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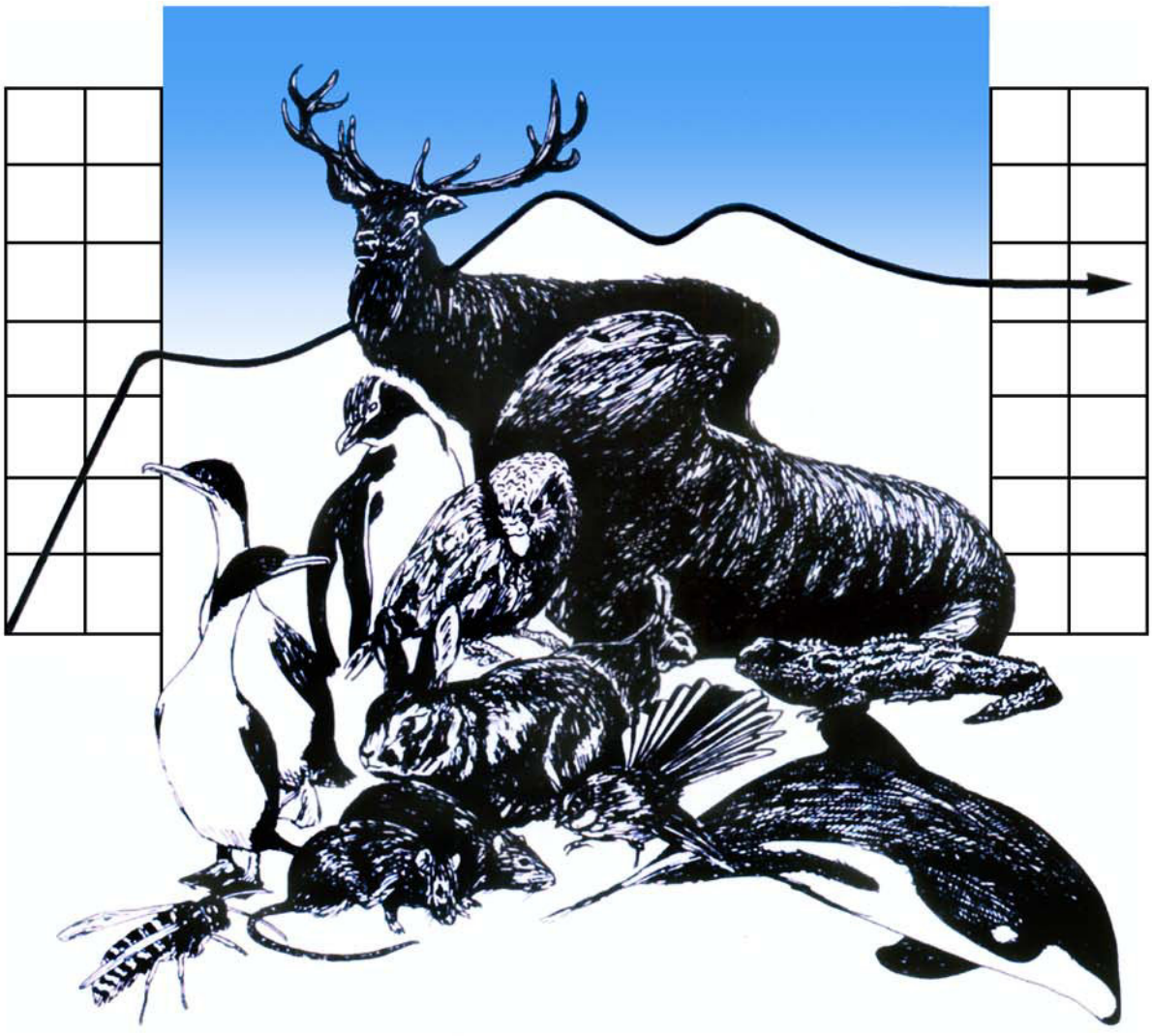

WILDLIFE MANAGEMENT

Abundance and dispersal of translocated common skink (Oligosoma polychroma) on Ulva Island

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Summary

This report describes a monitoring study carried out in 2011 to investigate the abundance and distribution of common skink (Oligosoma polychroma) on Ulva Island, Southland, New Zealand. Common skinks were introduced to Ulva in 2005 and 2006 for ecosystem restoration, and to investigate effects of weka (Gallirallus australis scotti) predation.

Skinks were monitored over 3 non-consecutive days using artificial cover objects. Where possible skinks were caught, weighed, measured and photographed. A total of 18 sightings were made which indicates a substantial drop in both populations but especially at West End Beach. A combination of insufficient habitat and predation/competition by weka are the probable causes. However some uncertainties with monitoring are acknowledged, with regard to sub-optimal weather conditions and 'settling' time for new ACOS. Skinks appear not to have dispersed more than 20-30 metres from their release site.

Recommendations include further monitoring, supplementing the populations and trialling the use of smaller weka-proof exclosures in an area of good habitat. The projected drop in weka numbers due to ingestion of rat poison from a forthcoming eradication provides an opportunity for further research, population supplementation and introduction of green skink.

Additional key words

Gecko, national park, reptile, refuge

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Introduction

Translocation of fauna is an important conservation technique, both for species protection, and for ecosystem restoration (Armstrong and Seddon 2007, Germano and Bishop 2009). Reptile translocations are especially difficult (Dodd and Seigel 1991) but are being used with increasing success (Sherley et al. 2010). One way to minimise the risks of translocation is to first work with more common relatives of the target taxa to identify and solve problems before introducing rarer species. An example of this technique is the reintroduction of common skink (Oligosoma polychroma) to Ulva island. Skinks were reintroduced there 5 and 6 years ago as part of ecosystem restoration and experimental work to evaluate effects of weka predation.

The process of reintroduction has 3 stages: survival of the release generation, breeding by the release generation, and persistence of the re-established population (Seddon 1999). On Ulva island, common skinks have survived and bred (Goodman et al. 2006) but trends in the population, as to both numbers and dispersal, are unknown. This project seeks to evaluate the population size and location of skinks on Ulva island, and to make recommendations about further reintroductions of other reptiles such as geckos or the green skink (Oligosoma chloronoton).

Background

Rakiura National Park (of which Ulva Island is part) has a nationally important lizard fauna, with 8 or more sympatric species within a small geographic range. It is also the southernmost diverse reptile community in the world (Department of Conservation 2011a). However, lizards here are vulnerable to exotic mammalian predators such as rats, cats and hedgehogs, as well as indigenous predators. An expansion in hedgehog range could significantly endanger some species, which makes it important to ascertain the suitability of using islands like Ulva as a refuge.

Reptile species proposed for introduction to Ulva island include green skink (threat status - Declining); jewelled gecko (Naultinus gemmeus - threat status - declining) and cloudy gecko (Hoplodactylus nebulosus - threat status - relict) (Department of Conservation 2011b). Before introductions can occur, the suitability of island conditions for the species needs to be confirmed. In the case of green skink, this means that sufficient habitat is available and

that skinks can increase and maintain their numbers in the context of competition and predation from Stewart Island weka (Gallirallus australis scotti).

Common skinks were introduced to Ulva Island in 2005 from The Neck, a grassland peninsula about two kilometres southeast of the island. Initially 35 skinks were released into a 50m x 50m weka exclosure constructed near the research hut at Old Landing Bay. At that time, 10 corrugated-iron artificial cover objects (ACOs) were placed inside the exclosure and four outside – for refuge and future monitoring. The population was monitored a year later, with 10 skinks found (Goodman et al. 2006). On the same day, 23 skinks (9 females, 10 males, 4 juveniles) were released under six ACOs at a different location, West End Beach. These ACOs were later supplemented by small pieces of onduline, to provide greater refuge opportunity from weka predation.

Methods

Study site

Ulva is a small forested island of around 266 ha located in Paterson Inlet, Stewart Island (figure 1). It was established as a scenic reserve in 1989 and is now part of Rakiura National Park. The island is highly valued for its predator-free status, biodiversity and tourism values, and is managed as an 'open sanctuary' with free day-visitor access. Under the Rakiura National Park Management Plan (Department of Conservation 2011a), Ulva Island is considered a 'special place', requiring more specific management than the park as a whole. Management objectives include: increasing public awareness of ecosystem restoration on the island and facilitating scientific study and research.

Introduced mammalian predators were eradicated by 1997 and four threatened bird species reintroduced since 2000 – South Island Saddleback/Tieke (Philesturnus carunculatus), South Island Robin/Toutouwai (Petroica australis), Rifleman/Titipounamu (Acanthisitta chloris) and Yellowhead/Mohua (Mohoua ochrocephala). Unfortunately, Norway rats (Rattus norvegicus) were found on the island in increasing numbers in late 2010 and an eradication programme is now underway (Department of Conservation 2011b).

The predominant vegetation is podocarp forest, with a narrow strip of coastal scrub of leatherwood (Olearia colensoi), muttonbird bush (Brachyglottis rotundifolia) and inaka

(Dracophyllum longifolium (Michel et al. 2010). The island is heavily indented with sandy or stony beaches, some of which are backed by a strip of more open vegetation such as grasses, club rush (Scirpus nodosus), Carex sedges and flax (Phormium tenax) (pers. obs).

Study species

New Zealand skinks are represented by a single genus, Oligosoma, which evolved through rapid island radiation in the last 25 million years (Liggins et al. 2008, Chapple et al. 2009). The common skink is a small skink (snout-vent length to 80mm) found throughout the southern North Island, South Island and Stewart Island to an altitude of 1700m (Gill and Whittaker 1996, Lettink et al. 2011). Taxonomically it has undergone various revisions and is now considered a species complex, consisting of 5 geographically distinct clades (Chapple et al. 2008). The study species belongs to Clade 5 which occurs in the south-east of the South Island from Canterbury to Stewart Island. Different colour morphs are recognised (Jewell 2008), the Stewart Island animals being light to mid-brown with attractive striping.

The common skink is diurnal and a sun-basker, preferring dry, grassy, open areas with low vegetation or logs and stones for cover (Wilson et al. 2007, Landcare Research 2011). It reproduces annually, bearing up to 10 live young in December-February. Diet consists of a wide range of arthropods, supplemented with berries. Conservation status is 'not threatened' (Hitchmough et al. 2010), however local extinctions appear to be occurring (Frank and Wilson 2011).

Objective, design and preliminary work

The primary objective was to assess skink numbers and distribution using multi-day counts from artificial cover objects (ACOs). The original ACOs had been informally monitored from time to time, with skinks seen under them (Goodman et al. 2006, Brent Beaven pers. comm.). These ACOs were supplemented with new ones (corrugated iron or Onduline), to maximise the number of sightings and assess distribution away from the original release points. Secondary objectives were to obtain morphometric and photographic data from caught skinks, and to assess habitat with a view to further reptile reintroductions.

Preliminary work was carried out to identify ACOs, check their suitability, and plan locations for new covers. Any skinks seen were recorded but not as part of the official

monitoring. On January 18 2011 the original ACOs were searched for and lifted. Many covers in the weka exclosure appeared untouched since the original release, and were overgrown and compacted, consisting of 3-5 layers of iron in varying states of decomposition. The intention was to replace them with just a single layer, which was effective in another location (J Hoare pers. comm.) and would reduce monitoring time. However after finding a heavily pregnant female between layers, it was decided to retain two layers of iron at each site. Many ACOs within the exclosure were shaded and sited on bare ground – not suitable for attracting skinks, but favoured by a number of large stag and carabid beetles (Geodorchus helmsi; Mecodema spp). Other ACOs were very wet underneath – to these dry grass and fern were added to improve habitat conditions. No skinks were found within the exclosure but one adult female was seen outside.

The search was repeated at West End Beach and was more straightforward due to fewer existing ACOs and layers.

On 21 January new ACOs were placed at approximately 20m intervals along the beach and around 100m in the forest at each end. These were made out of 2 layers of surplus corrugated iron, approximately 80cm x 80cm. Where possible, sunny, grassy areas were chosen. Some existing ACOs in the most shaded part of the exclosure were discontinued and 3 additional ones created in the sunny, seaward end. All were renumbered to give a total of 10 within the exclosure and 13 outside. Five skinks were seen including three under one ACO outside the exclosure.

At West End Beach, 16 ACOs were placed, two each in the rocky coves at both ends and a group of four in the general area of the grassy point at the eastern end of the beach. Three existing covers were found at this knoll and a small skink, possibly sub-adult was seen here. Most of the new ACOs were made from small pieces of Onduline (corrugated bitumen roofing material), stapled together into sheets varying between 40cm x 19cm and 40cm x 47cm in size. These required spacers of twigs or small stones to separate the layers.

All covers were within 40m of the beach, due to dense scrub and shading beyond. At each end of both beaches, a ‘forest’ site was also selected to test the limits of distribution.

A completely new location, Post Office Bay, was chosen to test for dispersal of skinks away from Old Landing Bay. Post Office Bay is only a few hundred (forested) metres from Old Landing Bay and has a sunny grassy area near a group of private houses. Three ACOs were placed behind the beach here.

Monitoring

The ACOs were left in place for one week to settle and allow skinks to become familiar with them (Lettink 2008). The covers were then checked by lifting, on three occasions separated by a time period of at least 3 days: 1/2, 5 and 11 February. General visual searches were also made, and natural cover objects such as logs were lifted. Any skinks were counted, and where possible, caught by hand. Captured skinks were measured to the nearest mm using a clear plastic ruler (snout-vent length SVL, vent-tail length VTL, and tail regeneration if any). They were also sexed and photographed. Occasionally an uncaught skink was able to be photographed when it reappeared at the site during processing of the other animals.

Attempts were made to check ACOs under optimal still, dry conditions of 12-18C (Hoare 2009) however the overall survey period was marked by cool conditions and strong winds. Surveys were carried out at varying times between 9am and 4pm. Access to some sites at West End Beach was tide-dependant.

Habitat assessment

Visits were made to two additional sites, Sydney Cove and Boulder Beach in order to assess habitat availability for proposed reintroductions of green skink, jewelled gecko and cloudy gecko. Assessments were based on an informal view of the nature and type of vegetation, aspect, shelter and accessibility for monitoring.

Results

Skinks were most numerous at Old Landing Bay. A total of 16 sightings were made here over 69 'trap days' (table 1). On the first visit, 6 adult skinks were recorded: 4 females and 2 uncaught. A heavily pregnant female was found under cover E (formerly N), inside the weka exclosure. The others were found under ACOs 4, 6(x2), 7 and 9, along the reed-covered foreshore. Weights ranged from 5-12 g, snout-vent length from 50-70mm. On the second visit (5 February), 5 skinks were found, under covers E, 6(x2) and 9(x2). The skink at E was the same individual as seen on 1 February and was not recaptured to minimise stress on the pregnancy. Weights ranged from 4-12g, SVL from 55-70mm. The third site visit took place on 11 February when 5 skinks were also seen, 3 at cover E, and at covers 6 and 9.

The 16 sightings do not represent 16 different animals. As no formal marking technique was used, it is not possible to know exactly how many skinks were present. However many individuals could be identified by size (pregnant female) or tail regrowth length and pattern (Table 1). There were two known resightings, giving an estimate of 14 different animals.

At West End Beach only two skinks were observed over the three visits (table 1); at cover 5 on February 5 and cover 6 on February 11. These were previously-established ACOs at the grassy knoll at the northern end of the beach. One skink was an adult male at approximately 4g and 60mm SVL. The other animal was smaller and not captured. This represents 2 skinks over 48 'trap days'

Skinks were found under only a few ACOs at both sites. At Old Landing Bay, 22% of covers were occupied, and only 12.5% at West End Beach.

No skinks were observed at Post Office Bay (9 'trap days'), no skinks were found under natural objects and no neonates were seen at any site. Overall, the largest skink captured was the pregnant female (total length 150mm, weight 12 g). The smallest was 95 mm long and weighed 4g (Table 2). The mean weight was 5.8g and mean SVL 59mm.

As to habitat, Sydney Cove was the most suitable site for skinks due to its open, sunny aspect and relatively large area of grass/rush. Boulder beach has little grass and many weka were observed there. It is backed by dense scrub of Brachyglottis and Olearia species, faces southwest and would suit arboreal geckos.

Discussion

Abundance and distribution

Skink counts from artificial retreats can provide an accurate indication of overall population size (Lettink et al. 2011). In that study, there was a linear relationship of 2.23 between ACO count estimates and the population size as measured by pitfall trapping capture-mark-recapture. However this linear relationship only occurred under optimal sampling conditions. If the method is valid for Ulva Island conditions, the 16 skink sightings would indicate a population of around 35 skinks at Old Landing Bay. This represents a 10 % decrease in the 6 years since 39 individuals were released.

The decline at West End Beach is more severe. With only 2 sightings and a possible population of 4, this population has declined dramatically from the 23 released, and appears headed for extinction. However it is likely that this study has underestimated the true population, for reasons discussed below.

The concentration of results indicate that skinks have not dispersed beyond their initial release site. They appear to show high fidelity to retreat sites (Wilson et al. 2007, pers. obs.). The pregnant female was observed on 2 occasions under the same ACO, even though there were 2 other ACOs within a few metres. The few ACOs that were used overall tended to be the original corrugated iron covers placed in sunny, grassy areas. Skinks appear to have dispersed only a few metres from where they were released, for example from inside the weka exclosure to outside it. There was no dispersal along the beaches or to Post Office Bay.

Confirming the success or otherwise of such a translocation may take many years as skinks are generally long-lived and slow-breeding (Cree 1994, Towns and Ferreira 2001). Germano and Bishop (2009) suggest monitoring for a period at least equal to the developmental time of the species. Common skinks probably reach maturity at around 4 years (Department of Conservation 2009) although information is scarce (Landcare Research 2011). To allow for longer-term changes in the physical environment, or predator-prey relationships would require longer.

Does this study reflect true numbers/distribution?

A further challenge in measuring the success of a translocation lies in the accurate assessment of the population over time. This can be difficult for skinks due to their cryptic behaviour, colouration, and the influences of weather conditions on their activity (Lettink et al. 2011).

Some limitations of this study mean that it may have underestimated skink numbers and distribution. For example, there is the question of how long new ACOs should be in place before they are used for monitoring. In this study, only 1 skink was found under newly-created ACOs. Other studies have let covers ‘settle’ for 1 - 7 weeks before checking them (Hoare et al. 2009, Frank & Wilson 2011, Lettink et al. 2011). To allow more than one week would have required a separate, earlier visit to Ulva for the preliminary work, and

additional travel costs. However in hindsight, two visits of approximately two weeks duration, separated by 4-6 weeks would have provided more data and better results.

Skink counts from artificial retreats are notoriously variable (Lettink and Seddon 2007, Lettink et al. 2011). Given this, the number of sampling days was probably insufficient to give an accurate result. The weather during the sampling period was not conducive to skink activity, being cold, wet and windy. However opinions vary as to the conditions which are most suitable for sampling. Lettink et al. (2011) recommend dry weather with temperatures between 12-18 C, and sampling during the day. On the other hand Frank and Wilson (2011) preferred sampling at low temperatures before sunrise. The current author noted more skinks during warmer, sunny weather, particularly the presence of more than one skink at a retreat. If capture is not required, warm, sunny afternoons are recommended for monitoring Ulva's skinks.

Population size

If a population becomes too small it may be unable to recover, even in the absence of predation, due to Allee effects or genetic problems such as inbreeding (Miller et al. 2009). Supplemental releases can address this problem provided that the original causes of decline are also being dealt with. The supplemental group should include a proportion of pregnant females, to maximise genetic diversity (Miller et al. 2011).

Habitat & refuge

Reintroductions fail if the habitat at the release site cannot support the species (Armstrong and Seddon 2007). Although common skinks prefer dry, sunny habitat (Wilson et al. 2007, Lettink et al. 2011), most of the weka exclosure is damp and forested. (It may have been more 'open' when first constructed). Only one ACO within the exclosure contained skinks; three were seen at one time, with a nearby fallen branch appearing to provide a basking spot (pers. obs.).

Availability of suitable habitat was limited, especially at West End Beach. Some ACOs were placed in microsites of dubious quality in order to obtain the necessary distribution coverage. Suitable habitat includes refuges which provide skinks with a place to rest, avoid thermal extremes and to hide from predators (Mensforth and Bull 2008). If the available habitat is providing insufficient refuges, artificial objects such as concrete pavers or rock piles can be added (Frank and Wilson 2011), possibly supplemented by planting berry-

bearing groundcovers. However, Lettink et al. (2010b) showed that providing artificial refuges did not by themselves increase the survival of the closely-related McCann's skink (Oligosoma maccanni).

Predation/competition

Weka are curious, active foragers whose diet consists of invertebrates, fruit and lizards (Department of Conservation 1999, Heather and Robertson 2005). They are a recognised threat to the persistence of island skink populations (Miskelly and Beauchamp 2004) and have been implicated in the decline of the Open Bay Island skink Oligosoma taumakae due to a combination of predation and competition (Lettink et al. 2010a). There are plans to eradicate weka from one or more of the Open Bay islands.

Weka were active and curious during the monitoring process, and had to be chased off at times. They were especially persistent at sites which turned out to contain skinks, as if they had noticed the lizards previously. This raises the question of whether the decline in skink numbers has been caused by weka predation.

Impacts from exotic predators are inversely dependent on prey density (Sinclair et al. 1998, Norbury 2001). This phenomenon may also hold true for indigenous predators, in which case the impact of weka will be greatest on low-density skink populations such as the current situation.

The forthcoming rat eradication programme is expected to cause significant weka mortality due to ingestion of poison bait. After Ulva's first rat eradication, weka numbers were reduced by 80-90% (Department of Conservation 2011b). More intensive skink monitoring for a few years post-eradication would provide an opportunity to investigate the effects of weka on skink numbers.

Other avian predators include kingfisher (Halcyon sancta), morepork (Ninox novaeseelandiae), and long-tailed cuckoo (Eudynamus taitensis). The morepork is a nocturnal predator and the cuckoo a seasonal visitor. Kingfishers co-exist with skinks throughout most of New Zealand. It is unlikely that these birds would have a large impact on healthy skink populations.

Rodents

Rodents, including mice, are known predators of skinks (Lettink and Cree 2006, King 2008) and also compete with them for invertebrate food sources. If recently-invaded rats found their way to Old Landing Bay and West End Beach they may have had a rapid adverse effect on skink numbers. The extent to which rats would preferentially target skink in a resource-rich environment is not known – but could perhaps be confirmed by examination of stomach contents.

Recommendations

1. Further monitoring of all ACOs on 3 warm, sunny days, about a week apart. Results from this monitoring will give a more accurate indication of dispersal, and possibly numbers. Following this monitoring, covers still not occupied by skinks may be removed (or retained as beetle habitat).

2. Longer-term monitoring done quarterly at the 3 or 4 most inhabited ACOs, plus a tracking tunnel on either side to check for dispersal (Bell and Pickett 2009). Monitoring within the exclosure can be limited to ACO(E) and one or two other sunny sites at the seaward end. At Post Office Bay, only one ACO or tunnel is required, in the grass to the right of the boatshed. Ongoing monitoring is important so that any interventions required can be carried out while they can still be effective (Seddon 1999).

3. The weka exclosure should be carefully checked as various gaps (especially around the door) mean that it may no longer be weka-proof. Weka are able to squeeze through very small spaces. During this research, one bird got through the small opening into a box rat-trap.

4. Additional island beaches to be surveyed for suitable skink habitat, especially the more remote sites where there may be fewer weka present. Weka appear to be attracted to sites with many visitors (Miskelly and Beachamp 2004; pers. obs.) Look for a sunny strip of grass/sedge – these may be suitable sites for more introductions of common skink or other skink species.

5. Sydney Cove appears to have very good habitat but also many weka. The mix of scrub and grass would suit green skink. Consider creating one or more small weka exclosures

(long and narrow, eg 3m x 5m) before introducing skinks. Alternatively, green skink could be introduced to the existing weka exclosure as this species favours damper conditions (Towns et al. 2001).

6. Sydney Cove would make a good site for a comparative trial with some refuges protected by an exclosure and others not. Also, consider trialling different refuge types such as rock piles and concrete pavers (Frank and Wilson 2011), or planting divaricating ground cover plants.

7. Use the rat eradication programme as an opportunity to reintroduce additional skinks to supplement the populations while weka numbers are low. However in the longer term, the population at West End Beach may be too small to warrant the continuing use of resources to support it.

8. The rat eradication programme could also provide an opportunity for a student project to monitor skink numbers as a Before-After-Control trial. Examine stomach contents of rats caught at Old Landing Bay and West End to provide an indication as to whether they are targeting skinks.

9. If further monitoring shows low numbers at West End, future use of that site and Boulder Beach could focus on arboreal gecko translocations due to the dense scrub available there. Boulder Beach is more suitable for cloudy gecko, which can tolerate cold, wet conditions (Jewell 2008).

10. Research any other locations in New Zealand where skink numbers are not affected by weka, to ascertain the factors which allow this co-existence to occur.

11. Trial exclosure types and sizes. For example, by protecting an area of a few square metres using chicken mesh (including on top), it may be possible to provide skinks with both a refuge and basking/hunting opportunities.

Concluding remarks

Determining the right habitat conditions for a population to persist is a vital component of a successful reintroduction (Armstrong and Seddon 2007). For common skinks on Ulva Island, the key challenges are the lack of open areas at the current release sites, and managing the effects of predation. A degree of active management will be required to meet

these challenges – for example, supplementing the populations and creating additional weka exclosures – but the project is worth persisting with. Firstly because lizards are an important functional part of ecosystem restoration (Bell and Pickett 2009, Department of Conservation 2011a). Secondly because addressing the problems requires only a modest use of resources, and the adaptive management involved will contribute to the stated National Park research objectives. Ulva island has the potential to become a significant reptile refuge and contribute to public understanding of this under-appreciated fauna.

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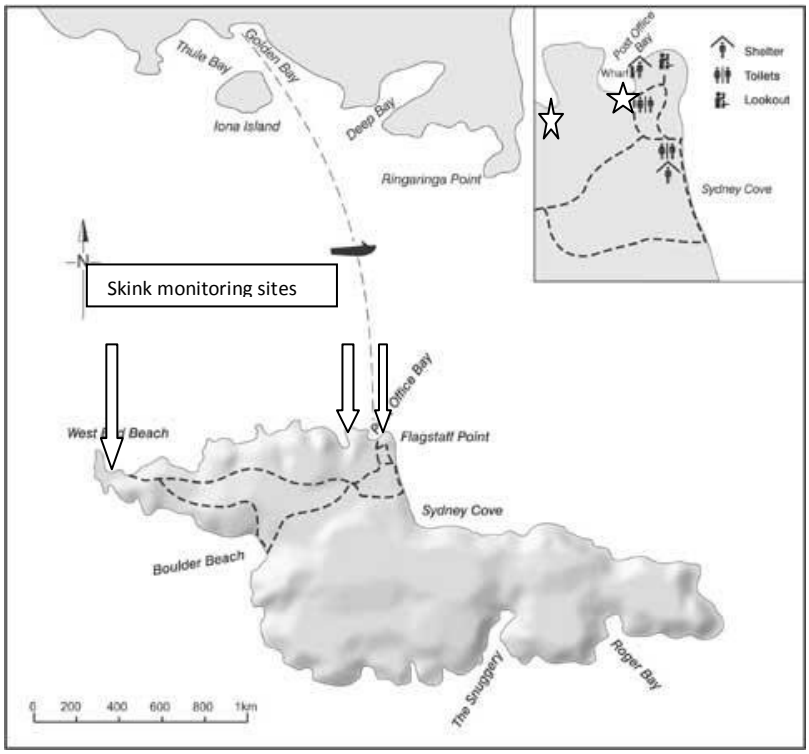
Tables and Figures



455 Figure 1. Map of Ulva Island showing the 3 skink monitoring sites (left to right): West End Beach, Old Landing Bay, Post Office Bay. Department of Conservation

Table 1. Numbers of skinks sighted under artificial cover objects (ACOs) during a 3-day survey
460 of 2 locations on Ulva Island in February 2011: Old Landing Bay (OLB) and West End Beach (WEB).

Site	Date, time & conditions		
Old Landing Bay	1 Feb, 12.30, 15C Part cloud, mod. breeze	5 Feb, 15.00, 18C Cloudy, 18C	11 Feb 14.30 18C Mainly fine, light breeze
OLB E	1	1	3
OLB 4	1	0	0
OLB 6	2	2	1
OLB 7	1	0	0
OLB 9	1	2	1
West End Beach	2 Feb, 09.30, 15C Cloudy, gale winds	5 Feb, 13.00, 20C Fine, light breeze	11 Feb, 13.00 18C Partly cloudy, light breeze
WEB 5	0	1	0
WEB 6	0	0	1

Table 2. Date, location and age class of skinks sighted; morphometric details of captured skinks

Date	Skink	ACO	sex	Age	Weight (g)	SVL (mm)	VTL (mm)	Comment
1,5 Feb	01	OLB E	F	A	12	70	80	Pregnant
11 Feb	02	OLB E		A				Not caught, on log
11 Feb	03	OLB E		A				Not caught, on log
11 Feb	04	OLB E		A				Not caught, photo
1 Feb	05	OLB 4	F	A	4	50	45	Stumpy tail
5 Feb	06	OLB 6	F	A	5	60	70	Dark, 20mm regen
5 Feb	07	OLB 6		A				Not caught
1 Feb	08	OLB 6		S	5	60	70	Same as skink 6?
1 Feb	09	OLB 7		A				Not caught
11 Feb	10	OLB 6		A				Not caught
5 Feb	11	OLB 9	F	A	4	55	70	25mm regen
1 Feb	12	OLB 7		A				Not caught
11 Feb	13	OLB 9	F	A	4			Not caught. Regen
5 Feb	14	OLB 9		A				Not caught. Regen
5 Feb		WEB 5	M	A	4	60	75	
11 Feb		WEB 6		A				Not caught

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