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Survey of the Lizard Fauna of Janet Stewart and Styx Mill Conservation Reserves, Christchurch

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Contents

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1. Abstract

A survey was conducted in two Christchurch urban reserves, Janet Stewart and Styx Mill Conservation Reserves to establish which reptile species were present, including species preferred habitat type and health and age structure of populations found. Methods used to assess reptile fauna in the chosen areas were low-intensity monitoring techniques such as pitfall trapping (PF) and artificial cover objects (ACO), placed at 14 sites throughout the reserves. 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 reptile population of the two reserves. Initial results appear to be promising indicating that there may be a significant population of skinks within the reserve however more investigation is required in order to validate initial findings.

2. Introduction

The ecologically and taxonomically diverse lizard fauna is probably one of New Zealand's best kept biological secrets – Daugherty *et al.* (1994).

New Zealand's lizard fauna currently consists of at least 90 species of native lizard, all of which belong to one genus unique to this country (Daugherty *et al.* 1994; Jewell, 2008) and play a large part in our ecosystem (Hudson, 1994). Once New Zealand was the home to as many reptile species as terrestrial birds (Wilson, 2004). Now almost half of all reptiles in New Zealand are threatened or endangered. All New Zealand lizards are absolutely protected under the Wildlife Act 1953, meaning that they cannot be captured, collected or deliberately disturbed without a permit issued by DOC (Lettink & Whitaker, 2004). The skink genus *Oligosoma* is the most diverse genus of terrestrial vertebrates in New Zealand (Freeman, 1997). New Zealand lizards all feed primarily on insects, but some also eat fruit, nectar, sea bird regurgitations and smaller lizards, and their ecological role is underrated (Wilson, 2004). *O. n.polychroma* and *O.maccani* are generally found in open areas, from coastal rocky stands to native or introduced tall grasslands, and will rarely enter forests (Barwick, 1959; Gill, 1976; Patterson, 1992; Newman, 1994; East *et al*., 1995 cited in Towns & Elliott, 1996).

Lizards or ngarara as they are known to the Maori have cultural significance as they were once used by tohunga (spiritual practitioners) to cleanse places were the dead had fallen, particularly in battle. Lizards also featured in other spiritual rituals, and were commonly feared and associated with death (Lettink & Whitaker, 2004).

In greater Christchurch City (including the Port Hills) there are, or have been in recent times, at least five species of lizard including two species of gecko, *Hoplodactylus aff. Maculates 'Canterbury'* (Canterbury gecko / moko-pápá) and *Naultinus gemmeus* (Jewelled Gecko / moko-kákáriki), and three species of skink, *Oligosoma lineocellatum* (Spotted skink / mokomoko), *Oligosoma nigriplantare polychroma* (Common skink / mokomoko) and *Oligosoma maccanni* (McCann's skink / mokomoko), can be difficult to distinguish from *O. nigriplantare polychroma* (Lettink & Whitaker, 2004; Reardon & Tocher, 2003; Freeman & Freeman, 1996). *Oligosoma* found within Canterbury have been assigned a DOC threat classification of NT (Not Threatened) based on the taxon's national status and range (Whitaker, 2008).

The following report focuses on two "urban reserves" situated north of Christchurch city. Janet Stewart and Styx Mill Conservation Reserves are two of an existing network of reserves along the banks of the Styx River. The area surrounding the river continues to be restored as part of the Styx 'Source to Sea' Vision (Christchurch City Council, 2000) see figure 1. The 'vision' aims to enhance the river through creating a continuous walkway along its length, therefore enabling the public to experience and learn about the river system, from its source to the sea (Christchurch City Council, 2000). Christchurch City Council has developed a strategy for the management of the drainage, waterways and wetlands in the Styx River and its associated tributaries. A values based approach (landscape, drainage, ecology, recreation, culture, and heritage) is being used to manage the city's surface water, and assessment of the health of the surrounding areas (Christchurch City Council, 2000). Over the years, the banks of the Styx River have been highly modified, and it is now the local councils aim to restore a number of reserves to their natural habitat.

Figure 1. Christchurch City Council Map of the Sty River and surrounding area.

Styx Mill & Janet Stewart are both urban reserves, situated within or in close proximity to residential housing. They contain vegetation at varying stages of restoration. 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'. Large numbers of natives such as Coprosma's, Leptospermum (manuka), Muehlenbeckia (mingimingi), Olearia 'Dartonii', Pittosporum, Phormium (Mountain Flax), have been planted and there are also patches (fragmented islands) of more mature bush.

An initial survey of the reptile fauna within the Styx Mill River catchments was undertaken from November 2009 to February 2010. The objective of the research was to establish baseline data of reptile fauna in Styx Mill Conservation and Janet Stewart Reserves, which can be added to as more knowledge of species distribution and density within both Reserves is collected. It is hoped that the information contained, within the report will encourage managers and people of the local community to consider reptile fauna which can be found both in reserves such as Styx Mill Conservation and Janet Stewart and in their very own back yard.

This research was carried out using Low Impact Permit Number CA-26338-FAU.

3.0 Methods

3.1 Study Areas

<u>3.1.1 Styx Mill Conservation Reserve</u>

Styx Mill Conservation Reserve (plate 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.

Plate 1. 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).

3.1.2 Janet Stewart Reserve: Pá Harakeke

Historically the land, which is now the location for Janet Stewart Reserve, was a flat, swampy paddock bordered by Willow trees. Janet Stewart Reserve was officially named in 1996. Edmond Stewart bequeathed the land to the Christchurch City Council on the condition that it be developed into a public reserve and named after his mother Janet Stewart (plate 2). This pastoral land has now been converted into a thriving habitat for bush and wetland birds (plate 3). The restoration project has been carried out in conjunction with the Styx Mill Project and is part of the ongoing development and restoration of the Styx Mill Conservation Reserve (Christchurch City Council, 2010).

Plate 2. Information sign at Janet Stewart Reserve.

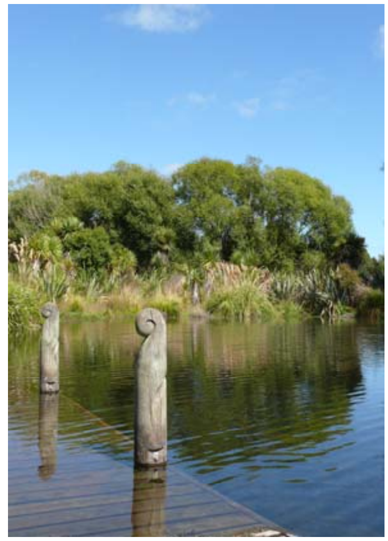

Plate 3. Pond and jetty with restored native plantings at Janet Stewart Reserve.

3.2 Predation

The eternal battle between predators and their prey maybe compared to a never-ending arms race. If lizards as prey are unable to stay ahead in this "race" then they entertain the possibility of one day becoming extinct (Pianka & Vitt, 2003).

Surprisingly few studies have examined predation on lizards (Pianka & Vitt, 2003). Before humans colonized New Zealand there were no rodent or mammalian predators present, however three species of rodent were introduced with the landing of early sailors (terra.govt.nz. 2010).

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. Predators that can be found in and around the study sites would include (as shown in Table 1):

Pest Species	Scientific name
Field/Feral Mice	*Mus muscles*
Ship Rat	*Rattus rattus*
Norwegian Rat	*Rattus norvegicus*
Pacific Rat	*Rattus exulants*
Weasel	*Mustela nivalis*
Stoat	*Mustela ermine*
Cat Feral/house	*Felis catus*
Hedgehog	*Erinaceus europaeus occidentalis*
Magpie	*Gymnorhina tibicen*
Rabbit	*Oryctolagus curisculus*
***Weka**	*Gallirallus australis*

Table 1. Shows the pest species which are likely to be found in either reserve. * Reintroduction of Weka intended in the future at Styx Mill Conservation Reserve

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).

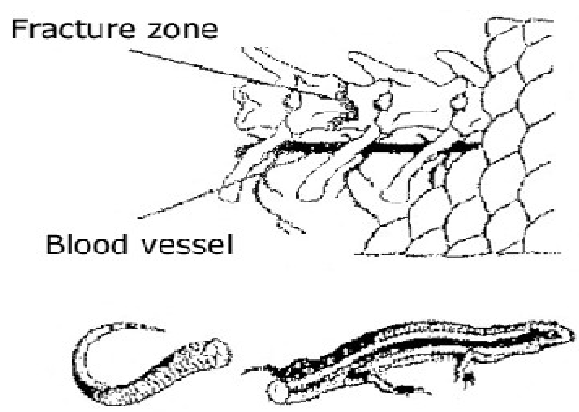

Figure 2. Shows the mechanism of lizard tail loss. The tail is used as a fat storage organ and is lost relatively easily (Pianka & Vitt, 2003).

The best-known and most spectacular predator defense mechanism of lizards is tail loss see figure 2, often referred to as tail autonomy (self-loss) or tail shedding; tails are often used as fat storage organs. An autotomized tail is packed with energy, nerves within the severed tail continue sending impulses, which make the severed tail, wriggle and thrash violently. Therefore hopefully assisting the lizards to escape will go unnoticed by the predator (Pianka & Vitt, 2003), making it an excellent distraction mechanism.

The most commonly found reptile in both reserves is the New Zealand skink (*Oliogosoma*). To assist several species prone to predation the Christchurch City Council is in the process of building a predator proof fence in the Styx Mill Conservation Reserve.

3.3 Sites and sampling

A total of 14 survey sites were chosen in both reserves (see table 2). The number of sites only allowed for minimal baseline data collection; the assessment of presence/absence of reptile fauna in either reserve (Janet Stewart, Styx Mill Conservation). If there were existing populations/individuals, analysis of their health, numbers and dynamics (age, sex ratio, habitat preferences) would reveal only coarse scale trends. This was an initial survey of the two reserves, and hopefully the baseline data collected will be added to in future reptile surveys.

Site Number	Site Name	Number of PF	Number of ACO
1	Contemplation Point	1	-
2	Line of flaxes	8	5(*1)
2A	Opposite Line of flaxes	8	5
3	Ponds to the left	ABANDONED	-
4	Mature flaxes over bridge(R&L)	ABANDONED	-
4A	Wasteland	ABANDONED	-
5	Past Small stream	2	-
6	Mother Load	8	6
7A	Clump of flaxes	ABANDONED	-
7	Clump 1	2	1
8	Clump 2	2	1
9	Flaxes by the ponds	5	4
10	New Area	6	3
11	Janet Stewart Reserve	8	4 (*2)
	Totals	**50**	**29 (plus *3 which were stolen)**

Table 2. Sites, site names and number of traps that were located at each site

Monitoring was undertaken between November 2009 and February 2010, along the Styx River. Both reserves have undergone extensive efforts to restore native flora and encourage native fauna to return to the area.

A total of 50 pitfall traps (PF) and 16 (double) artificial cover objects (ACO's) were installed in areas presumed to be suitable for reptile fauna. A variety of habitat types were chosen to prove presence or absence of lizard fauna. Photos were taken of each individual PF trap lid and an aerial photo of the area was also taken for location records. A field notebook was used to record any highlights or abnormalities encountered each day. All captures were also recorded in the field notebook, and later entered in to an Excel spreadsheet.

3.4 Site descriptions (Refer to appendix for photos of each site).

3.4.1 Contemplation Point (Plate 4) – a maintained gravel walkway leading to a dead end, a picnic table (unfortunately vandalized on a number of occasions)and the merging of two branches of Styx River are located here (from the ponds and the main flow). The surrounding substrate was swampy, exotic grasses (EG), mature flaxes, substantial canopy cover consisting of broadleaf shrubs and trees, also lots of blackberries. A number of pitfalls (PF) were placed here and found flooded. One PF was removed and the can crushed (vandalism).

3.4.2 Line of flaxes (Plate 5) – The maintained gravel walkway that leads to Contemplation point (left hand side of path closest to the pond). Substrate fluctuates in water content depending on the amount of rainfall and the water level found in the pond. Soil is dominated by sands and gravels and therefore excess water drains very quickly. Mature flaxes and Cabbage trees line the edge of the pond. There is a strip of exotic grasses approximately 2-3meters wide separating the flaxes from the walkway. General public have diverged from the walkway and formed pathways through vegetation to gain access to the pond; this disturbance was obvious and regularly observed.

3.4.3 Opposite line of flaxes (Plate 5) – this site was the opposite side of the path leading to Contemplation Point (right hand side closest to the grazed paddocks). Substrate was dry and very sandy, dominated by exotic grasses and native shrubs (recent plantings; last 5-10yrs). Area was adjacent to an electric fence enclosing a grazed paddock.

3.4.4 Ponds to the left (Plate 6) – large ponds, South of Contemplation Point (Bird ponds). This area has been highly modified and landscaped. Pitfalls were at 10m intervals along the bank of mature broadleaf bush, consequently canopy cover was substantial and the substrate was dry and dominated by leaf litter and bark chippings. Workers were observed spraying roundup' regularly in this area, large amounts of rubbish and disturbance were also observed.

3.4.5 Mature Flaxes over bridge (L) (Plate 7) – a bridge allows you to cross the Styx River, directly to the left (once over the bridge) there is a large group of mature flaxes. Adjacent to the mature flaxes the land has been stripped and replanted with young natives (last 2-5yrs). PFs were placed at the base of the flaxes at 10m intervals as far from the river as possible. Substrate here was very dry and little invertebrate life was observed. I was later informed of a large rodent (rat) living in this area (pers. obs. Van Tendeloo).

3.4.6 Mature flaxes over bridge (R) (Plate 8) – a bridge allows access across the Styx River, directly to the right (once over the bridge) there is a large group of mature flaxes, and Willow trees. A number of these exotic Willows had been drilled (poisoned) and left to die and form natural mulch. This area was also highly modified and had previously been striped and sprayed with roundup. Bark chippings and exotic weeds dominated the substrate in this area.

3.4.7 Wasteland (Plate 9) – continues along the walkway in a northwesterly direction. Directly to the left is an area of the reserve where all of the exotic Willows have been drill poisoned and made into natural mulch. This area had recently been stripped of all exotic species and replanted with natives (2-5yrs), spraying of roundup was observed to kill persistent exotic weeds. Substrate was damp-very wet; ground in this area seem to be below the river bank level and I experienced problems with PF flooding and therefore area was abandoned.

3.4.8 Past small stream (Plate 10) – continuing in a northwesterly direction along the maintained walkway; pass over a small drainage channel and to the right is an area of broadleaf bush, EGs and brambles. Bare ground and dry leaf litter dominated substrate.

3.4.9 Mother Load (Plate 11) – area closest to the car park and dog walking park; is an area which has been recently cleared and replanted with natives it is also bordered by mature broadleaf bush. The substrate in this area varied depending on the proximity to the Styx River. Traps placed on the southeastern edge were prone to flooding (close to the Styx River), traps situated further north remained dry and the substrate was dominated by leaf litter.

3.5.0 Clump of flaxes (Plate 12) – mature flax islands situated in a picnic area. Evidentially this area was intended for recreational purposes, a grass lawn always mown (by a contractor) provides limited ground cover. PF and ACO's were initially placed next to or amongst the mature flaxes. Substrate here was good and the soil was not prone to flooding, unfortunately this area was abandoned, as rodents were evident, limiting the possibilities of reptile life.

3.5.1 Clump 1 (Plate 13) – broadleaf bush fragment, encompassed by mown exotic grasses, also part of a recreational area. PF's and ACO's were placed within the fragmented bush (and if possible in patches of sunlight). Bark chippings and leaf litter dominated the substrate. Many invertebrates were observed in traps, also feral chickens were also seen in these patches (clump 1 & 2)

3.5.2 Clump 2 (Plate 14) – broadleaf bush fragment, encompassed by mown exotic grasses, also part of a recreational area. PF's and ACO's were placed within the fragmented bush (and if possible in patches of sunlight). Bark chippings and leaf litter dominated the substrate.

3.5.3 Flaxes by the ponds (Plate 15) – was an area identified later on in the study as potentially suitable habitat for reptiles. The area was not accessible to the general public and therefore disturbance was minimal. Mature flaxes and exotic grasses dominate the area, the substrate was dry and full of gravel making it free draining. Some weeding was undertaken in this area to remove thistles, weeding was done at knee height, and not at ground level as previously observed (pers. obs. Van Tendeloo).

3.5.4 New area (Plate 16) – this was the most westerly site in Styx Mill Conservation Reserve. Another area identified later on in the study as a potential habitat for reptiles, it is also an area that has and still is being regenerated. Approximately half of this site had been cleared and bark chipping had been laid. The remaining area was mature flaxes and mature exotic trees such as pine and birch trees.

3.5.5 Janet Stewart Reserve – eight pitfall traps and 6 (double) ACOs were placed throughout the reserve covering as many different types of habitat and area possible. All traps remained dry; unfortunately a substantial amount of vandalism was experienced at this reserve.

3.6 Pitfall Traps (PF)

Low-intensity monitoring by means of pitfall trapping was used to establish the existence of any reptile fauna at 14 different sites within Styx Mill Conservation and Janet Stewart Reserves.

PF trapping was used to assess the presence or absence of reptiles. Large 840g tin cans (Commercial catering size – sourced from Christ College; see plate 18) were dug into the ground; the lip of the can was made level with the surrounding substrate. PF were originally spaced 10m intervals at each site. As the study progressed and areas of interest were identified PF trapping was intensified in these areas by placing traps at 5m intervals (Site 2,2A [see plate 19]and 9). Lizards such as the Common Skink and McCain's skink generally have a home range of approximately $5m^2$ (personal communication Marieke Lettink, Nov 2009). Traps were covered with wooden plywood lids, designed to allow lizard access to pitfall traps while preventing their desiccation and predation (Lettink & Patrick, 2006). Lids were also supported above the pitfall traps by small spacers (plywood legs) which were glued and nailed securely under each corner. Additional foliage was added over lids which were obvious from the maintained walkway to provide shade, protect the open can from the elements, and minimize the risk of predation and vandalism. A small quantity (handful) of grass (natural substrate) was placed in the bottom of the can to reduce reflectivity (on bottom of the can) and also giving the lizard something to shelter under.

Plate 18. Lizard pitfall traps (PF) used in both Styx Mill Reserve and Janet Stewart Reserve. Plywood lid with small spacers and large tin cans.

To attract lizards each can was baited with a piece of canned pear ($1cm^3$ approx). Traps remained baited from Monday – Friday. They were re-baited and checked (at approximately 09:30 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.

Plate 19. Photo of grasses on opposite line of flaxes (site 2A) and line of flaxes (site 2). Areas were the majority of skinks were caught during the survey.

PF's were removed from areas that were regularly flooded and/or devoid of life; pitfall trap by-catch will usually be experienced. At sites such as Ponds to the left and the Wasteland by-catch was limited, insinuating that fauna in these areas was minimal and therefore reptiles were unlikely to be trapped due to limited food source, or inhospitable environmental conditions (inadequate appropriate habitat).

3.7 Artificial Cover Object (ACO)

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). Originally 16 double Onduline sheets were set out at Styx Mill and Janet Stewart Reserves. Initially I hoped that this survey would allow me to trap both geckos and skinks.

Double sheets were used in an attempt to trap *Hoplodactylus aff. Maculates 'Canterbury'* (Canterbury gecko / moko-pápá), because they prefer to be above the substrate and will tend to shelter within sheets of Onduline. The two layers of Onduline were separated by a small gap, created by short lengths of circular pine dowel that were glued under the centre and corners of the top sheet. No geckos were observed in either reserve and therefore a decision was made after a number of trapping weeks to separate all double ACO’s to utilize the equipment in the most efficient way doubling the number of ACOs as seen in Picture 2 (below).

Plate 20. Picture of a separated double ACO. Small circular doweling can been seen glued to the piece on the right, these helped to form a small gap between double ACOs (so geckos could shelter).

In contrast to geckos, skinks prefer to be in contact with the surrounding substrate (for a quick escape) and will shelter under a single sheet of Onduline (pers. com. Lettink, 2009). Unfortunately a number of ACO’s were periodically vandalized or tampered with – as they must be in direct sunlight and are therefore usually in sight of the general public.

Sheets were weighed down with small rocks and checked for lizards by sequentially overturning each sheet/layer. Each ACO was checked (at approximately 09:30 hours) every 24hrs (in accordance with ethical regulations). The artificial retreat trapping methodology is in accordance with New Zealand Department of Conservation ethical standards and has been approved as a standard management protocol.

3.8 Physical variables measured

Snout vent lengths (SVL) (see table 3 below), 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.

Age Range	Age (years)	SVL (mm)
Neonate (N)	0 - 1	20 -25+
Juvenile (J)	1 - 2	30 – 48
Adult (A)	2+	49 – 50+

Table3. showing the snout vent lengths (SVL) of common and McCain's skinks related to their age group.

Sex determination (male or female) was only undertaken on individuals with a SVL of 50+mm (adults) as neonates and juveniles are far too young to determine gender. When adult females were caught they were assessed to be pregnant/ not pregnant. Additional information recorded included the site at which they were caught, PF trap number and/or ACO number. This helps to identify areas of interest to within a few meters of a trap or retreat. Once skinks had been measured a silver dot was placed on the top of their heads with a non-toxic pen (American Craft metallic marker). Any skinks caught bearing a silver mark was then recorded as a 'recapture'.

Weather data was obtained for each trap day from Cliflow Database, this include rainfall (mm/day), minimum and maximum temperature (˚C/day), and also sunshine (hrs/day). With continued monitoring and additional data referring to seasonal/ temporal fluctuations maybe analyzed for trends.

4.0 Results

4.1 Species Identified

Two species of skink were caught over the 10-week survey at Styx Mill Reserve (see plates 21 & 22), and two individual lizards were caught at Janet Stewart Reserve. *Oligosoma nigriplantare polychroma* (Common skink / mokomoko) is a brown diurnal skink (up to 16cm long) SVL up to 79 mm. Markings are similar to those of *O. maccanni* but without prominent straight edges (castilation). They have 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). *Oligosoma* is an abundant and conspicuous skink which may be found in many parts of central New Zealand. At present *O. nigriplantare polychroma* is a composite of several species; which opens up possibilities for future DNA analysis on this species to produce a current phylogenetic tree. Early descriptions of New Zealand skinks were inaccurate and largely inadequate, with many of the type specimens subsequently lost or lodged in overseas museums. This has led to multiple descriptions of the same species. More recently, genetic analysis has uncovered the existence of cryptic species within several widespread New Zealand skink species (Chapple *et al.* 2009). Females breed annually, producing 1 – 10 young each litter from about January to February (Jewell, 2008).

Plate 21. *Oligosoma nigriplantare polychroma* (Common skink / mokomoko). Picture shows a neonate with a silver mark.

Plate 22. *Oligosoma maccanni* (McCann's skink / mokomoko). Picture shows a juvenile with a silver mark.

Oligosoma maccanni (McCann's skink / mokomoko), is a brown diurnal skink, an avid sun-basker (up to 16cm long), with a SVL of up to 73 mm, and distinct striped longitudinal markings. This species can be very difficult to positively distinguish from *O. nigriplantare polychrome.* They also occupy a variety of different habitats including beach litter, sand dune vegetation, coastal shrub land, suburban gardens and tussock grasslands (Lettink & Whitaker, 2004) and is a very common species in drier regions of the South Island (Jewell, 2008). Distinguishing features include a mid-dorsal stripe that becomes notched or wavy/blotchy toward the tail (unlike *O. nigriplantare polychrome)*. Its throat is whitish grey and usually bears fine black speckling (Jewell, 2008). Females breed annually, producing between 1 – 6 young in each litter, from about January – March.

4.2 Site Results

Sites 2, 2A and 9, (refer to figure 3) were the areas found to have the highest abundance of skinks. In particular the line of flaxes (site 2) proved to be the one location within Styx Mill Reserve with a substantial population of skinks. However, pitfall trap capture rates decreased after 14/12/2009 due to site mowing. On 14/12/2009 both banks of exotic grasses at site 2, which lead to contemplation point, were mown by a contractor. After talking with the Assistant Park Ranger (Dany Van Tendeloo) it was explained that this had to be done because this area leads to a dead end (Contemplation Point) the exotic grasses are considered a fire hazard in this urban area, and the council are required to maintain these areas.

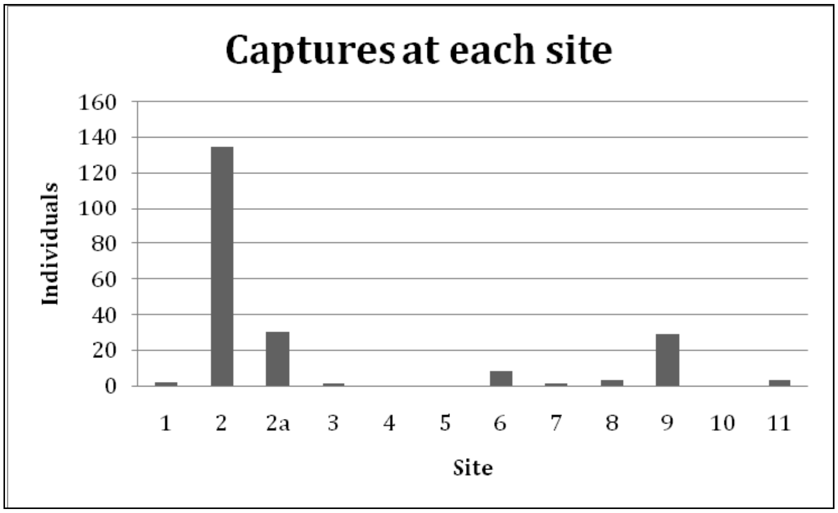

Figure 3. Chart shows number of individuals caught at each trap site over a 10 week period. This is not a quantitative study and therefore no error bars were added.

Sites 2A and 9 (plate 23) which also proved to be populated were located late in the study, which may help to explain the large number of captures at site 2 .

Plate 23. (Left) Site 2 & 2A, (Right) Site 9 areas found to have the highest abundance of skinks*
*I would recommend that these areas and other identified by either myself or from recommendation (pers. obs Van Tendeloo) be surveyed more intensively in the future.

Habitat at these site corrolated well with habitat preferences of both species of skink found; dry grassland no dense overhead shrub or bush cover and limited disturbance. In addition to this whilst trapping and walking from an abundant supply of food (insect life) was noted.

In urban reserves PF trapping proved to be a much more efficient form of monitoring compared to artifical retreats (ACO) see figure 4. In this study a total of 50 pitfall traps were installed and a total of 32 ACO's. Unfortunately the ACO's in both reserves were tampered with and also vandilised. In such habitat (as found in both reserves) ACO's require direct sunlight which generally means that they are also visible to the general public and a temptation.

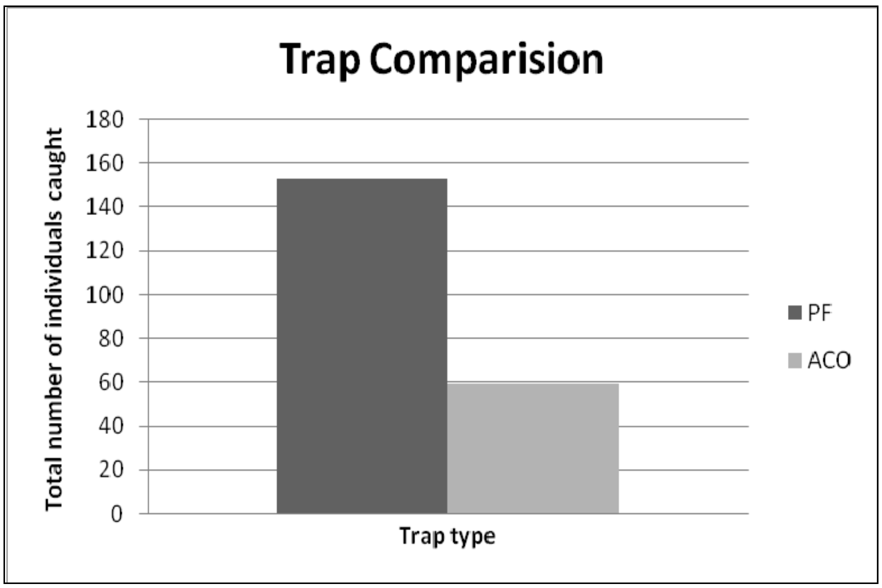

Figure 4. Chart shows the quantity/number of lizards caught in each trapping method. Comparison of trap techniques with regards to an urban reserve environment.

ACO's also proved to be problomatic when trying to catch lizards thermoregulating beneath. Lizards are extremely quick and when there is more than one they are very difficult to catch. This has limited the data collected and a new categorie of "sex unknown " was applied to the sudy.

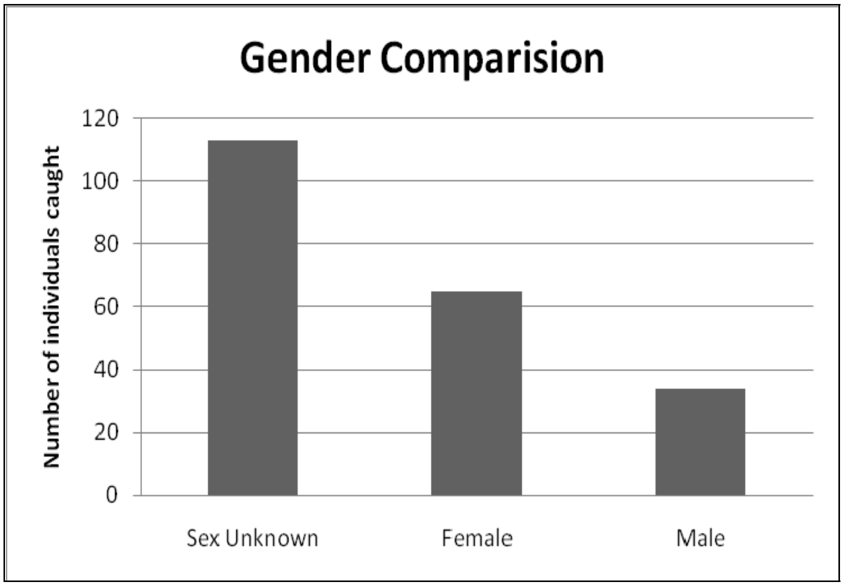

Figure 5. Chart shows data collected from adult skinks (50+mm), which were sexed and gender was recorded. Sex unknown lizards – lizards seen but not caught under ACOs.

All adult skinks (>50mm) were sexed to determine their gender. Information from each site was then amalgamated to help estimate a sex ratio (see figure 5). A large proportion of skinks were observed under ACO's and were unable to determine the sex of these individuals. The baseline results show that there is a larger proportion of females compared with males, however due to the high proportion of sex unknown individuals further research would be benefical in defining results.

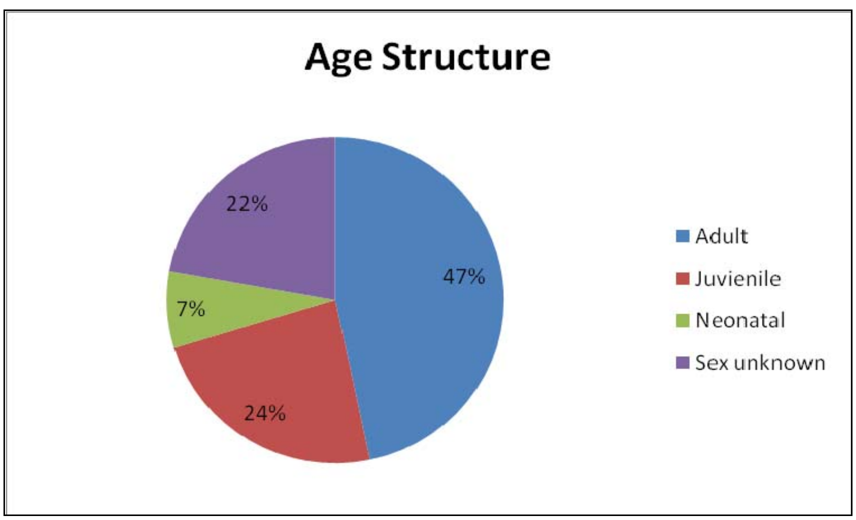

Figure 6. After all data had been collected over a 10 week period all lizards caught/observed were compiled to form an estimate of age structure. Neonates were observed as adult females give birth Jan-Mar.

Once all data collection, had been completed, data from all 14 sites were compiled to form an estimate of existing lizard population age structure (figure 6). Once again this information is extremely vague and would benefit from additional surveys and data collection. However the inital study showed that there is a relatively large proportion of adults (47%) which is positive for the ongoing existence of populations found. Neonates were also observed/caught (7%) which is also a positive sign, as females are reproducing and bearing young (Jan-Mar – both species found), continuing to expand/ sustain existing populations.

5.0 Discussion

Janet Stewart and Styx Mill Conservation Reserves have undergone an extensive transformation from post-European agricultural/pastoral land use. 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 showed that dry grassland areas with no dense over head shrub or bush cover and limited disturbance were suitable habitats for skinks.

According to results there were higher capture rates of females than males, and over all age structure showed that there were a reasonable number of new born (neonates) lizards, this was due to the study coinciding with the reproduction and birth of New Zealand Skinks. These results are not part of a quantitative study and only prove baseline data on the presence of reptiles in the two urban reserves. If more detail is sort about population structure and overall health of the population a more scientific study is required.

5.1 Effects of vegetation change on lizard habitat use

O. n.polychroma is generally found in open areas, from coastal rocky stands to native or introduced tall grasslands and rarely enters forest (Barwick, 1959; Gill, 1976; Patterson, 1992; Newman, 1994; East *et al*., 1995 cited in Towns & Elliott, 1996). Studies of habitat use by *O. n.polychroma* 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 *O. n. polychroma.*

The completion of this initial study has allowed us to identify a number of sites containing populations of skinks within the reserve. Three areas Sites 2, 2A and 9, (refer to figure 3) two of which were located later I the study (2A & 9), were the areas found to have the highest abundance of skinks. 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). In this survey, initial trap placement was 'random' as our aim was to cover as much area and as many different types of habitat found within the reserve, to prove the presence/absence of reptiles.

After the 10 week study period the majority of traps (PF and ACO's) remained in areas of dry substrate, undisturbed dense grassland (native and exotic) which were the areas where skinks were most abundant. In order to conserve and increase lizard population numbers, Council planners may consider planting suitable environments for lizards which may include

- 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)

Artificial retreats such as rock or wood piles would provide suitable habitat and shelter for lizards. 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. 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.

There are large areas of fragmented habitat and isolated patches of bush within both reserves. 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 (such as *Oligosoma nigriplantare polychroma* and *Oligosoma maccanni*) will decline in numbers and distribution, as the current habitat is lost.

5.2 Herbicides

The use of the herbicide "Round-up" in Styx Mill Conservation and Janet Stewart Reserve was observed on a number of occasions. Lizards and other reptiles have been reported to be much more sensitive to the effects of persistent insecticides and herbicides compared with birds and mammals. This apparent sensitivity may result from their low metabolic rate and resultant inability to quickly detoxify contaminants (Hall 1980 cited in Spurr, 1993).

It would be unrealistic to discontinue the use of herbicides and pesticides in the reserves due to the quantity of land area being restored (57ha at Styx Mill Conservation Reserve) and comply with current weed management strategies. According to Park Rangers, members of the general public inform the council if there are areas overwhelmed by exotic weeds; requesting them to be maintained/sprayed. Due to the areas being urban reserves, members of the general public and local community are encouraged to make decisions concerning the maintenance of the reserve. I would therefore suggest that community days be encouraged, asking members of the community to come and help out on hand-weeding days around the reserve.

5.3 Predators

At Styx Mill Conservation Reserve a predator proof fence is under construction (Plate 24.). The fence runs parallel to the Styx River. Karori Wildlife Sanctuary, (2003) has published a report informing managers that unless you have a clearly defined long-term vision for a site, a project like this can go off track very quickly. This is because the conservation of vulnerable species relies heavily upon the identification of threats and effective management (Caughley, 1994 *cited in* Hoare *et al.* 2006). Findings from a study done by Lettink *et al.* (2009) highlights the detrimental impacts exotic predators have on indigenous prey and calls for improved means of reducing predator impacts.

Plate 24. Shows a section of the predator proof fence

Plate 25. Shows the mesh size on the predator proof fence (6cm square)

Deciding on which species of pest you are trying to exclude before installing a fence is also essential, adding more critical predators like ship rats, stoats and cats to the fence exclusion list radically changes the type of fence required (Karori Wildlife Sanctuary, 2003). By building a fence you are committed to its maintenance for the duration of the project (Karori Wildlife Sanctuary, 2003). It is important to understand that the fence may not reduce ongoing management costs or effort.

As can be seen in plate 25, the mesh diameter at Styx Mill Conservation Reserve is approximately 60mm square. A mesh fence with this diameter is designed to exclude cats and dogs from the urban surroundings, entering the reserve. Unfortunately rodents are a significant predator for the lizard population, and the fence is not suitable for preventing their entry into lizard habitats. Once the predator proof fence has been completed an additional layer of smaller mesh will be added to (retro-fitted) the original fence; designed to exclude additional predators such as rodents (pers. com. Styx Mill Reserve Park Ranger, 2010).

5.3.1 Predator population eruptions

A profound change in vegetation in New Zealand's dry grassland ecosystems has been reported, with native species being replaced by introduced species that are, better adapted to grazing (Norbury et al. 2009). Changes in the extent and type of vegetation cover can have complex effects on lizards and may also influence distribution of their predators.

The removal of stock; as done at many sites nominated for restoration within the reserve can also produce mouse irruptions through habitat change that favor mice (e.g. proliferation of rank grasses; Towns & Elliott, 1996). By limiting the extent of introduced seeding grasses within the reserve, this would help to passively control the abundance of feral mice (*Mus muscles*; Fizgerald et al. 2004). Generally house mice prefer areas with dense ground cover (Ruscoe, 2001); habitat manipulation provides another means whereby mice numbers could potentially be controlled (Towns & Elliott, 1996 cited in Lettink & Cree, 2005). Therefore planting native grasses would be an excellent substitute, of exotic species because

1. It will help protect habitat against stock/humans, which, also improves the quality and quantity of available habitat, to species sensitive to predation and disturbance (such as reptiles).
2. Reduced grazing increases the extent of introduced seeding grasses leading to periodic irruptions of mice and increased detrimental effects of these and other introduced predatory mammals.
(Towns and Elliott, 1996).

Mus musclus are potentially one of the most damaging predators of both *O. nigriplantare polychroma* and *O. maccanni* at both Janet Stewart and Styx Mill Conservation Reserves. 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).

It is said that every bit of bush in the North and South islands harbors house mice (*Mus musculus*), sometimes in plague numbers. By eating insects and fallen seeds and berries, mice deprive many native ground-feeding animals of food (terra.govt.nz. 2010). Eradicating or reducing mice numbers through trapping and poisoning 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).

5.4 Vandalism

Vandalism was experienced during a number of occasions during the summers study; it was thought to be young teenagers (as the study coincided with school holidays). Both pitfall (PF) cans, lids and artificial cover objects (ACO), were removed, stolen, thrown into a nearby pond or damaged. Evidence of other vandalism in the reserve was also noticed e.g. Picnic table which was dismantled on a number of occasions, foliage damaged and rubbish dumped within the reserve.

5.5 Recommendations

As the study progressed it became evident that lizards in these reserves generally avoided recently disturbed ground. Such as the area around PF and ACO (pers. obs. McClure, 2010), therefore I would recommend that

That artificial retreat (ACO's) and all pitfalls are placed in the field at least 2 week prior to the first check. This will hopefully allow enough time for the surrounding substrate (disturbed by digging) to settle and also allowing skinks time to start using retreats. Interestingly Hoare *et al.* (2009) found that sampling on consecutive days did not reduce skink counts which contradicted the results from the two urban reserves were regulary disturbed ACO's did have a reduction in the number of skinks observed. If future studies are undertaken at Styx Mill Conservation Reserve a study design based around distrubance of ACO's in an urban reserve would be interesting data.

- That sampling is recommended to start in early December under favorable conditions. Dry periods with moderate to warm temperatures would be preferable to ensure that reasonable capture and recapture rates can be achieved. According to Lettink (2009), early morning skink counts are highly variable and influenced by weather conditions; counts generally increase with ambient temperature and decrease in the presence of rain. Weather variables such as cloud cover (cc), an approximate ambient air temperature, were recorded whilst in the field. No equipment was used in the field to verify data and I would recommend that future studies source monitoring equipment. There were some preliminary correlations between warmer temperatures and number of lizards caught and observed. This is not a quantitative study and for detailed correlations I recommend further studies.

- Hoare *et al*. (2009) has helped to identify optimum conditions for the use of artificial retreats (ACO) as a monitoring technique. Results from the study reveal that skink counts were less variable when conducted within a temperature range of 12 - 18°C regardless of the time of day, and without significant rainfall events (>0.5 mmh^{-1}) in the 3 hours preceding counts (Hoare *et al.* 2009 cited in Lettink, 2009). I recommend that the ambient air temperature (in the shade) be measured and recorded each trap day in the field. When optimum temperatures are reached then ACO's may be checked.

5.6 Conclusion

- Over the long term, ongoing management will be required to maintain and protect existing lizard populations. This may include predator control, maintaining clearings and open areas for basking; with the addition of rock/timber piles, that would help by providing suitable predator proof retreats, educating the public about the reptile fauna present and preventing the general public from disturbing and/or collecting lizards.
- All summer scholarship observes should undergo a standardized training programme to ensure that all data collected is of the same quality and standard.
- Regular review of lizard and predator trapping data to highlight and identify any recurring trends.
- I would also advise that members of the council consider additional contingency planning for dealing with mouse eruptions, once the predator proof fence has been constructed.

5.7 Further Study

Future studies would be a great benefit to our knowledge about the reserves reptile populations, providing more information on possible populations, number of species present including geckos *Hoplodactylus aff. Maculates 'Canterbury'* (Canterbury gecko / moko-pápá), additional data for statistical analysis, habitat preferences, informed recommendations on specific plant species that would benefit lizard habitat construction.

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.

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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 research and work experience as well as improving my research skills.

I have found this project particularly useful as its herpetological focus is not something I have been able to experience during my undergraduate degree at Lincoln University. I found it particularly advantageous that I could create my own project and follow it from start to finish, focusing on what I considered to be interesting. With this experience I hope to continue to focus on the area of herpetology in to future research and study opportunities.

Appendix

 Plate 4. Contemplation Point	 Plate 5. Line of Flaxes(R), Opposite Line of flaxes (L)	 Plate 6. Ponds to the left
 Plate 7. Mature flaxes over bridge (L)	 Plate 8. Mature flaxes over bridge (R)	 Plate 9. Waste land
 Plate 10. Past small stream	 Plate 11. Mother load	 Plate 12. Clump of flaxes

 Plate 13. Clump 1	 Plate 14. Clump 2	 Plate 15. Flaxes by the ponds

 Plate 16. New Area	 New Area

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