Sinbad Skink Investigatory Study

Sinbad Gully, Fiordland

2010

Department of Conservation
Te Papa Atawhai

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Cover photo: Laying traps in Sinbad Gully, Milford Sound. *DOC*

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1. Background

The Sinbad Gully in Fiordland National Park is a unique location for rare lizard species. Two rare lizards are found in the valley: the Sinbad skink (*Oligosoma pikitanga*) and the Cascade gecko (*Hoplodactylus "Cascades"*). The site is also the home of a morphologically distinct population of Cryptic skink (*Oligosoma inconspicuum*). The Sinbad skink is currently listed as Data Deficient under the New Zealand Threat Classification System (Hitchmough et al., 2010) and deserves urgent priority for research and conservation.

The Sinbad skink was discovered in 2004 and is currently one of the least known of New Zealand's herpetofauna. Sinbad skinks are only known to occur on the rock face in the hanging valley at the head of the Sinbad Gully, near Milford Sound, Fiordland, at an altitude of around 1200m a.s.l. They are difficult to observe as their known habitat consists of small pockets of grasses and herbs on near-vertical rock walls (Jewell, 2008). Prior to this study only ten Sinbad skinks had been captured (Edmonds, 2009). Due to insufficient knowledge of their population biology the Sinbad skinks are listed as Data Deficient in the revised threat classification list (Hitchmough et. al, 2010). More research is urgently required to understand their population biology, ecology and threats, and to be able to improve their threat classification.

Figure 1. A male Sinbad skink (*Oligosoma pikitanga*), a species only known from the Sinbad Gully.

The Cascade gecko appears to be sparsely distributed through parts of northern Fiordland (Edmonds, 2009). It was formerly recorded in the Sinbad Gully by a team of herpetologists in 2004 which in turn lead to the discovery of the Sinbad skink. A lizard survey in the Sinbad Gully in 2009 caught eight Cascade geckos: three adult males, three adult females (one gravid) and two juveniles (Appendix 2; Edmonds, 2009). The Cascade gecko is now listed as Nationally Vulnerable (Hitchmough et .al 2010).

Figure 2. The Cascade gecko (*Hopdactylus "Cascades"*) has been found in the Sinbad Gully, Fiordland.

The species *Oligosoma inconspicuum* is currently being reclassified as a species complex. Recent genetic analysis indicates that the species found in the Sinbad Gully falls within the species *O. inconspicuum* **sensu stricto** (Patterson, pers. comm. 2010). The Sinbad population is morphologically very distinctive, and is tag named the "Mahogany skink" due to its' unique colouration, however it is genetically similar to other *O. inconspicuum* populations. This species is ranked as Not Threatened/ in partial decline. Researchers in the Sinbad Gully caught six Cryptic skinks in 2009 (Appendix 2; Edmonds, 2009). The revised Cryptic skink species is widespread throughout Southland, Otago and the West Coast with sightings known from locations such as Big Bay, Tiwai Point, the Eyre Mountain and Macraes Flat (G. Patterson, pers. com.).

Mice (*Mus musculus*) and rats (*Rattus* spp.) are present in the Sinbad Gully head basin and could be a serious threat to the lizard populations. Mice are known to occur in lizard habitat, as climbers saw a mouse on the rock wall 200m up the Shadowland climb on the Sinbad Gully head basin (Craig Jefferies, per. com.) and a specimen was collected from within the Sinbad skink study site (Willans and Gutsell, 2009, Reardon, pers. com.). A rat was caught in a DOC 150 trap set in the head basin in February 2010 (Reardon, pers. com.). Rodent monitoring in 2009 using tracking tunnel lines only detected mice in the cirque basin (at the campsite) and not on the rock walls (Edmonds, 2009). It was recommended after this research that further rodent monitoring be undertaken. A line of DOC 150 traps intended for stoat control is maintained up the valley, with three traps set in the head basin.

The Sinbad Gully is managed as a Sanctuary by the Department of Conservation. The lead donor for the project is Southern Discoveries a local tourism company

Figure 3. The Cryptic skink (*Oligosoma inconspicuum*), tag named the Mahogany skink, is also found in the Sinbad Gully, Fiordland.

providing interpretive boat and underwater observatory tours in Milford Sound. Fiordland Conservation Trust are the administrator of the funds and employ the Department of Conservation to manage the project. This year additional supporting donors to the project included the Otago Community Trust and the Lottery Environment and Heritage Trust.

An important component of conservation for Sinbad Skinks is locating other populations. This is a high priority and the first step in addressing their Data Deficient status. Surveys for new populations were undertaken in 2010 with funding from the Department of Conservation's Data Deficient Fund.

2. Study Objectives

Very little information is known about the population ecology and threats faced by the Sinbad Skink. The species is currently ranked as Data Deficient and further investigation is required to be able to effectively manage this species and to classify its threat status.

Research on the Sinbad Skink in 2010 was conducted in two parts; the first assessing the status and threats facing the known population in the Sinbad Gully; and the second surveying for new populations of Sinbad Skink in northern Fiordland. The specific objectives for each part of this research are outlined below.

Part One - Sinbad Gully research objectives

- Capture and record details of lizards in the head basin of Sinbad Gully to improve our understanding of the species present and their population dynamics
- Use tracking tunnels and chew tags to detect the presence of rodents in lizard habitat in the Sinbad head basin and measure tracking rates throughout the year
- Measure refugia thermal inertia at occupied and unoccupied sites within the Sinbad head basin to test the assumption that skink occupancy is, at least in part, determined by winter thermal refugia
- Start developing a conservation management plan for Sinbad skinks

Part Two – Data Deficient Survey objectives

- Search additional sites similar to the Sinbad Gully for new Sinbad skink populations in northern Fiordland
- Use information from these and other surveys to move the status of Sinbad Skinks from Data Deficient to a higher threat classification.

3. Methods

3.1 STUDY SITE

The Sinbad Gully is a steep-sided glacially carved valley that joins onto the southern end of Milford Sound, Fiordland (Figure 4). Forming part of the Llawrenny Peaks range, the Sinbad Gully is a northwest facing cirque enclosed by vertical granite rock cliffs 150-250m high. The ridge of Mitre Peak forms one edge of the steep-sided main valley.

Lizards have been located on the rock faces of a hanging valley near the head basin of Sinbad Gully (see circle in Figure 4). The only known population of Sinbad skinks occurs here in an area of around 100m^2 to the lower right of the waterfall pictured in Figure 5.

Figure 4. The location of Sinbad Gully, near Milford Sound, Fiordland. The circle on the main map indicates where lizard species have been discovered in Sinbad Gully.

Figure 5. The vertical habitat of Sinbad skink is to the lower right of the waterfall amongst the fissured rock and vegetation.

3.2 LIZARD CAPTURES

Due to the steep terrain of Sinbad Gully, rock climbing was essential to reach areas of known and potential lizard habitat. Climbers set Gee's minnow traps (a minnow trap widely used to catch lizards; Figure 6) baited with tinned pear halves on the rock wall in the head basin of the Sinbad Gully to catch lizards and were to catch any lizards sighted by hand if possible. Trap locations were recorded as top, middle or bottom of the rock wall and were placed in similar locations to the traps from the 2009 survey. Trap locations were similar to the locations of the i-buttons (see Figure 7).

Figure 6. An example of a Gee's minnow trap commonly used to catch lizards.

Captured skinks were photographed to create a photo identification gallery and marked (with a xylene free pen) to identify any recaptured individuals during each field trip.

The following details were recorded for each skink captured:

- Species
- Age
- Sex
- Weight
- Snout to vent length (SVL)
- Tail length (VT)
- Regeneration length
- New individual or recapture
- Location on slope of capture

3.3 THERMAL REFUGIA INVESTIGATION

To test the assumption that a determining component of skink occupancy is the thermal and/or hygrological characteristics of refuge sites, i-button data-loggers were deployed in the Sinbad Gully head basin. I-buttons gather data at hourly intervals recording temperature (in degrees Celsius to 0.06 accuracy) and relative humidity (to an accuracy of 0.002).

Sixteen i-buttons were attached to the rock wall in four sites, two within the occupied skink habitat and two in apparently good but unoccupied skink habitat amongst the rock/vegetation interfaces in the habitat in front of the rock wall (Figure 7).

Two types of i-buttons were used. Ten i-buttons were deployed that record the temperature and relative humidity (Dallas 1, 2010), while the remaining six i-buttons will just record temperature (Dallas 2, 2010).

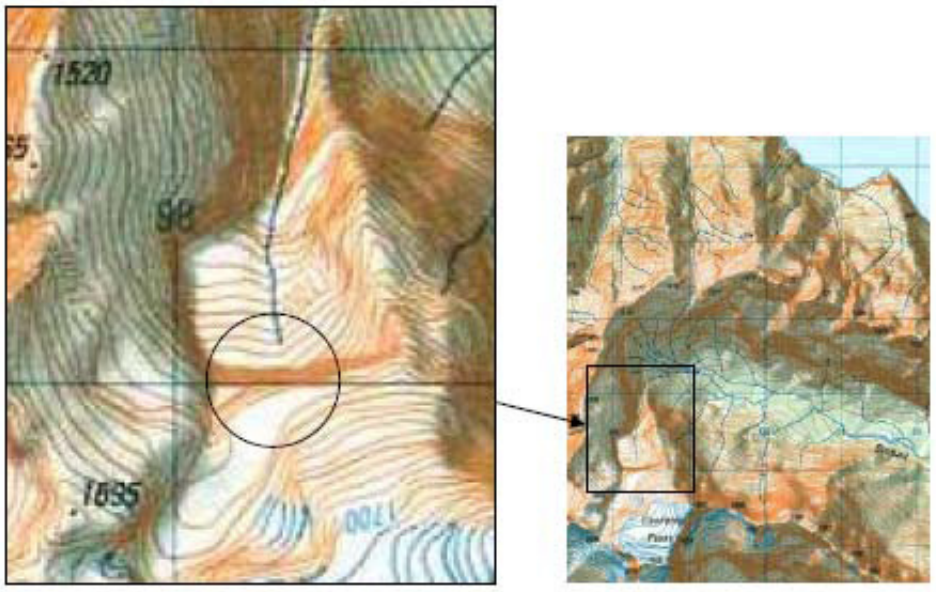

Figure 7. The i-buttons were deployed inside the circled area (left map) at the head of the Sinbad Gully side basin (right map).

3.4 RODENT MONITORING

Tracking tunnels and rodent chew sticks were used to monitor the presence of rodents in Sinbad Gully.

Forty semi-permanent tracking tunnels were established: ten tunnels on the rock wall within occupied skink habitat, twenty below the bluffs and ten below the tent sites at the bottom of the hanging valley (Figure 8). These were baited with peanut butter and set overnight on 3rd to 4th February and again overnight between the 2nd to 3rd June 2010.

To increase the chances of detecting rodents in skink habitat the tracking tunnels were left out for a longer monitoring period. After the 2nd to 3rd June field trip the tunnels were re-set and baited. They will be checked on an upcoming field trip 28th to 29th June 2010 and re-baited again to determine rodent presence or absence over winter.

Fifteen rodent chew sticks were deployed in February on and below the rock wall in the Sinbad Gully head basin. These were checked on subsequent field trips and will continue to be monitored on future visits to the valley.

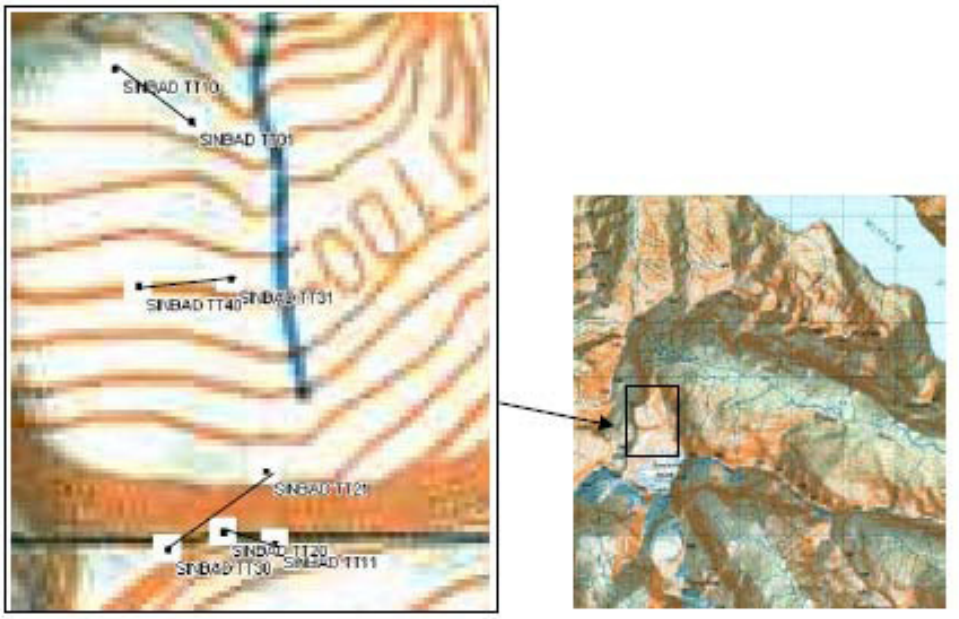

Figure 8. The location of four tracking tunnel lines (left) in the hanging valley at the head of Sinbad Gully (right). Each line has ten semi-permanent tracking tunnels spaced evenly along it.

3.5 SURVEYING FOR NEW POPULATIONS

Sinbad skinks are currently ranked as Data Deficient due to the lack of knowledge on their range and demographics. Only being known from a small area in Sinbad Gully, this species is extremely vulnerable. Finding additional populations would help to ensure the security of this species and assist in determining their current threat classification.

Funding from the Department of Conservation's Data Deficient Fund enabled field trips to three sites in northern Fiordland to search for new populations of Sinbad Skinks. Three sites were chosen because of their geographical similarities to the Sinbad Gully site. All three sites were in northern Fiordland within 10km of the head of Sinbad Gully (Figure 9) and had northerly facing rock walls. Sites were restricted to those with a helicopter landing site nearby and that had areas suitable for skink searching by foot or climbing.

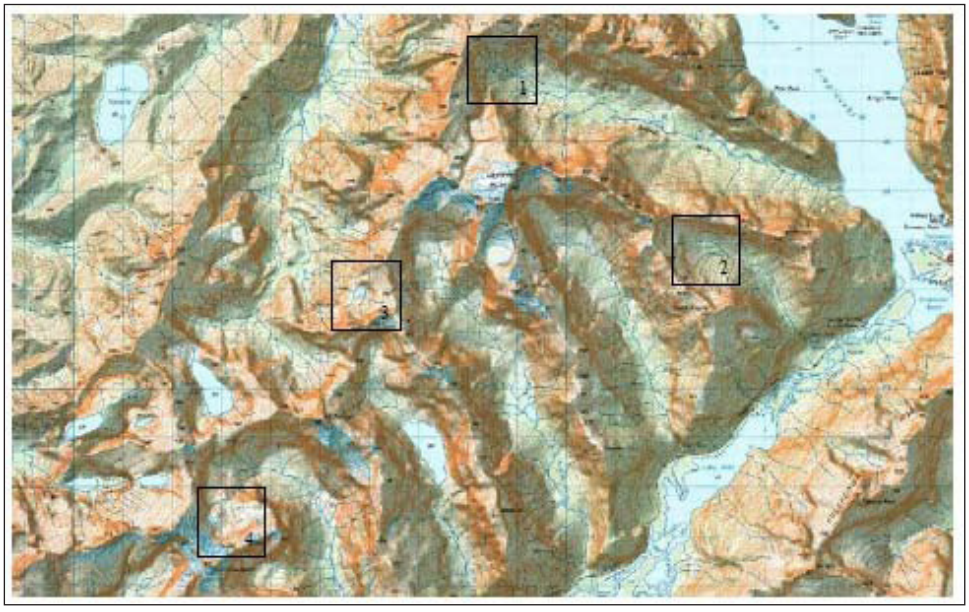

Figure 9. Location of additional sites surveyed for skinks in 2010 compared to the Sinbad Gully (1): Devil's Armchair/ Camp Oven Creek (2); Transit Valley (3); and the Lady of the Snows (4).

Skinks were searched for using binoculars and the naked eye during fine weather. Gee's minnow traps were deployed in known favoured habitat as well as other likely habitat nearby on or below rock walls. Captured individuals were photographed to allow identification, marked with a xylene free pen to enable recapture identification and relevant measurements recorded.

Detailed maps of three sites surveyed for new Sinbad Skink populations are shown below: Devil's Armchair/ Camp Oven Creek (Figure 10), Lady of the Snows (Figure 11) and the Transit Valley side basin (Figure 12).

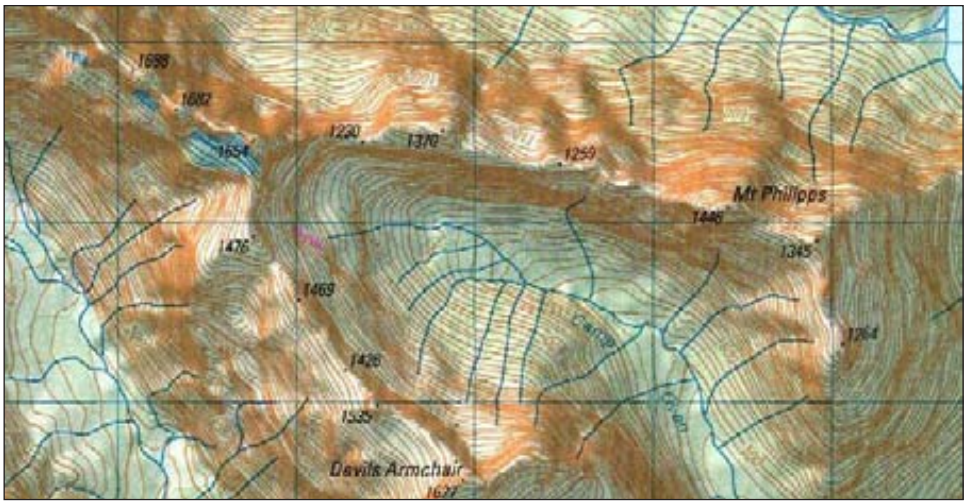

Figure 10. Devil's Armchair-Camp Creek site (searched location shown by pink line).

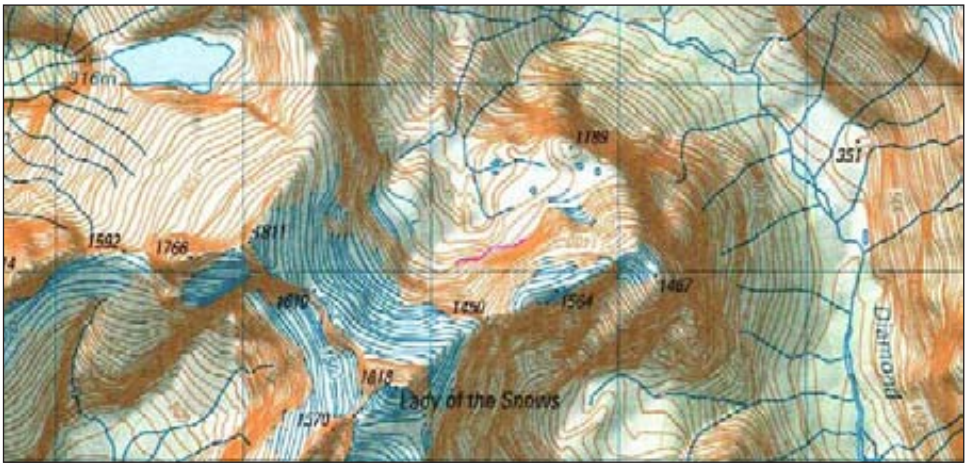

Figure 11. Lady of the Snows site (searched area shown by pink line).

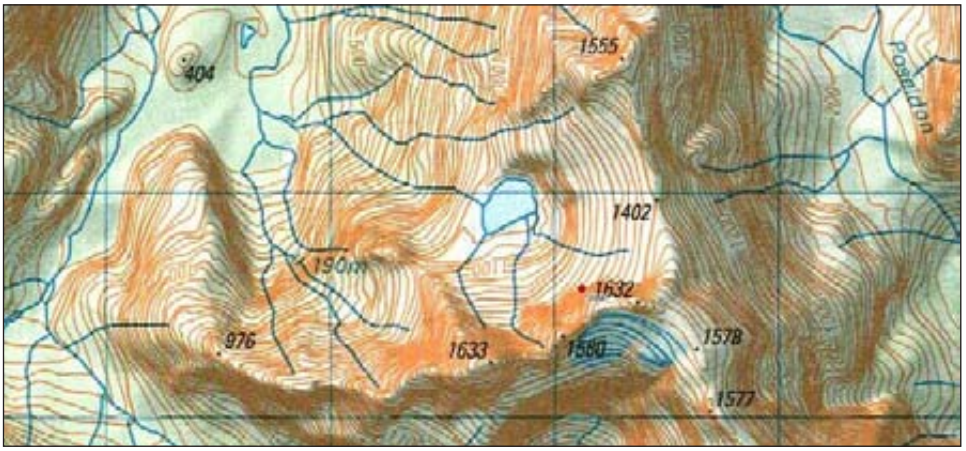

Figure 12. Transit Valley side basin (where skinks approximately found is shown by a red dot).

3.6 FIELD TRIPS

Sinbad Gully Surveys

Three field trips were conducted to the Sinbad Gully during 2010 funded by Southern Discoveries and administered by the Fiordland Conservation Trust.

Trip One: 3 -5 February 2010

Personnel: Joe and Dave Newman (climbers/staff from Southern Discoveries), James Reardon (TSO fauna) and Hannah Edmonds

Objectives: Skink catching and information gathering

Trip Two: 10 - 11 May

Personnel: James Reardon, Adrian Braaksma (climber), Luke Padgett (climber)

Objectives: Climbers to set up anchor points on the rock wall in skink habitat for ease of access. Deploy i-buttons to monitor temperature and humidity.

Trip Three: 2 - 3 June

Personnel: James Reardon, Eric Edwards (TSs Fauna), Les Judd (Grand and Otago Skink Ranger)

Objectives: Set up more i-buttons and put in semi-permanent tracking tunnels

Data Deficient Surveys

Three field trips were conducted to search for new Sinbad Skink populations in northern Fiordland funded by the Department of Conservation's Data Deficient Fund.

Trip One: 11 - 12 February 2010

Location: Devil's Armchair/ Camp Oven Creek

Personnel: James Reardon, Luke Padgett, Hannah Edmonds

Trip Two: 16 -18 February 2010

Location: Lady of the Snow's

Personnel: Marieke Lettink (independent herpetologist), Luke Padgett, Hannah Edmonds

Trip Three: 26 - 27 February 2010

Location: Transit Valley side basin

Personnel: Marieke Lettink, Hannah Edmonds

4. Results

4.1 LIZARD CAPTURES

During three field trips to the Sinbad Gully head basin 14 lizards were caught, 13 in Gee's minnow traps and one by hand (Appendix 1). Only two of the skinks captured were Sinbad skinks. Six Cryptic skinks (*Oligosoma inconspicuum*) and six Cascade geckos were also captured. Full details of captures are included as Appendix 1.

The Sinbad skinks were both caught in Gee's minnow traps placed midway up the rock faces. They were both adults; one male and one female. The male weighed 15 grams and the female 14 grams. One of the Sinbad skinks had been caught previously in 2009.

From the six Cryptic skinks caught:

- four were caught on lower slopes, one on the mid-slope and one near the waterfall
- one juvenile skink was caught (the remaining five were adults)
- one skink was a recapture from 2009
- three were females and two males (sex indistinguishable in juveniles)

From the six Cascade geckos caught:

- all were adults
- three were male and three female
- three geckos had previously been caught in 2009
- three were caught on the lower slopes and three on the mid-slopes
- one very big female was in the early stages of pregnancy

4.2 THERMAL REFUGIA INVESTIGATION

Sixteen i-button data loggers were deployed on rock faces of the Sinbad Gully head basin between altitudes of 1120 and 1480 metres a.s.l. The data-loggers are still in place collecting temperature and humidity information on an hourly basis over the winter period. They will be retrieved and downloaded in November 2010 to obtain a profile of winter conditions, then redeployed in the same locations until the following summer.

Manual weather records were also recorded throughout the days that skinks were captured in February 2010 (Table 1).

TABLE 1. WEATHER RECORDS FROM SINBAD GULLY FIELD TRIPS, FEBRUARY 2010.

DATE	TIME	TEMP (OC)*	WIND	CLOUD COVER**	NOTES
3-Feb-10	10:00 a.m.	24.3	calm	0	
3-Feb-10	12:32 p.m.	28	calm	0	
3-Feb-10	1:54 p.m.	30.3	calm	0	hot
3-Feb-10	4:54 p.m.	25.6	calm	0	hot, no wind
4-Feb-10	10:00 a.m.	20.8	calm	1	
4-Feb-10	11:00 a.m.	24.2	calm	0	
4-Feb-10	12:51 p.m.	23.7	calm	0	
4-Feb-10	6:09 p.m.	20	calm	0	
5-Feb-10	1:18 p.m.	25.4	calm	0	

* all temperatures represent shade air temperatures taken c. 1.3 m above ground

**cloud cover is measured in octiles where '0' is a clear sky and '8' is fully overcast

4.3 RODENT MONITORING

The rodent chew sticks deployed in February showed no sign of rodent presence when assessed on later field trips. Kea chews were detected on some tags. They have been left in place to continue monitoring and will be removed once they have lost their usefulness.

From the two nights that the tracking tunnels were set (one night in February and one night in June) no rodents were detected. The tunnels have been left for a longer monitoring period of approximately four weeks. They will be checked again on the next field trip planned for the 28th to 29th June 2010. The tunnels will be re-baited following this trip to continue monitoring rodents throughout the winter.

Probably the most interesting observation this season was a dead pregnant female mouse that was found on the rock wall amongst skink habitat during the May field trip. Not only does this confirm that mice do occur in this habitat but also that they can most likely breed in this environment, including in winter.

4.4 SURVEYING FOR NEW POPULATIONS

Devil's Armchair/ Camp Creek area

Two days of searching in this area (including 29 Gee's minnow traps being set) resulted in no skinks being caught. The rock faces searched are shown in Figure 13 below.

Figure 13. Photos of rock faces searched in the Devil's Armchair/ Camp Creek area.

Lady of the Snow's site

Two days of searching in the Lady of the Snows area also found no skink species. Twenty two Gee's minnow traps were set amongst the rocks. The types of rock faces searched are illustrated by the photos in Figure 14 below.

Figure 14. Two photos showing the types of areas searched at the Lady of the Snows site.

Transit Valley side basin

This was the only one of the three sites where skinks were caught. Twenty-two Gee's minnow traps were set amongst the rock faces illustrated by the photos in Figure 15.

Two skinks were caught in a side basin of the Transit Valley in February 2010. They have been identified from photos (Figure 16) as Cryptic skinks, although tail tip samples are still to be analysed for genetic confirmation (Rod Hitchmough, pers. com.). One skink was a female and the other a juvenile. Full details of

Figure 15. Rock climbers searching for skinks on the faces of a side basin of the Transit Valley.

measurements are included in Table 2. Both skinks were caught on the same rock face pictured in Figure 17. The female was caught in a Gee's minnow trap set amongst vegetation on the upper part of the rock face and the juvenile was caught by hand under a rock at the base of the rock wall (Figure 17). The female has an unusual kink in her body indicating an old injury.

TABLE 2. DETAILS OF THE TWO CRYPTIC SKINKS CAUGHT IN A SIDE BASIN OF THE TRANSIT VALLEY, FEBRUARY 2010.

CHARACTERISTICS	SKINK ONE	SKINK TWO
Snout to vent length/ SVL (mm)	57	49
Vent to tail length/ VT (mm)	63	50
Tail regeneration (mm)	Complete	13
Weight (g)	3.5	1.7
Sex/ age	female	Juvenile
Appearance	Common skink looking. Thick dorsal stripe. Very hunched looking	Lighter brown, hint of dorsal stripe. Faint yellow belly
Notes	Has had injury on back. Tail tip sample taken.	

Figure 16. Photos of the two Cryptic skinks caught in a Transit Valley side-basin while searching additional sites for Sinbad Skinks, 27 February 2010. Skink (a) was caught in a Gee's minnow trap, while skink (b) was caught under a rock in the locations shown in Figure 17. Error! Reference source not found.

Figure 17. Locations of where two cryptic skinks were caught in a side basin of the Transit Valley.

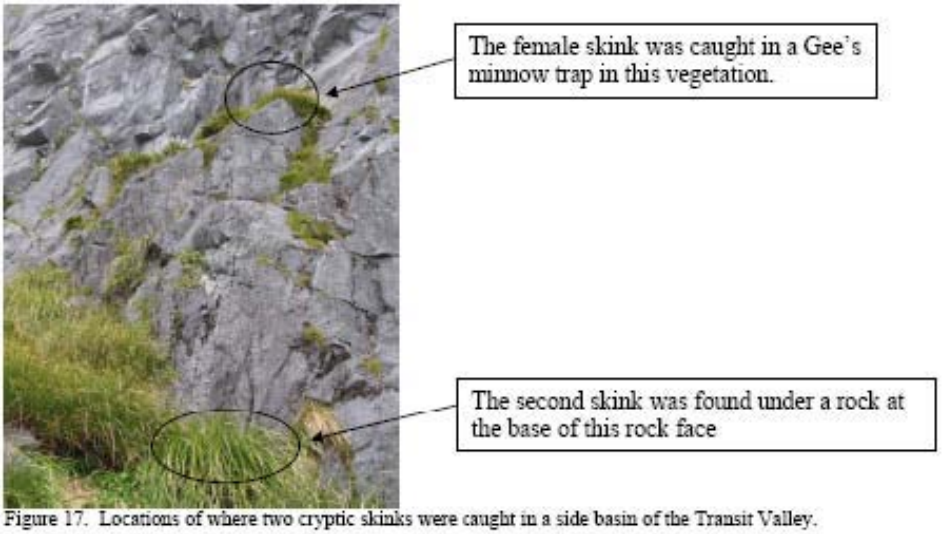

Figure 17. Locations of where two cryptic skinks were caught in a side basin of the Transit Valley.

5. Discussion

The field trips into the Sinbad Gully resulted in the refinement of our strategic approach to developing a research and management plan for Sinbad skinks. Although the surveys for new populations were unsuccessful in locating Sinbad skinks outside of the Sinbad Gully, these results place a higher priority on protecting the only known population in the Sinbad Gully.

5.1 LIZARD CAPTURE AND IDENTIFICATION METHODS

Thirteen lizards were caught in Gee's minnow traps and one by hand in the Sinbad Gully over three days in February 2010. Of these lizards only two were Sinbad skinks. Although it may appear that the traps are working effectively, Fauna Technical Support Officer James Reardon was present on the skink catching trip and made observations that question their effectiveness and sensitivity. In an area of approximately 20m^2 James observed four individual Sinbad sinks but none of these target animals were caught in the five Gee's minnow traps that were set in the same area for three days (Reardon, 2010). This current method of capturing skinks using Gee's minnow traps may be too inefficient to gather useful population data in the short term unless significantly more effort is employed to improve their capture rate. The effectiveness of the trapping may also be influenced by potential trap shyness acquired by individuals (Reardon, 2010).

Until a more effective trapping method can be developed (see recommendations) the method could be continued as a coarse measure of relative abundance and to enable the development of photographic identification for Sinbad skinks. Unfortunately the photos taken during this and last years field trips were of variable quality which may have influenced our ability to accurately identify individuals as either new or recaptures.

5.2 THERMAL REFUGIA INVESTIGATION

The assumption that a determining component of skink occupancy is the thermal and/or hygrological characteristics of refugia during winter is still being tested. Sixteen i-button data loggers are currently in place recording temperature and hygrological information in occupied and unoccupied skink sites in the Sinbad Gully head basin. Information will be recorded throughout the winter and will be available for analysis later in 2010.

5.3 DETECTION OF RODENTS

Rodent monitoring using tracking tunnels and chew sticks did not detect any rodents during two field trips in 2010. The tracking tunnels were only left out for one night on each of the February and June trips, as is standard practise with

most tracking tunnel monitoring. Due to the potentially low numbers or detection probability of mice on and around the Sinbad rock faces, one night of monitoring may not be sufficient to detect the presence of mice. To allow a great chance of detection, the forty tracking tunnels were re-baited and left for approximately four weeks. They will be re-checked in late June 2010, and re-baited to continue monitoring during the winter.

5.4 CHARACTERISING SKINK HABITAT AND ECOLOGY

Some trapping and observational effort was expended to detect skinks amongst the scree/vegetation interfaces on the slope below the rock wall site. Superficial appearances suggest this should be ideal habitat for Cryptic skink which is sympatric with Sinbad skink on the observed lower rock face. However observation and 8 trap-nights of effort failed to detect any skinks, although two possible skinks scats were observed.

Cryptic skink is known to exist in reasonable abundances in the presence of intense predator pressure and a full suite of predators and competitors (populations are locally robust in eastern Otago and in the Nevis and Eyre Mts., and comparable altitudes of 700-1100m), which makes it's possible absence from these scree/ boulder habitats in Sinbad Gully intriguing. We might hypothesise that if true, this observation suggests that Cryptic skink habitat occupancy is more likely the result of climatic parameters rather than predation/ competition although the two factors may interact. Whilst we have no data on the broader habitat preferences of Sinbad skink we might wish to base conservation management decisions in the short term on assumptions that ecological processes impact similarly on both species.

Figure 18. Sub-adult Sinbad skink moving swiftly and confidently over smooth vertical rock habitat.

Field observations of Sinbad skinks suggest the skink is relatively specialized as a vertical rock habitat specialist (Reardon, pers. com.). Observations of both juveniles and adults scaling apparently un-featured vertical rock surfaces (Figure 18) during the morning of the 3rd of February suggest a level of competence and agility on vertical surfaces beyond that which one would anticipate for an agile but non-

specialist skink. Of course, the ability to traverse vertical rock surfaces would be as useful to a skink inhabiting a boulder field of large scree habitat as to animals dwelling on a cliff but the observation lends weight to the opinion that these are rock habitat specialists rather than a generalist skink that has been removed from other habitat types by pressures from invasive species (Reardon, pers. com.).

5.5 SURVEYING FOR NEW POPULATIONS

Surveys of three sites in northern Fiordland (funded by the Department of Conservation's Data Deficient fund) were unsuccessful in finding new Sinbad Skink populations. The only lizards seen were two Cryptic skinks caught in a side basin of the Transit Valley.

A number of difficulties were experienced during these surveys. Firstly only three sites were able to be surveyed due to poor weather in February and March. The short weather windows also meant that at the sites surveyed traps were not out for as long as they should have been. There were also difficulties accessing potential habitat on the rock walls so only parts of all potential lizard habitat could be surveyed at each site.

No detection of lizards in the other two areas searched may show, as would be expected, that they are not present, or may be a reflection of poor capture technique and our inability to survey all potential lizard habitat. To be absolutely certain that lizards do not occupy these sites, additional surveys using a revised capture method involving more intense trapping may be required (see Recommendations section).

Absence of Sinbad Skinks from these three sites in Fiordland provides further information to help with the assessment of their threat classification. A lack of detection of Sinbad Skinks from Lake Morton during surveys in 2009 (Edmonds, 2009) and from the three sites surveyed in 2010 adds weight to the argument that the Sinbad Skink has an extremely restricted range and is deserving of a high priority threat classification.

It may be possible to use information from alpine gecko surveys in Fiordland over the past seven years to indicate absence of Sinbad Skinks from the sites they surveyed. Further investigation would be required to determine if the methods used in this work (Chartris et al., 2006) would allow for this kind of comparison. Alternatively sites where alpine geckos were found may be good places to search for Sinbad skinks as the presence of geckos may indicate suitable habitat/ refugia for other lizard species.

5.6 DEVELOPING A CONSERVATION MANAGEMENT PLAN

After the first field trip into the Sinbad Gully in February 2010, Fauna Technical Support Officer James Reardon compiled the following nine hypotheses that could be tested to advance out ability to manage Sinbad Skinks (Reardon, 2010). Methods to investigate these hypotheses are also described along with their priorities and time frames. This information forms the basis for an initial conservation management plan for Sinbad Skinks and will help prioritise future research and management for this species.

Sinbad Skink Research Hypotheses

Nine hypotheses we should test to advance our ability to manage Sinbad Skinks:

H_1 *Oligosoma pikitanga* is a point endemic species to the rock face at the head of the Sinbad Gully.

H_2 *Oligosoma pikitanga* occupies habitat with distinctly higher winter minimum temperatures and dryer hygrological characteristics than adjacent rock/scree/ vegetation interface habitats.

H_3 *Oligosoma pikitanga* occupies habitat with significantly lower population abundances of rodents than adjacent rock/scree/vegetation interface habitats.

H_4 *Oligosoma pikitanga* occupies habitat with significantly lower encounter rates of mustelids than adjacent rock/scree/vegetation interface habitats.

H_5 *Oligosoma inconspicuum* 'Sinbad ecotype' shows the same habitat preferences (presence/absence) as *O. pikitanga*.

H_6 *Oligosoma pikitanga* occurs at the Sinbad Gully rock face site in a total population of less than 2,500 individuals.

H_7 Capture and removal of rodents by conventional means (either poison or trapping) can achieve a significant decline in the frequency of detection of rodents in the Sinbad alpine system during autumn and winter periods of rodent activity and abundance.

H_8 Rodent diet in the alpine zone of Sinbad Gully includes native herpetofauna

H_9 Removal/suppression of rodents in Fiordland alpine habitats allows for an increase in native biomass

Methodologies to test these hypotheses

H_1 Searching for other O. pikitanga *populations*

The first priority for conservation management of these skinks is to attempt to identify other distinct populations of *O. pikitanga*. If a minimum of 6 distinct (separated by more than 1000m) populations consisting of more than 500 individuals can be identified then we can assume some security for the species in the short term (<5yrs) and annual occupancy monitoring should be conducted annually to ensure their continued survival and allow the gathering of data to enable more informed searching of other habitats in the medium term with a lower priority. Estimation of population size is unlikely to be achieved by an adequate CMRC study and so we must be willing to extrapolate observed density of skinks in small areas to the total area of habitat recorded as occupied by *O. pikitanga*. Whilst scientifically questionable, this method will allow us to make short term conservation management decision which can be corroborated by subsequent and more thorough studies of the populations in question. Funds are already designated for the surveying of potential *O. pikitanga* habitat.

H_2 Gather data on thermal and hygrological climate of cliff/scree/ boulder/vegetation microhabitats

Following from initial observation suggesting *O. pikitanga* shares habitat selection criteria with *O. inconspicuum* which is known to be able to persist in the presence

of moderate pest abundance at similar altitudes we may postulate that climate rather than predation/competition is driving the habitat occupancy of both species. This region of northern Fiordland receives significant precipitation and so habitat with good drainage and aspect may be critical in providing dryer habitat, equally winter snowfall and the combination of ground moisture may make habitats with less severe aspect too cold due to snow depth for the thermal refugia necessary for these populations to survive harsh winters. If we are able to place temperature and humidity data-loggers in known skink habitat and also in adjacent apparently suitable but vacant habitat and test the data for differences we might identify parameters that indicate habitat suitability for these species in this potentially snowy environment. The placement of 'ibuttons' will allow circadian temp and RH profiling over extended periods.

Ideally we would place replicated loggers at the surface and in likely skink refugia so we are able to profile the habitat dynamics more completely. Similarly, if resources are available it would be an ideal study design to place the ibuttons at a prescribed density within the skink habitat and at two unoccupied rock face sites in the vicinity as well as at three sites within the scree/boulder/vegetation habitat on the slopes below. If this was done using 6 loggers per site a total of 36 loggers would be required pushing thermal/hygological study capital costs to ~ $5000.

H3 Investigate the frequency of detection of rodents in skink occupied rock face and unoccupied bolder/scree habitats within Sinbad Gully

Ink tunnels, mouse hotels and Sherman traps will be established in equal numbers and equal spacing over the rock wall habitat of *O. pikitanga*, on at least one adjacent apparently suitable but unoccupied rock wall site and at a minimum of three sites within the bolder/scree/vegetation interfaces below the cliff. These sites should match those being monitored for thermal and hygrological characteristics if possible. Frequency of encounter using passive monitoring will be supplemented with tag recapture data gathered by ear tagging mice using the Sherman traps in an attempt to generate sufficient data to conduct a basic analysis within Mark to estimate population size of areas monitoried. A minimum of six sites containing an approximate 4x4 grid spaced at ~10m intervals (likely to be compromised by access and ledges on the rock face) will be established requiring 96 Sherman traps (~$40 ea., $3,840 unless we can borrow traps) each housed within a timber box (to protect from blowing away and crushing, and to offer some insulation, approximate cost of materials and construction $2,000) together with 24 'mouse hotels' to provide data on longer term presence of mice should they fail to be detected during monitoring sessions (cost approximately $500) plus 96 ink tunnels. Trapping/ monitoring periods will run for two to three week periods in summer, autumn and if access allowed, winter.

H4 Monitoring for mustelid activity.

Appropriate numbers and spacing of meat/egg baited ink tunnels will be placed on the rock face skink habitat and in the bolder/scree/vegetation slopes below to detect mustelid activity. Monitoring will be conducted during the two to three week periods of rodent field research. Minimal capital costs.

H5 Monitor for the presence of both **Oligosoma inconspicuum** *and* **O. pikitanga** *within the bolder/scree/vegetation habitat below the skink habitat rock face.*

This study is to determine the extent of occupancy of both species within this habitat. Thirty Gee's minnow traps checked and baited daily fruit and active for a minimum of 7 good weather days within a two week period should enable a robust assessment of the presence of these skink species beyond their known rock wall habitat within the upper Sinbad gully catchment. Gee's minnow traps are already available to the project.

H6 Access and trap a greater extent of the known rock face inhabited by **O. pikitanga** *to estimate area of occupancy.*

Rope accessing the rock wall from the tops of the rock face and further exploration by expert rock climbers from the base of the rock face to determine the extent of skink occupancy beyond the currently known skink site. This will involve the placement of Gee's minnow traps in significant numbers and checking daily within a relatively short period (< three weeks to assume minimal population movement and migration) to enable a crude assessment of total area occupied. Together with this a study of the number of individuals from more easily accessed sites of known area should be conducted so that we might extrapolate approximate densities over total known occupied habitat to generate total population estimates for the Sinbad Gully population of *O. pikitanga*. Major logistical issues will be access to climbers and good weather for extended periods.

H7 Investigate the population dynamics and control of rodents in autumn and winter

By establishing two or three paired grids of 20x20 trap/tracking tunnels within the scree/boulder area of the upper Sinbad gully we will either poison bait or snap-trap (ideally poison would be used and then snap trapping used at the end of the monitoring period to record relative mouse abundance in study areas after treatment) mice from one of the paired grids, whilst ear tagging and releasing all mice captured in the adjacent control grip (capture using Sherman traps) to establish the relative abundance of rodents over the trap/removal period. Ink tunnel monitoring can be maintained throughout period within and adjacent to the treatment and control areas as an indices of rodent activity.

H8 Testing rodent gut contents and faeces for the presence of reptile tissues

Molecularly stable samples of stomach contents will be collected from mice captured through the rodent monitoring programme for molecular analysis to test for the presence of skink tissue. If possible stomach contents may be searched visually for the presence of skink scales and distinctive body parts but due to the nibbling behaviours of rodents this has not been hugely successful in the past. I would imagine that this work would cost a minimum of $8K.

H9 Testing mice impacts with rodent exclusion plots

Develop 6 paired exclosure sites where low (30cms high) metal exclusion areas of 3m x3m can be made mouse-proof with similar structures with mouse sized

holes maintained as adjacent controls. Conduct plant and invert abundance monitoring within the structures at treatment day 1 and annually for three yrs. Sample sward for biomass of plant and invertebrate matter at inception of study (random 3 samples of 10cms x 10cms from all exclosures, therefore 18 treatment and 18 control) and again after three years of maintaining the treatments. Snap traps or other means would be maintained within the rodent proofed exclosures to account for incursions. Material costs likely to be <$5000 but establishment time and maintenance commitment significant. Scale and design must be thoroughly reviewed before taking further.

Priority and time frames

In total this is clearly a significant body of work. However a number of the hypotheses posed and work pland necessary to address are already under way. Hypothesis 1 is already being tested by the systematic surveying of proximate and similar habitat to that known for *O. pikitanga* in Sinbad Gully. Adequate search effort to determine presence/absence of small but significant populations has been quantified by capture frequencies from trapping effort at the Sinbad Gully site. The priority is to search and establish presence/absence from a minimum of 6 likely locations within 5km of the known site and 6 likely locations from beyond this area as soon as possible. Similarly, assessing the presence of *O. pikitanga* and *O. inconspicuum* outside of the rock face habitat could be conducted this summer.

Thermal/hygrological probes could be placed into the study sites this summer so that we have late summer data as well as more critical data from this coming autumn and winter.

Rodent ecology investigations could commence this summer/autumn with the establishment of monitoring and trapping grids that may be run this season. Any investigation of impacts through rodent exclosures would need to wait until next spring for establishment following a refined assessment of design.

Molecular studies of diet are less likely to provide strong management indications and are expensive. Therefore this work has a lower priority.

Relevance of proposed study beyond O. pikitanga conservation

The alpine system is not only valuable because of its unique herpetofauna. The rock wren, *Xenicus gilviventris* is reported to be declining with the supposed primary agents of decline being rodents and the consequent predators such as stoats which result from their population dynamics.

We also have very limited knowledge of the interaction of rodents with fauna and flora ecological processes and biomass within these systems. This study constitutes the foundations of knowledge necessary to begin considering the management and restoration of Fiordland ecosystems above the bush line as an essential compliment to the on-going work to manage and restore security and function to ecosystem processes in the forests below. This unique system is only now coming under pressure from introduced browsers which are further able to influence ecosystem processes and so it is urgent that we protect this remaining ecosystem integrity from damage. The cost of restoration or event triage for biodiversity management in these ecosystem is far higher than the costs of protection and management of current function. These management units have the potential to become the first ‘whole ecosystem’ informed management programme within New Zealand.

6. Study Recommendations

Regardless of the specific conservation needs of lizards, the highly isolated area of Sinbad Gully should be presented as a high priority area for ecosystem management because of: 1) it's proximity to Milford Sound for access; 2) containment of the site by rock walls which would significantly inhibit the dispersal of pest species into the area; and 3) the manageable size of the area for pest management application within reasonable resource bounds (Reardon, 2010).

There are two main objectives for future work on Sinbad skinks: firstly, to improve our understanding of the abundance of Sinbad Skinks in the head basin so that population trends can be monitored, particularly in response to management; and secondly to investigate potential sightings of Sinbad skinks so that at least one more population of Sinbad skinks can be identified and managed. This work would help to protect the existing skink population and enable a review of their current threat classification.

The specific actions that would be required to achieve these objectives are outlined below:

1. Develop access to the entire skink habitat by rope from above and below the rock wall to determine the extent of the habitat occupied and intensively monitor a portion of skink habitat to generate an estimate of skink abundance.
2. Develop new techniques to deploy and check Gee's minnow traps that will enable intensive monitoring.
3. Use initial skink abundance records to monitor population trends, and possibly trends that occur in response to any management implemented (although this may be difficult to distinguish in such a small population).
4. Use life history data collected from skink captures to build basic population viability analysis (PVA) models to improve our understanding of the long-term sustainability of the species. (This may not be possible until a larger number of skinks have been captured).
5. Continue the thermal refugia investigation to determine how skink occupancy might be at least in part determined by thermal and/or hygrological conditions.
6. Review the results of current rodent monitoring to inform future plans for monitoring and/ or control that may be required.
7. Conduct further surveys for Sinbad skink populations by focusing on known skink or gecko sightings and searching these areas. Sights where lizards were found during the alpine gecko surveys in Fiordland (Charteris et al., 2006) may provide good locations to search first. Trampers and climbers should be encouraged to report lizard sightings in alpine areas and these should be followed up with searching trips.
8. Investigate the hypotheses suggested in developing a Conservation Management Plan for Sinbad Skinks (Section 5.6) and incorporate these into future research and management.

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9. Appendices

APPENDIX 1: DETAILS OF SKINKS CAUGHT IN SINBAD GULLY, FEBRUARY 2010

Date	Area	Trap	ID	Recap/ or new?	Species	SVL (mm)	VT (mm)	Regen	Age	Sex	Wt (g)	Notes
5/02/2010	mid slope	6	2	Recap 09	sinbad	88	99	0	ad	female	14	Same as ID 22 from 13/02/09. Sex different, but probably sexing error.
3/02/2010	mid slope	7	1	New	Sinbad	91	108	0	ad	male	15	hemipenes not overly distinct
3/02/2010	near waterfall	hand	1	New	Cryptic	44	37	0	juv	?	3.8	
3/02/2010	lower slope	4	2	New	Cryptic	65	72	0	ad	female	4	gravid
3/02/2010	mid slope	4	3	New	Cryptic	59	76	0	ad	female	4	gravid, one other skink in trap UNID
4/02/2010	lower slope	14	4	New	Cryptic	61	74	0	ad	male	3.7	
4/02/2010	lower slope	14	5	New	Cryptic	64	73	16	ad	female	4.7	gravid
5/02/2010	lower slope	11	5	Recap 09	Cryptic	62	77	0	ad	male	4.3	natural toe loss 0-3-0-0
4/02/2010	mid slope	7	2	Recap 09	cascades	73	67	0	ad	female	8.5	Sloughing. Same as ID 12 of Feb 09
4/02/2010	mid slope	7	3	New	cascades	75	55	2	ad	female	10.5	gravid
4/02/2010	mid slope	4	4	Recap 09	cascades	75	74	0	ad	male	9.5	Same as ID 13 from Feb 09
4/02/2010	lower slope	14	1	New	cascades	78	78	0	ad	male	11.5	yellow/green colour
5/02/2010	lower slope	11	5	Recap 09	cascades	80	80	0	ad	male	11.5	wound on right 2nd toe. Same as ID11 from Feb 09
5/02/2010	lower slope	12	6	new	cascades	93	92	0	ad	female	20.7	early stages preg. Very big female

APPENDIX 2. LIZARDS CAUGHT IN THE SINBAD GULLY HEAD BASIN DURING THE 2009 SEASON ARE INCLUDED HERE FOR COMPARISON TO THE 2010 CAPTURES (EDMONDS, 2009).

Date	Area	Trap	ID	Recap/ or new?	Species	SVL (mm)	VT (mm)	Regen (mm)*	Age	Sex	Wt (g)	Notes
2-Feb-09	lower slope	hand-caught	1	new	Sinbad skink	83	92	1	A?	F?	9.7	hand-caught in crevice near S24
2-Feb-09	lower slope	S22	2	new	Cryptic skink	61	76	c	A	M	4.1	natural toe loss 0300, mites
2-Feb-09	lower slope	S23	3	new	Sinbad skink	90	81	4	A	F	14.8	salmon belly, possibly post-gravid, mites
2-Feb-09	lower slope	S23	4	new	Sinbad skink	67	89	c	J		6.1	salmon belly, mites
2-Feb-09	lower slope	S21	5	new	Sinbad skink	92	108	1	A	M	15.7	salmon belly, no mites
2-Feb-09	mid slope	S17	6	new	Cryptic skink	46	46	9	J		1.8	not very yellow belly, mites
2-Feb-09	mid slope	hand-caught	7	new	Cryptic skink	56	74	c	A	F	4.2	possibly post-gravid, caught c. 2m north of S17 trap
3-Feb-09	eastern face, c. 200 m N of waterfall by traps	hand-caught	8	new	Cascade gecko	79	83	c	A	M	N/A	2nd gecko sighted in crevice c. 100 away, not captured
4-Feb-09	western face by shadowlands climb	hand-caught	9	new	Cascade gecko	63	65	c	J		6.1	extracted from crevice, 2nd gecko sighted in crevice c. 100 m away
4-Feb-09	lower slope	S23	10	new	Cascade gecko	72	72	c	A	F	9.3	lots of mites
4-Feb-09	lower slope	S23	11	new	Cascade gecko	75	81	c	A	M	11.8	scar under left ear, mites
5-Feb-09	mid slope	S16	12	new	Cascade gecko	70	66	c	A	F	8.1	not gravid
5-Feb-09	mid slope	S18	13	new	Cascade gecko	72	69	c	A	M	7	small hemipenial sac
5-Feb-09	lower slope	S20	14	new	Cryptic skink	55	61	1	A	F	2.8	not gravid
5-Feb-09	lower slope	S22	3	recap	Sinbad skink							
5-Feb-09	lower slope	S24	4	recap	Sinbad skink							

5-Feb-09	lower slope	S25	15	new	Sinbad skink	55	72	c	J		3.4	
5-Feb-09	top ledge	S29	16	new	Sinbad skink	103	107	1	A	F	23.8	gravid, biggest animal caught
5-Feb-09	top ledge	S29	17	new	Sinbad skink	96	99	4	A	F	17.9	gravid
12-Feb-09	lower slope	S13	18	new	Cascade gecko	73	68	2	A	F	10.5	early stages of pregnancy. Light colour
12-Feb-09	Shadowland	S25	19	new	Cascade gecko	54	52	C	J		3.5	
13-Feb-09	mid slope	S4	20	new	Cryptic skink	51	66	1	A	F	2.7	
13-Feb-09	mid slope	S2	21	new	Cryptic skink	64	71	c	A	F	2.5	gravid
13-Feb-09	lower slope	S2	22	new	Sinbad skink	85	97	c	A	M	15.7	
13-Feb-09	lower slope	S11	23	new	Sinbad skink	70	70	c	A	M	8.5	
13-Feb-09	lower slope	S6	24	new	Sinbad skink	61	77	c	J	M?	4.3	

* c = complete/ no regeneration.