights were recorded to the nearest 0.5 g using a 1000 g Pesola scale. The SVL and VTL were measured on the ventral surface of the animal; from the tip of the snout to the cloacal opening (vent) and from the vent to the tip of the tail, respectively. The length of the regenerating tail was measured when observed. The sex of each animal was determined by a number of criteria (Table 1). The presence and number of external parasites, such as mites and/or ticks, on each individual was recorded. The processing time for each tuatara varied between 5 – 10 minutes.

Table 1. Sexual dimorphic characteristics of tuatara (*Sphenodon punctatus*) (Dawbin, 1981).

Characteristic	Male	Female
Nuchal crest/ dorsal spines	Large, distinctive nuchal crest separated from a further dorsal crest	Less developed or absent nuchal crest and often lacking distinct dorsal spines.
Head width	Head usually proportionately wider than abdomen, due mainly to musculature of the jaw.	Head similar width to the abdomen, due to less developed jaw musculature.
Weight	Between 500 - 800 grams	Very occasionally exceed 500 grams
SVL	Up to 265 mm	Usually less than 225 mm

Raw data were analysed to provide information on the status of the population, including:

- Total captures of founders and island-born individuals,
- Number and proportion of island-born individuals within the Recovery Group criteria size range
- Change in individual weight and condition index since release
- Qualitative assessment of clustering of individuals

Changes in animal condition over time were calculated using a condition index which gives a ratio of animal weight to SVL corrected for growth over time:

$$C_i = \frac{((W_i / L_i) - (W_R / L_R))}{(W_R / L_R)}$$

where:

C_i = Condition Index

W_i = Weight at time i

L_i = SVL at time i

W_R = Weight at release (2003)

L_R = SVL at release (2003)

This index assumes that gross morphology of tuatara (e.g. retention of tail) remains essentially constant between release and this survey, which was confirmed by viewing tail length and regeneration information for each individual.

Body condition of tuatara changes with season, particularly over drier months when individuals can lose up to 20% of their body weight. This can have a significant effect on body condition, so comparing condition between times and different seasons potentially confounds season with trend over time. This survey was undertaken during November and is therefore comparable to the time of year when animals were originally released into Tiritiri (October). Hence comparisons of body condition and change over time between 2003 and 2014 can be considered to be valid indicators of true change in animal condition over time.

3 Results

3.1 Questionnaire

Eight responses were obtained to the questionnaire. Together these represented people who had the greatest experience of the island off-track and at night, and who were most likely to have encountered tuatara during their time on the island.

The questionnaires generated approximately 35 unique sightings (possible multiple sightings of animals and sightings older than 3 years were excluded).

3.2 Search effort and areas

Searches were conducted for 102.5 person hours search effort over 7 daytime periods and 132.5 person hours search effort at night giving a total search time of 235 person hours (Appendix B).

Approximately half of the time was spent searching key known areas with the remainder split between grid-searching valley areas in the central part of Tiritiri and searching track networks and visiting individual sighting areas.

Total area searched by day and/or by night amounted to approximately 32 ha (approx. 15 % of Tiritiri's land area, by plan view).

Weather conditions in the first search week were less than ideal for tuatara activity. However, by the second survey week night-time air temperatures were far warmer and more favourable for tuatara activity.

3.3 Captures

Thirty-one unique animals (i.e. excluding re-captures during the survey) were caught (Appendix C). Of these, 22 were founders (originally released on the island in 2003) and 9 were individuals which had been born on Tiritiri since the release in 2003.

In addition, four individuals were sighted but not caught (they evaded capture), comprising two adults and two juveniles. Sign or recent sightings (within the past 2 years) are known for another 13 individuals.

The 2009 5-year survey detected 27 founder animals (of which 24 were captured), of which 16 were also caught during this (2014) survey. The 2009 survey caught 8 other founders not caught during this survey, and this survey caught 6 founders not caught during the 2009.

In total, the 2009 and 2014 surveys have re-captured 30 of the 60 founders released in 2003.

Table 1 provides a summary of the captures, missed individuals and suspected individuals present that were not sighted.

Evidence	Founder Male	Founder Female	Island-born juvenile or sub-adult	Total	Notes
Captures (this survey)	13	9	9 (range 144 mm to 220 mm SVL)	31	Includes one adult female killed by accidental collision with ute on road immediately prior to survey.
Evaded capture (seen but not caught this survey)	2		2	4	
Recent record of sighting or sign	13			13	
Total				48	48 individuals represents the results from a 2-week survey over 15 % of the island area and collective recent records from others.

3.4 Health and condition

All of the animals caught, except one, were in excellent condition. Body weights compared to release (2003) had increased on average 36 % (range -21 % to +163 %). One individual has lost weight by 21 %. The same individual had lost 3 % of release weight by 2009, indicating a likely gradual decline over time.

While weight indicates increase in mass over time, a more accurate assessment of animal condition can be obtained by also incorporating the body length of individual i.e. accounting for the increase in growth over time. Table 2 provides an analysis of the change in body condition for founders as a measure of overall individual health since release.

Table 2. Change in body condition for founder individuals between release in 2003 and 2015 (this survey).

Most animals have increased in condition substantially (between 20 % and 50 %) since release. One individual has decreased in body condition (by 20 %), and two have increased condition by a very large degree (79 % and 101 %).

Change in condition	Number individuals	Magnitude of change for each individual (% change since release)
less than 0	1	-20
0 – 24 %	11	7, 13, 9, 4, 4, 15, 24, 23, 20, 15, 14
25 – 49 %	7	41, 47, 42, 26, 34, 34, 43
50 – 74 %	1	52
75 – 99 %	1	79
100 -	1	101
Total	22	

Table 3 presents the body length (SVL) and body condition (weight/ SVL) for the 9 island born tuatara captured during the survey.

Condition values ranged from 0.8 to 2.1 and are broadly consistent with condition indexes of young tuatara found elsewhere; juveniles caught on Whale Island in 2006 in the same size range had condition indexes ranging from 0.8 to 1.6 (n=4); juveniles from the established population on Lady Alice Island in 2000 in the same size range had condition indexes ranging from 0.9 to 1.8; average 1.3; n = 16).

Table 3. Length, weight and body condition of island born tuatara from the Tiritiri survey.

Individual	SVL mm	weight g	Condition (w/SVL)
1	215	450	2.1
2	191	280	1.5
3	193	315	1.6
4	212	415	2.0
5	144	115	0.8

6	150	135	0.9
7	174	195	1.1
8	207	345	1.7
9	220	420	1.9

All individuals caught were checked for ticks and mites – none were present.

4 Discussion and options for management

4.1 Methods

The survey followed traditional methods of day and night survey to detect individuals active above ground and to find sites where tuatara presence was likely or known. The strategy of targeting known sightings as a priority provided valuable initial information on individuals known from tracks and beach areas, although by itself did not provide a representative picture of habitat use and local density (given the search bias for one habitat type over others). Searches were subsequently undertaken (during the survey) through adjoining vegetation and grid-searches of vegetation blocks to provide a comparative estimate of tuatara density in other habitats.

The overall pattern of habitat use is clear and reinforces patterns seen from other surveys and casual observation by others on Tiritiri – that of a concentration of tuatara along tracks, roads, open grassland areas, beaches and anywhere there is a sharp transition between forest/scrub and grassland/coast. Tuatara on other islands use the full suite of habitats present on Tiritiri, including forest interiors. Therefore, it is likely that tuatara on Tiritiri are preferentially using optimal habitats, and it is likely that the ample additional habitat on Tiritiri comprising scrub and forest interiors can support future growth of the Tiritiri tuatara population.

The use of volunteers with a detailed knowledge of Tiritiri's tracks and forest patches was extremely useful, as was the pre-survey questionnaire distributed to pin-point recent sightings.

The timing of this survey (November) was different to the timing of the 2009 survey (February/March) – this choice was deliberate. Tuatara surveys are typically conducted in early summer or early autumn – both times of year potentially provide the right climatic conditions for a good level of tuatara activity, including of juveniles. November was chosen for this survey so that comparison could be made for changes in individual animal condition between the October 2003 release and the 2014 survey, without the potentially confounding factor of the seasonal change in body condition known to occur in tuatara populations elsewhere.

4.2 Management

From the results of this survey, there are clear indications that the Tiritiri tuatara population has all of the elements needed for an established, healthy population. A summary of the relevant evidence is as follows:

1. We re-caught 22 of the 60 founders within an area encompassing the main release sites, although that area is likely to support founders not caught in the survey. The area surveyed comprises approximately 15 % of the total area of Tiritiri available to support tuatara and individuals are known to have dispersed widely throughout such areas post-release.
2. Six of the founders caught on this survey had not been caught during the 5-year post-release survey. Low detectability, but high survivorship of translocated adult tuatara has been noted on other islands where individuals have sometime not been detected for up to 10 years despite intensive searching. This indicates that it is very likely that most of the founding tuatara released onto Tiritiri in 2003 are still alive, and if in proximity to other individuals, may be contributing to the breeding population.
3. Individual condition of founders is excellent (with the exception of one individual). It can be assumed that there is sufficient food to support the density of animals currently present, and given the increase in condition above their pre-translocation condition on Middle Island, it can be inferred that the habitats occupied on Tiritiri could support a greater density they currently support.

4. Three clusters of tuatara comprising island born and founder individuals were identified with adult females in close proximity to males. Results of radio-tracking studies on other islands showed that male tuatara move between female territories during the breeding season, often moving 60 m or more each night over several weeks before returning to their home territory. In each of the clusters identified on Tiritiri, adult males and females were well within range of each other for breeding purposes. Observations in past years on Tiritiri of female and male tuatara together during the breeding season and where movements of at least 100 m must have taken place for animals to meet up, confirm that breeding potential exists between multiple males and females within (and probably between) clusters.
5. Nine island-born tuatara were caught on this survey. The body lengths likely represent at least three separate breeding years ranging from 4 years up to 9 years⁴. This indicates that founders are breeding in several locations and between years within clusters.

We estimate that the total number of tuatara known or likely to exist (comprising individuals caught during the 2014 survey as well as individuals that evaded capture and recent sightings of individuals or their sign) is, at a minimum ca. 50 individuals.

In reality, this number is likely to be a substantial underestimate of the true population size, as it does not include individuals that reside within the other 85 % of Tiritiri not searched during this survey nor does it include individuals not active or detected within the search area during our searches (including adults, juveniles of detectable size and young juveniles difficult to detect).

So, how do the results of this survey compare to the Tuatara Recovery Plan guidelines and, more importantly, what does this suggest in regard to the long-term persistence of the Tiritiri tuatara population?

The Tuatara Recovery Plan guidelines were written before information from island translocations was available. The guidelines use small individuals as the measure of success, presumably on the assumption that founders will be indistinguishable from island-born individuals and that island-born individuals below 120 mm to 180 mm SVL will remain in those size classes for a period of time. Furthermore it assumes that individuals in this size class will be detectable by survey methods and be an accurate representation of the status of breeding in the population.

The island-born individuals on Tiritiri are mostly larger than 180 mm SVL, and the use PIT tagging of founders makes island-born individuals of any size easily distinguishable from founders. Individuals around 180 mm SVL equate to an approximate age of 6 years old. This suggests that individuals between the ages of ca. 4 - 6 are less than the 180 mm SVL limit of the guidelines and maybe detectable by survey; individuals older than 6 years are likely to be larger than 180 mm SVL (and therefore not counted in the assessment of population viability) and those less than 4 years old may be too small to be reliably detected.

Using the Recovery Group's guidelines as strictly stated provides an estimate of less than 10% island-born young and an indication that the Tiritiri population has not yet established and that there may be cause for concern about its future self-sustainability.

Alternatively, if the measure of success is instead taken as the proportion of island-born individuals caught during the survey (i.e. juveniles and those of breeding age), the result could indicate a healthier population with recruitment occurring across age classes. The 9 island-born individuals represent 29 % of the 31 total captures and could be interpreted as showing that the Tiritiri population has established.

⁴ Based on known growth information from captive reared tuatara from Little Barrier, and information from the Whale Island translocation, the Tiritiri island-born individuals probably range in age from 4 years to 9 years old. Juveniles smaller than 4 year-old individuals are typically smaller, very cryptic and not usually picked up during population surveys such as this survey i.e. they are probably present, but have eluded detection.

Ultimately, it should be remembered that the guidelines were written prior to translocations being undertaken. The Tuatara Working Group of the Herpetofauna Technical Specialist Group (led by DOC) is aiming to review the guidelines in the coming year – and the results from this Tiritiri survey add relevance in this regard (Dr Rod Hitchmough and Associate Professor Nicky Nelson, Tuatara Working Group members, *pers. comm.* 2 February 2015).

Irrespective of how the guidelines are interpreted or revised in the future, there remains a key management question relating to the long-term viability of the Tiritiri tuatara population, which is:

“Is breeding occurring at a rate sufficient to guarantee long-term population persistence and increase, and what can be done, if something is deemed necessary, to improve the rate of increase?”

There is insufficient information available on recruitment rates on Tiritiri, mortality of founders and contributions by males and female founders to the effective breeding population to answer the first question. It may be that only further survey over time, particularly of the three clusters on the island, can provide a clear indication of population trend.

The second part of the question relates to management approaches to augment (or leave) the population as part of active population manipulation.

Options for intervention include:

1. Do nothing. Monitor the population to better assess longer-term viability on the assumption that the results of this survey indicate that the population is indeed establishing and that breeding is occurring at a level sufficient to grow the founding population. There is a risk that if the population is not established that lack of intervention now may exacerbate issues further down the track and require substantially greater or more intrusive management in the future (e.g. captive rearing and egg incubation programme).
2. Use isolates to reinforce breeding nodes. Move animals which are well away from the known clusters to reinforce the clusters and increase the likely contribution of these individuals to the overall Tiritiri population. This option makes assumptions about the reproductive isolation of individuals, and relies upon the ability to successfully relocate individuals and to establish territories at sites desired by managers, and the ability of those individuals to contribute even if successfully relocated to within the node. This option can be used as a research opportunity to trial localised relocation, hard versus soft release and potential impacts of such management on resident individuals. Risks of this option are that it may be costly with negligible benefit to the overall population (if individuals move away or breeding clusters are disrupted). Potential benefits are a greater understanding of how to successfully utilise all founders in a translocated population, increased breeding within clusters and increased rates of recruitment and population growth.
3. Augment the Tiritiri population with new founders from elsewhere. The logical source is Middle Island, the source of the original founders. Alternatively, new founders could be sourced from other islands in the Mercury Group or elsewhere if genetic mixing of such island stocks is deemed appropriate. The risk with this approach is gaining the approvals necessary to undertake another translocation to Tiri. There may not be support scientifically or politically for another harvest of animals for Tiritiri. The willingness of DOC (and other stakeholders such as iwi) has not been tested with regards to mixing island tuatara stocks for translocations already undertaken.

5 Applicability

This report has been prepared for the benefit of Supporters of Tiritiri Matangi Inc with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:



Graham Ussher

Senior Ecologist

Authorised for Tonkin & Taylor Ltd by:



Brett Ogilvie

Project Director

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AppendixA: Questionnaire

Tiritiri Matangi Tuatara Pre-Survey Questionnaire

Background:

In November 2014, we are doing the 5 yearly survey of our tuatara population. To help the survey teams, we want to gather as many sightings of tuatara over the past 2 years as we can. This will help us plan the survey to cover as many known tuatara territories as possible.

Every sighting you can remember will help us. Please send us as many sightings as you can remember. All those sightings help! Put the sighting on the map attached (even a rough location helps) and give us any other details you can remember. You can either post the survey back to me: Hester Cooper, 14 Long Bay Drive, Torbay, Auckland 0630, or email an electronic version back to me at hester@brilliant.co.nz

Please return this survey before 15th October 2014 so that we can use your observations to plan the tuatara survey in November.

Please complete the details below, so we can contact you if we have any queries.

Many thanks!

Hester Cooper, Biodiversity Subcommittee

Mob. 021-631-248

Name _

email _

Telephone number _

Observations

Numbered location on your map	Date if known	Notes
1	Mid Oct 2013	(Example) Seen at night just off track by old puriri on Bush 1 boardwalk

Please mark the location(s) of sightings of tuatara within the last 2 years or so. Number sightings and provide more detail for each numbered sighting in the text box on the first page (e.g. time of day/night, date if known, seen on or off track, on ground or in burrow).



Appendix B: Survey Search Effort

Date	Number people searching	Day/ nightsearch	Timestart	TimeFinish	Minus time for breaks	Search hrs	person hrs	
							day	night
2-Nov	5	night	8.15pm	3.15am	30 mins	6.5		32.5
2-Nov	5	day	1.00pm	4.30pm	30 mins	3	15	
3-Nov	5	day	12:00 p.m.	5.00pm	30 mins	4.5	22.5	
3-Nov	5	night	8.30pm	1.30am	30 mins	4.5		22.5
4-Nov	5	day	12.30pm	4.00pm	30 mins	3	15	
4-Nov	5	night	8.30pm	12.00am	30 mins	3		15
5-Nov	5	day	1.00pm	4pm	30 mins	3.5	17.5	
23-Nov	5	day	1.00pm	3pm	15 mins	2.25	11.25	
23-Nov	5	night	9pm	2.30am	30 mins	5		25
24-Nov	5	day	1pm	3.30pm	15 mins	2.25	11.25	
24-Nov	5	night	9pm	2.00am	15 mins	4.75		23.75
25-Nov	5	day	1pm	3.30pm	30 mins	2	10	
25-Nov	5	night	9pm	3.00am	30 mins	5		27.5
26-Nov	5	night	9pm	1.00am	15 mins	3.75		18.75
						Total	102.5	132.5

Appendix C: Morphometrics

											all 982 0091 then
Animal number	date	time	Gender	SVL mm	Old tail mm	New Tail mm	Bag wgt g	Gross wgt g	net weight	Clips (LF, RF, LR, RR)	PITnumber
1	2-Nov	2.30pm	m	235	58	90	30	600	570	nil	1690831
2	2-Nov	9.30pm	m	215	257	0	30	480	450	nil	islandborn
3	2-Nov	9.50pm	m	191	220	0	30	310	280	nil	islandborn
4	2-Nov	10.00pm	m	193	229	0	30	345	315	nil	islandborn
5	2-Nov	10.35pm	m	212	250	0	30	445	415	nil	islandborn
6	2-Nov	10.45pm	juv	144	167	0	30	145	115	nil	islandborn
7	2-Nov	11.10pm	f	206	39	65	30	430	400	nil	1328453
8	2-Nov	11.35pm	juv	150	182	0	30	165	135	nil	islandborn
9	2-Nov	11.55pm	f	206	133	31	30	390	360	nil	810392
10	2-Nov	12.27pm	m	264	253	0	65	815	750	nil	1175218
11	2-Nov	12.35pm	f	215	240	0	30	370	340	nil	1466479
12	3-Nov	4.15pm	f	190	115	43	30	215	185	nil	1686551
13	3-Nov	9.20pm	m	231	145	70	80	730	650	nil	812430
14	3-Nov	9.55pm	m	250	114	95	65	725	660	nil	1471342
15	5-Nov	9.35pm	juv	174	206	0	35	230	195	nil	islandborn
16	6-Nov	3.30am	f	200	218	0	0	440	440	nil	838894
17	23-Nov	deceased	f	258	175	46	30	560	530	nil	813150
18	23-Nov	9.10pm	m	240	120	51	30	670	640	nil	24567
19	23-Nov	9.38pm	f	214	180	0	30	380	350	nil	1702020

20	23-Nov	10.00pm	m	229	275	0	30	590	560	nil	1484941
21	23-Nov	10.45pm	f	232	61	117	30	555	525	nil	1481353
22	23-Nov	11.20pm	m	237	105	67	30	510	480	nil	1529556
23	23-Nov	12.47pm	m	251	271	0	65	850	785	nil	1313570
24	23-Nov	1.05am	m	220	247	0	30	450	420	nil	islandborn
25	24-Nov	10.50pm	m	251	172	52	65	720	655	0,0,2,0	1020016
27	24-Nov	10.55pm	m	255	53	72	65	675	610	nil	1686428
28	24-Nov	1.30pm	m	207	227	0	30	375	345	nil	islandborn
30	25-Nov	12.25pm	m	250	114	77	30	710	680	nil	809646
31	25-Nov	12.55pm	m	246	267	0	30	640	610	nil	882328
32	26-Nov	1.00am	m	260	317	0	65	830	765	0,0,4,4	1475402
33	26-Nov	10.50pm	f	207	200	0	30	360	330	nil	1537496



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