Prepared for Styx Living Laboratory Trust 2012

Effectiveness of a predator-proof fence for conserving lizard fauna in the Styx Catchment , Christchurch

: A mark-recapture study.

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Effectiveness of a predator-proof fence for conserving lizard fauna in the Styx Catchment, Christchurch.

1. Abstract

A mark recapture study was conducted in the Styx Mill Conservation Reserve to establish population numbers for resident skinks in grassland and regenerating native shrubland environments. The sampling method used to assess reptile fauna in the chosen areas was a low-intensity monitoring technique such as pitfall trapping (PF). Pitfall traps were installed at 3 sites different sites throughout the reserve. Results show that there are two species of skink; *Oligosoma nigriplantare polychroma* (Common skink / mokomoko) and *Oligosoma maccanni* (McCann's skink / mokomoko) inhabiting dry grassland habitats at Styx Mill Conservation Reserve. The findings are consistent with known natural habitats.

As a result of the survey recommendations have been made to improve the current reptile population residing at Styx Mill Conservation Reserve. Initial results appear to be promising indicating that there may be a significant population of skinks within the reserve.

2. Introduction

New Zealand's reptiles are of global significance, as they have adapted over many millions of years to live and reproduce in a cold climate. Reptiles and amphibians occur almost everywhere in New Zealand, from coastline to mountain top (Jewell, 2008). There are currently 109 known reptile taxa and undescribed entities, an increase of 11 since the 2005 list (Hitchmough *et al,* 2010), 99 of these are native lizard species endemic to New Zealand (Daugherty *et al.* 1994; Jewell, 2008; Hitchmough *et al,* 2010). The lizard fauna plays a large part in New Zealand's ecosystems (Hudson, 1994), such as natural food webs including scavenging, predation and prey (Markwell & Daugherty, 2002; Pianka & Vitt, 2003; *cited in* Wedding, 2007). Once the home of as many reptile species as there were terrestrial birds, now almost half of all reptiles in New Zealand are threatened or endangered (Wilson, 2006).

The Styx Mill Conservation reserve is an urban reserve, situated within close proximity to residential housing. The reserve has under gone extensive planting of native vegetation including species such as Coprosma's, Leptospermum (manuka), Muehlenbeckia (mingimingi), Olearia 'Dartonii', Pittosporum, Phormium (Mountain Flax), which are now at varying stages of regeneration. Exotics such as the willows which would have once lined the river are now being drill poisoned (they are left in situ to break down and form a natural mulch) and green ground weeds are being sprayed with 'Round-up'. A large fence is also under construction which when finished will encompass a large proportion of the reserve. It is hoped that this fence will exclude large mammalian predators such as cats and dogs, reducing their impacts on the native flora and fauna found within the conservation reserve.

With increases in habitat modification and the introduction of predators, monitoring biological populations has become increasingly important. Conservation managers are routinely asked to provide information about the status of threatened populations or species (Lettink & Armstrong, 2003). Accurate and reliable monitoring is necessary for effective management of threatened species in New Zealand (Lettink & Armstrong, 2003). Effective species management relies on identifying the location and size of populations and establishing baseline measurements against which to measure future changes (Pryde, 2003). By analysing data from subpopulations managers can incorporate the results of mark-recapture studies into their adaptive management of populations (White & Burnham 1999; cited in Pryde, 2003).

A population of lizards where identified at the Styx Mill Conservation reserve in 2010, consisting of two species from the genus *Oligosoma*. The conservation trust subsequently requested a quantitative study of current lizard numbers in the Styx reserve. A mark-recapture method was used to estimate skink abundance. Mark-recapture and/or mark-resight studies have become more prevalent in New Zealand with the development of easy to use software; particularly the program MARK.

It is hoped that the information contained, within the report will encourage managers and people of the local community to consider and value the reptile fauna which can be found within the reserve and in their very own back yard. This research was carried out using Low Impact Permit Number CA-32357-FAU.

3. Methods

3.1 Study Area

The Styx Mill Conservation Reserve (Figure 1) covers an area of approximately 57 hectares and runs adjacent to the Styx River for 1.6km (Macfarlane, 2007). The reserve forms part of a natural corridor associated with the Styx River. The important ecological values of the Styx River have been recognized by the Christchurch City Council and, as a result, the Styx Mill Conservation Reserve was created (Coleman, 2007). Styx Mill Conservation Reserve encourages people from the local and surrounding community to utilize the urban reserve for walks, walking the dog (Dog Park), picnics and the opportunity to enjoy nature not far from urban life.

Figure1. Entrance sign to Styx Mill Conservation Reserve.

Styx Mill Conservation Reserve became publically owned in the 1970's and restoration and development began in the 1980's. Historically (during European settlement) the area was used for a number of different vocations such as sheep farming. The river used to drive waterwheels which were an essential supply of power to local saw mills, flax mills and flourmills (Christchurch City Council, 2010). Recently the local community has been actively encouraged to take responsibility, and play important roles in any future development of the reserve, ensuring that this natural resource provides enjoyment for the local community and its ecological values are retained and further enhanced (Christchurch City Council, 2010).

3.2 Predation

Native reptile species in New Zealand have suffered major declines since the arrival of humans at least 700 years ago and are now scarce and patchily distributed on the mainland. Lizards would have been important functional components of pre-settlement shrub-land and forest ecosystems, as fruit and nectar eating lizards can be significant pollinators and dispersers of seeds for many trees and shrubs (Lord and Marshall, 2001). The importance of New Zealand lizards in our ecosystem has been highlighted as a gap in our knowledge regarding New Zealand's native lizard fauna. The number of lizards recognised and described as species in New Zealand is still increasing. Lizards have evolved to live in a wide range of habitat types from coastal areas to mountains.

Globally, lizard predators include birds, mammals, snakes, other lizards, fish, spiders, centipedes, scorpions, and insects such as praying mantises. Surprisingly birds are one of the main predators of reptiles, due to high metabolic demands associated with heat production and a need to eat large amounts of food, making them the most important predators of moderate-to-small-sized diurnal lizards, during periods of activity (Pianka & Vitt, 2003). During periods of inactivity mammalian predators such as the common house mouse, *Mus musclus,* (Lettink & Cree, 2005), which also have large demands for food and energy are most likely to be an influential and detrimental predator.

Reptiles throughout the world have evolved remarkable diversity of predator escape mechanisms: cryptic coloration; amour; alertness and high running speeds; mimicry; scratching, biting, and aggressive displays; tail autonomy; skin loss; and even bad-tasting blood. Not only do lizard species use a variety of predator escape tactics, these tactics can change with a lizard's age. Predation can occur at any life history stage, but usually is most intensive on eggs/juveniles (New Zealand lizards bear live young). In these young and vulnerable stages of life reptiles may not have yet developed the skills required to avoid predators (Pianka & Vitt, 2003).

The most common reptile found at Styx Mill reserve is are two skink species from the New Zealand genus *Oliogosoma*. To assist several species prone to predation residing within the boundaries of the reserve the Christchurch City Council is in the process of building a predator proof fence in the Styx Mill Conservation Reserve.

3.3 Mark-recapture

In addition to estimating population size and survival rates, mark-recapture methods can be used to evaluate the impacts of threats on survival, record population trends, collect information for population viability analyses, set performance targets against which responses to management can be measured, and highlights areas were further research is necessary (Lettink & Armstrong, 2003).

Mark-recapture analysis can potentially be used whenever animals can be marked or otherwise identified. Marks are usually individual-specific, and can consist of metal bands (birds or bats), colour bands (birds), ear tags (mammals), toe clip combinations (frogs, lizards, small mammals), or pen markings (lizards, tuatara, invertebrates) (Lettink & Armstrong, 2003). However mark-recapture methods are not always appropriate for the study intended, understanding the principles and requirements for mark-recapture is important before setting up a study.

The design of a mark-recapture study is very important, and will determine what the results can be used for. For more information regarding the basic principles of mark-recapture analysis refer to M. Lettink & D.P. Armstrong, (2003).

3.4 Study sites locations

Three sites at Styx Mill Conservation reserve were used during the mark re-capture study in 2011 – 2012 (Figure 2). The three sites were chosen either as a know site (where skinks reside), a site of interest and a control site where no lizards were thought to reside. Site one was known as “Lizard Island” and is an area John Parry (Park Ranger) had highlight as a sight of interest. The island is at present are still connected to the main reserve, however it will at some point be cut off and become a true island habitat. This site has undergone intensive planting and regeneration of native habitat, and no known lizard sightings had been reported in this area.

Site two (paddock) was an area highlighted in the 2010 report (McClure, 2010), as a sight of high skink numbers. It was situated at the eastern end of the reserve. The third site was situated in an area of exotic and native planting. In 2010 this area was recorded as being cleared of all flora and allowed to regenerate. It is at present over grown with exotic weed species, with some native shrubs. This area was referred to as the “control” area where skinks were not thought to inhabit.

Figure 2. Christchurch City Council map 03 – Styx Mill Reserve. Grid numbers 1-4 are highlighted on the map (in red). Shaded area (green) is the dog park.

3.5 Sampling methods

Low-intensity monitoring by means of pitfall trapping (PF) was used to establish the existence of any reptile fauna residing within both Styx Mill and Janet Stewart Conservation Reserves in 2009 – 2010 (McClure, 2010). This research highlighted key areas within the reserves where skinks were present and further studies maybe undertaken in the future.

In November 2011 a mark recapture study was requested by the Styx Living Laboratory Trust to determine population numbers of skinks in these key areas. Three sites were identified within the Styx Mill conservation reserve that were of interest to this study.

3.5.1 Artificial Cover Objects (ACO)

Initially artificial cover objects (ACO), see figure 3, were placed in areas of interest. Artificial cover objects are sheets of Onduline, which is an extremely tough lightweight, corrugated roofing and cladding product made from organic fibers saturated with bitumen (Lettink & Patrick, 2006).

ACO are a low intensity sampling technique, they allow for a quick and simple preliminary study to determine the presence or absence of lizards in areas of interest. ACO's were place at both

site one “Lizard Island” and site two prior to the installation of pitfall traps. ACO’s where set and they left for one week, this allows lizards to identify and utilize the refuge. On our return to the sites all ACO’s were lifted and if skinks were observed at these sites then pitfall traps were installed.

Figure 3. (Left) Picture of an atrifical cover object (ACO). Onduline is an extremely tough lightweight corrugated roofing and cladding product made from organic fibers saturated with bitumen. **Figure 4.** (Right) Two liter round plastic containers with plywood lids with small spacers (plywood legs) glued and nailed securely under each corner.

3.5.2 Pitfall Trapping (PF)

Pitfall trapping was used to as part of a capture, mark, re-capture study at Styx Mill Conservation reserve. A total of 100 two litre round plastic containers (Containment solutions, figure 4.) were installed at three different locations around the reserve.

3.6 Study design

Four grids, each consisting of 25 pitfall traps were set up within the reserve (refer to figure 2 for grids 1-4 locations). Each grid measured 10 meters square with each trap within the grids spaced at two meters from the adjacent traps (figure 5). Site one (lizard island) contained grid 1, site two (paddock) contained grids 2 and 3, and site 3 (control) contained grid 4.

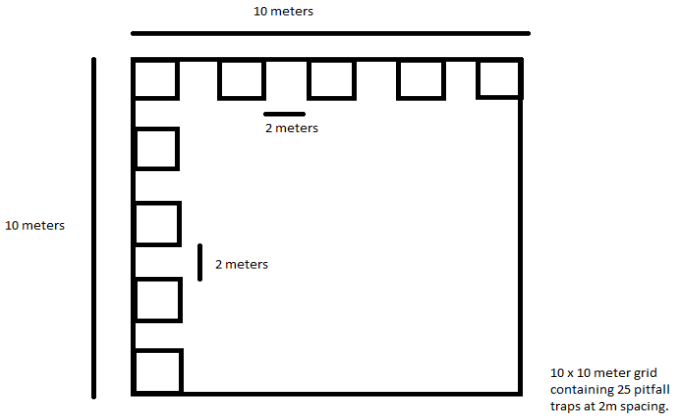

Figure 5. Grid lay out. A total of 25 pitfall traps per grid. Each grid was 10 meters square with two meter spacing between all traps

Each container was placed in the ground so that the lip of the container was level with the surrounding substrate. Traps were then covered with wooden plywood lids, designed to allow lizard access to pitfall traps while preventing their desiccation and predation (Lettink & Patrick, 2006).

To attract lizards, each can was baited with a piece of canned pear (1 cm^3 approx, figure 6; see Whitaker, 1967). Traps remained baited from Monday – Friday. They were re-baited and checked (at approximately 08:30 hours) every 24hrs (in accordance with ethical regulations). The pitfall trapping methodology is in accordance with New Zealand Department of Conservation ethical standards and has been approved as a standard management protocol.

Figure 6. Baiting a pitfall trap (which has been dug into the ground) with a piece of pear (photo taken by Griffiths, 2010)

3.6 Physical variables measured

Snout vent lengths (SVL), is the most basic measurement in reptiles and amphibians (Jewell, 2008). SVL was measured in accordance with Herpetological field handling techniques – the measurement is read at the vent (cloacal opening) between the limbs (Jewell, 2008) not at tip of the tail. In addition vent tail length (VTL) was also measured, this will help to identify individuals when they are re-captured. Sex determination (male or female) was only undertaken on individuals with a SVL of 40+mm as neonates and juveniles are far too young to determine gender. Additional information recorded included the grid at which they were caught, PF trap number, any scars on the body, regeneration length (from historical tail loss), natural toe loss and any other individual features which may help in their identification if they are trapped again in the future.

Once skinks had been measured individual silver markings were placed on the dorsal surface (figure 7) of the skink and an individual number written on their abdomen, with a non-toxic pen (Sharpie, metallic silver marker). Any skinks caught bearing a silver mark were then recorded as a 'recapture', they were identified by their silver mark, number and or individual features.

Figure 7. McCann's skink bearing a silver dorsal marking for mark recapture purposes (Photo taken by Henderson-Fitzgerald, 2012).

Additional variables recorded during the study included weather data such as air temperature (˚C) recorded using a Kestral 3000, cloud cover (C/C) which is a scale out of 9 and precipitation.

4.0 Results

4.1 Lizards

Only skinks were caught during the trapping period at Styx Mill reserve. Skinks are generally referred to as 'classic' lizards and are sometimes described as snakes with legs. They are sleek in appearance, fast moving, covered in shiny over lapping scales and the majorities are active in the open on hot sunny days (Jewell, 2008). Skinks have relatively small eyes with a moveable eyelid, allowing them to blink.

4.1.1 Species identified

Two species of skink have been identified at Styx Mill Conservation reserve they are both members of the skink genus *Oligosoma* (Chapple *et al.* 2009) which is the most diverse genus of terrestrial vertebrates in New Zealand (Freeman, 1997). They are the Common skink (*Oligosoma nigriplantare polychrome*), and the McCann's skink (*Oligosoma maccanni),* both species of skink generally inhabit similar habitats and are very difficult to tell apart. Common skinks are morphologically very similar to the McCann's skink; however they do not have a dorsal strip with prominent straight edges (castellation) (Jewell, 2008). McCann's skink can be difficult to distinguish from the Common skink (Lettink & Whitaker, 2004; Reardon & Tocher, 2003).

Common skinks are generally found in damp denser areas, from coastal rocky stands to native or introduced tall grasslands and rarely enter forests (Barwick, 1959; Gill, 1976; Patterson, 1992; Newman, 1994; East *et al*., 1995 cited in Towns & Elliott, 1996). Studies of habitat use by common skinks indicate that they avoid areas with shady habitats. Consequently, increased cover by shrubs and coastal forest are likely to greatly reduce the distribution and abundance of Common skinks. Females breed annually, producing between 1 – 10 young per litter from about January to February (Jewell & Morris, 2008).

The McCain's skink (figure 8), which is also a brown diurnal (avid sun-basker) skink, up to 16cm long, with a SVL of up to 73 mm, and distinct striped longitudinal markings. They have also been known to occupy a variety of different habitats including beach litter, sand dune vegetation, farmland, coastal shrub land, tussock grasslands, suburban parks and gardens (Lettink & Whitaker, 2004) and are generally found in drier regions of the South Island (Jewell & Morris, 2008). Females breed annually, producing between 1 – 6 young in each litter (2.3 average; see Holme & Cree, 2006), from about January – March. Distinguishing features include a mid-dorsal stripe that becomes notched or wavy/blotchy toward the tail (unlike the Common skink). Its throat is whitish grey and usually bears fine black speckling (Jewell, 2008).

During the mark recapture study McCann's skink was more predominant than the Common skink. This may have been because of the dry grass land environment being sampled; the Common skinks will prefer more over grown and damp habitat, which can be found adjacent to the mark recapture grids at site two.

Figure 8. McCann's skink (*Oligosoma maccanni)* photo taken by Lettink, 2010.

4.2 Site Results

Grids 1, 2 and 3 (refer to figure 2 for map locations) were the areas found to have the highest abundance of skinks. In particular grid 3 (figure 9) which is the grid closest to Contemplation point had a total of 66% of total captures. The study undertaken in 2010 also highlighted this as an area of significat skink abundance.

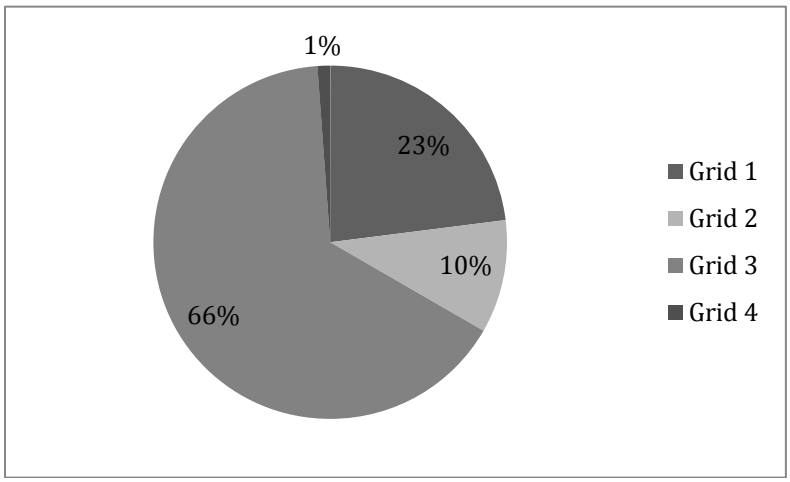

Figure 9. Total numbers of new and recaptured individuals over the entire trapping session, from each of the four grids shown as a percentage of total lizards caught.

Bar chart shown in figure 10. also shows that grids 1 & 3 had a larger nuber of recaptured individuals, over the duration of the study.

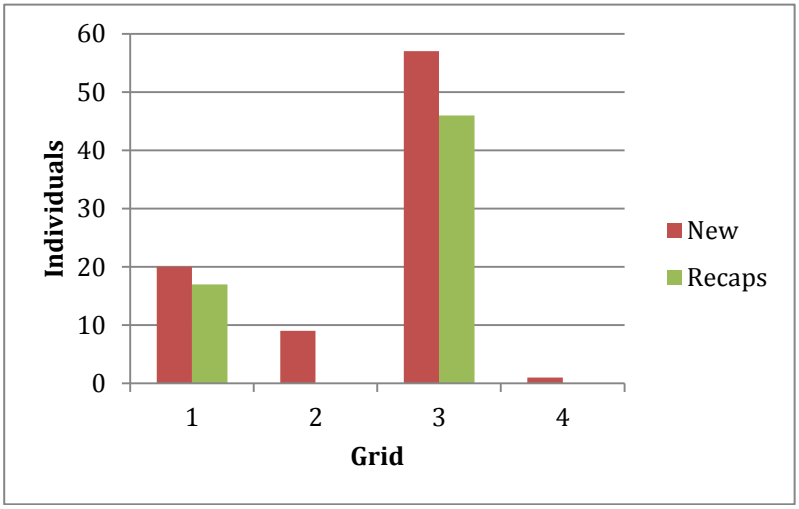

Figure 10. Total numbers of new and recaptured individuals over the entire trapping session, from each of the four grids.

During the study all skinks caught were sexed to determine their gender. Data collected from each grid was then amalgamated to help dertermine whether there was a bias toward catching and recatching male or female skinks (figures 11 & 12), at the different locations.

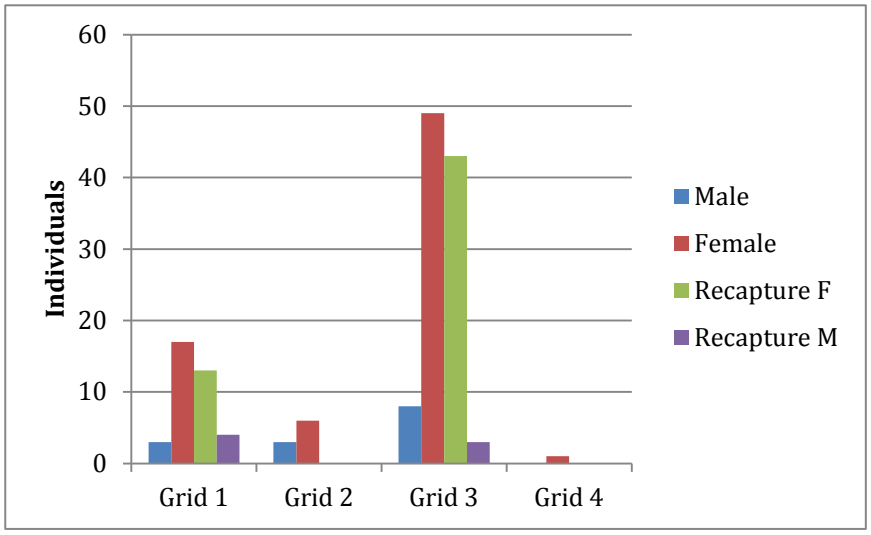

Figure 11. Data has been separtated in to trap grids, to show the number of individual male and female skinks caught and then recaptured during the study.

The baseline results taken in McClure 2010, study showed that there was a significantly larger proportion of females compared with males. The data collected in this study clarified this base line data; with 81% of all captures (new and recaptures)were females at Styx Mill conservation reserve in 2012.

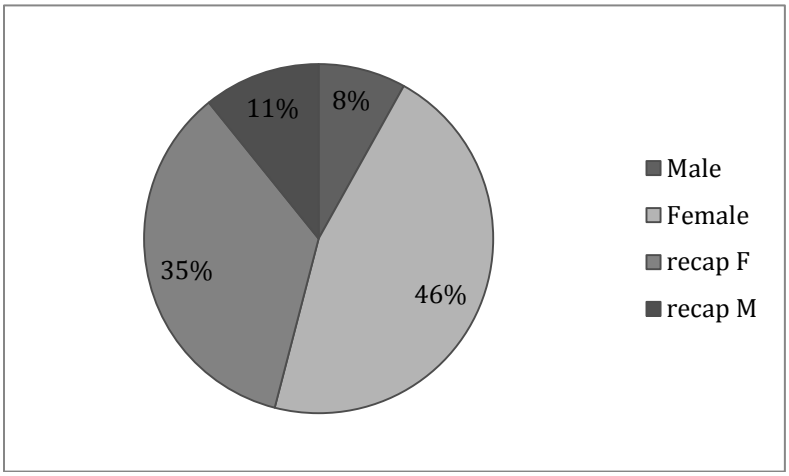

Figure 12. A piechart to visually highlight the percentage of male and female skinks caught and then recaptured, over the duration of the study.

An aim of this study was to achieve aleast a 30% recapture rate from the mark recapture data. The 30% recapture rate was achieved within the first 3 days, however the study was continued until day 12 and a 72% recapture rate was achieved. Which means that 72% of all lizards caught were then recaught on subseqent days.

From each grid the total number of new individuals, male and females caught was calculated (figure 13). From this data some basic calculations myay be done to estimate to total number of skinks per hectare at each grid site.

Grid	Male	Female	Recap F	Recap M	Totals
Grid 1	3	17	13	4	20
Grid 2	3	6	0	0	9
Grid 3	8	49	43	3	57
Grid 4	0	1	0	0	1

Figure 13. Numbers of skinks caught at each of the four trapping grids at the Styx mill reserve over a 12 day sampling duration.

With each grid sampled (Grid 1-4) measuring 10 meter square (refer to figure 5.) This means that to calculate the number of lizards present in a 1 hectare area we have to multiple to total of new captures by 100. The estimated numbers of skinks per hectare at each of the four trapping grid locations can be found in figure 14.

Grid	per $10m^2$	per ha
Grid 1	20	2000
Grid 2	9	900
Grid 3	57	5700
Grid 4	1	100

Figure 14. Number of lizards caught in a 10 meter square grid and the number of skinks estimated to be in a one hectare area, at ech location at Styx mill reserve.

5.0 Discussion

5.1 Population numbers

Styx Mill Conservation Reserve has undergone an extensive transformation the land is now being returned to native flora and fauna; which is enjoyed by visitors and members of the local and surrounding community. There are now areas within the reserve that are suitable habitats for *Oligosoma*. Results of the survey undertaken in 2010 and 2012 showed that two species of Oligosoma are present at the Styx Mill conservation reserve, and are residing in moderate numbers in two grids (Grid 1 & 3) sampled in this study (figure 14).

According to results there were higher capture rates of females than males; however this could be attributed to a number of environmental and behavioral factors. There are a number of factors known to bias capture rates of lizards including trap placement with respect to microhabitat features, trapping methods used, age or sex of individuals, abiotic factors such as temperature and moon phase, food availability, and previous encounters with traps (Lettink & Seddon, 2007).

This data (baseline data) was collected as the first of yearly mark recapture studies to determine the effectiveness of a predator-proof fence for conserving lizard fauna in the Styx Catchment, Christchurch.

5.2 Fence - Cat/dog proof fence.

At Styx Mill Conservation Reserve a large fence is under construction (Figure 15). The fence runs parallel to the Styx River, and once finished it will encompass a large proportion of the reserve. As can be seen in Figure 16, the mesh diameter at Styx Mill Conservation Reserve is approximately 60mm square. It is hope that the fence, once completed, will help exclude large mammalian predators such as cats and dogs from the adjacent urban areas from entering the reserve and predating upon native flora and fauna.

Figure 15. Predator (cat/dog) proof fence

Figure 16. Mesh size on the predator (cat/dog) proof fence (6cm square)

Mus musclus are potentially one of the most damaging predators of both *O. nigriplantare polychroma* and *O. maccanni* at the Styx Mill Conservation Reserve. It is clear from previous studies (Lettink & Cree, 2005) that mice do include lizards as part of their diet. During cooler weather when lizards are less able to defend themselves (Burt, *op. cit*.; Pickard, *op. cit*.; cited in Lettink & Cree, 2005) house mice can have substantial impacts on lizards numbers. At times when food is bountiful there are explosions in mouse population numbers (e.g. mast seeding events / seeding of EG species) or following the removal of mice predators (Ruscoe, 2001).
Unfortunately the size of the mesh used on the fence at the Styx Mill reserve is too large in diameter to exclude mice. It is therefore recommended that eradicating or reducing mice numbers through trapping and poisoning is undertaken as this is likely to have direct (reduce mortality of lizards) and indirect benefits (reduced abundance of predators that rely on mice as primary prey) for at least these two species of New Zealand lizard (Lettink & Cree, 2005).

5.3 Recommendations

5.3.1 Habitat improvements

Two species of endemic skink live currently occur in natural populations at the Styx Mill Conservation Reserve, Christchurch. This study focused on collecting baseline data, which may be used as part of an annual mark recapture study for the Styx Living Laboratory Trust. In addition to the predator proof (cat/dog) fence, here are some further recommendations to help improve the environment and hopefully help increase numbers of resident skinks at the reserve.

5.3.1.1 Additional plantings

In order to conserve and increase lizard population numbers, Council planners/managers may consider additional planting at two of the sites sampled in this study. Grids 2 & 3 were situated in areas, which have not yet been regenerated and are still in their present rank grass/ agricultural state. Here are a list of a number of native plants which may be considered for this site.

- Native flaxes in swampy areas
- Native grasses
- Coprosma's – fruiting sp. (food source)
  C. repens 'Poor Knights'
  C. propinqua var martini 'Taiko'
  C. neglecta
- *Pimelea prostrate* (New Zealand daphne)

It is my belief that if ecological restoration in the form of new planting is to be undertaken in these areas then I recommend that the ground is not stripped of all flora (exotic/native). The current habitat is suitable for skinks, and removing it would disperse/ increase mortality in these moderate populations. Allowing new plants, such as native grasses to take over and replace the exotic species will mean that the current habitat is conserved and ultimately the required maintenance (commercial mowing) in these areas will be decreased.

Larger plants such as Coprosma sp. could be planted amongst existing exotic species and allowed to grow up through helping protect original habitats and form a corridor for fauna. Here it is important to highlight that skinks do not generally enter areas of dense bush, which may be shaded due to a mature canopy. There are large areas of fragmented habitat and isolated patches of bush within the reserve. As reported by Freeman & Freeman, (1996) that if grassland areas are replaced by shrub land and vegetation it is almost certain that the present species (*Oligosoma nigriplantare polychroma* and *Oligosoma maccanni*) will decline in numbers and distribution, as the current habitat is lost. It is important to understanding of how large a plant will become once it reaches maturity, and therefore not planting individual plants too closely together, shading out grass land environments.

5.3.1.2 Mowing

Reducing the quantity of commercial mowing done in the reserve (I understand that some areas are mown due to fire hazards), allowing exotic/ native grass to grow.

5.3.1.3 Retreats

Artificial retreats such as rock or wood piles (figure 17) would provide suitable habitat and shelter for lizards. These structures are not required to be large; they may be small and discreet. Making a feature of them may be an interesting project.

These structures will help to provide not only an area where skinks may retreat at night, hide from larger predator's mammals or birds, but also provide ideal areas for basking and mating.

Figure 17. Examples of refuge. Left a wood pile. Right slabs of sand stone rock. These flat pieces of rock make for ideal basking sights as they warm up in the sun.

One are highlighted by Park Ranger John Parry was grid one or "lizard island" as it became commonly referred to. This site was highlighted as of interest to the park ranger as it had undergone restoration a number of years earlier. This entailed stripping the original exotic plants and weeds and then planting numerous native plant species, which have been allowed to mature. Lizards were caught and observed at this site in moderate to low numbers.

The site was referred to as "Lizard Island" however it is not yet a true island, as it is still connected to the mainland. It is a recommendation of mine that this be the site at which refuge (rock/wood piles) are considered. Once this site is isolated from the mainland there will be not be members of the general public on the site. Information signs could possibly be installed on the adjacent side (figure 18), of the ponds informing the public what these structures are and how they benefit the species present on the island.

Figure 18. In the background "Lizard Island" and the location of Grid 1. In the foreground a site where an information board may be erected informing the general public regarding species present on the island.

5.3.2 Future Improvements

For future mark recapture studies undertaken at the Styx Mill Reserve I recommend that all protocols used including data collection and analysis be standardized.

During the 12 days of trapping it was noted that the habitat surrounding the trapping grids was being substantially degraded due to individuals walking over the rank grass land, flattening it down. This could have had an effect on the trapping efficiency within those grids. It is therefore a recommendation that a set path is designated for entry and exiting the trapping grids also field works must refrain from sitting at site of pitfall; flattening the habitat.

Weather data was recorded during the study however it has not been used in any data analysis. Using this data additional research and analysis of skink behavior and the relationship between trapping efficiency and environmental conditions could be undertaken.

5.4 Conclusion

Over the long term, ongoing management will be required to maintain and protect existing lizard populations. This may include predator control for smaller mammalian species such as rats, mice and hedgehogs that have large detrimental impact on skink populations. Maintaining clearings and open areas for basking; with the addition of rock/timber piles, which would benefit the skinks by providing suitable predator proof retreats. Continued education for the public about the reptile fauna present and preventing the general public from disturbing and/or collecting lizards.

5.5 Further Study

On going monitoring of the skink populations at Styx Mill Conservation Reserve, will enhance our knowledge of the health of the skinks residing in two areas within the reserve. With annual data collection a reliable database of results will be accumulated.

On completion of the predator proof fence reptile studies undertaken within the reserve will be able to determine whether the skink numbers are increasing or decreasing. Additional sampling techniques may be implemented at the study sites, such as tracking tunnels to help determine the presence or absence of mammalian predators ant the study sites. Also to assess if there are increases or decreases in certain predator numbers, and what affect this may have on the reptiles.

Skinks, which represent about 25-30% of all lizard species (Greer, 1989; cited in Eifler & Eifler, 1999), are underrepresented in studies of lizard behavioral ecology. Interactions and social structure – it is often assumed that lizards have very simple social structure in relation to other vertebrates. However according to Germano (2007), recent studies are starting to show that perhaps this is not always the case. Urban reptile populations such as the ones found at Styx Mill Conservation Reserve are convenient and accessible lizard populations where future social structure research may be carried out.

6.0 Acknowledgements

This scholarship and the material used to build traps were funded by the Brian Mason Trust (Grant 2011/4) through the Styx Living Laboratory Trust. Thank you to Kelly Walker and Maree Henderson-Fitzgerald for their assistance with both field work and sourcing relevant articles. Also thank you to John Parry (the park ranger at Styx Mill Conservation Reserve), for his assistance. All research was conducted with Department of Conservation (DOC) Animal Ethics Committee approval and in accordance with DOC Low Impact Research and Collection Permit.

7.0 Benefits of the Scholarship

I have found the Lincoln Summer Scholarship beneficial in terms of gaining valuable field research and work experience as well as improving my research skills.

After undertaking the initial reptile study in 2009, I was personally very keen to be involved and undertake this continued research at the Styx Mill reserve. I personally have a keen interest in reptiles and have carried this interest through to my postgraduate studies at Lincoln University. I hope to continue in this line of work in and around the Canterbury region, assisting with the research and fieldwork of fellow herpetological consultants.

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