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METHODOLOGY FOR EXAMINING THE RELATIONSHIP BETWEEN SKINK DENSITY AND HABITAT FEATURES

(Short Answers in Conservation Science)

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PREAMBLE

There is circumstantial evidence that habitat degradation is the primary reason for declines in populations of grand skinks *(Leiolopisma grande)* and Otago skinks *(L. otagense)* but the relationship between habitat features and skink populations has not been directly studied. A recent research proposal by Tony Whitaker and Graeme Loh outlined appropriate field techniques to collect data to investigate the relationship between skink populations and habitat features, and this report outlines an appropriate statistical methodology and constraints that such a methodology places on the collection of data

METHODOLOGY FOR STUDYING HABITAT RELATIONSHIPS

Two approaches to this problem are possible, one simple requiring less data, one more complicated requiring more data.

Simple approach

In this approach we only address the problem - does modification of tussock land affect skink populations.

Two areas containing rock outcrops and skinks are chosen, one in tussock the other in modified pasture. The two areas are as similar as possible in every other respect. Within each area all rock outcrops are visited and the presence or absence of skinks noted.

The difference between the proportion of rock outcrops with skinks in the two areas is assessed using contingency table analysis (Chi-squared or G test).

More complicated approach

The relationship between habitat features and skink populations can be investigated quantitatively and in more detail by creating a model of the relationships using multivariate analysis. Such models are usually constructed using multiple regression and/or analysis of variance but such an approach makes the inappropriate assumptions that skink population density is normally distributed and that zero populations are rare. Similar models can be constructed by assuming that lizard numbers are distributed as a

poisson variable or by using only presence absence data and using maximum likelihood estimation. This approach is appropriate for skink data.

In general terms such models take the form

Lizard density = a function of habitat features

and the best model is found by trial and error to determine which functions and combinations of the habitat variables are best able to predict lizard density. When an appropriate model has been found the relative affect of each habitat variable can be assessed by determining what effect its exclusion from the model has on the models predictive power. This approach enables us to assess not only whether or not modification of tussock land has an effect on skinks, but it will enable us to determine whether there are other habitat features that are important determinants of skink populations.

Sample size

Without knowledge of the variability of skink density and habitat features it is not possible to estimate a minimum required sample size for the complicated approach. For the simple approach, however we can make a few "worst case" assumptions and estimate a required sample size. The required sample size for the complicated approach will be larger than that for the simple approach.

To estimate minimum required sample sizes I made the following assumptions:

1. We are only interested in detecting differences between the occurrence of skinks in tussock and pasture of greater than 20%. Smaller differences are likely to have little significance to managers.

2. We assume that overall skinks occur in about 50% of rock outcrops. Contingency table analysis is more sensitive at the extremes, e.g. it more readily detects differences between 90% and 95% than it does between 45% and 50%. Choosing skink occurrences of 50% gives us a "worst case" statistical test.

3. We apply Yates correction to our contingency table analysis. Contingency table analysis with Yates correction is less sensitive than without, so once again we have a "worst case" statistical test.

Using these assumptions I estimate if we sample 60 outcrops in tussock and 60 in pasture we will be able to detect 20% differences in the rates of occurrence of skinks regardless of the overall rate of occurrence.

It would be impossible to reliably assess the skink density in 120 rock outcrops in the 80 days of field work available for the study so only presence absence of skinks need be recorded.

Constraints on data collection

Both approaches place the following constraints on the way in which data is collected.

1. Sample units have to be consistent. Rock outcrops are the obvious sampling units, but because outcrops sometimes are continuous with one another a

definition of a "sample rock outcrop" will have to be devised and only rock outcrops that are consistent with the description should be used.

2. Samples without skinks are as likely to provide information about the relationship between skinks and their habitat as are samples with skinks. For this and other reasons, samples should be random and independent and no attempt should be made to preferentially sample outcrops with skinks. The following is an appropriate methodology for choosing sample outcrops:

   Two areas containing a range of different rock outcrop types should be chosen: one in relatively unmodified tussock and the other in highly modified pasture. Both areas should contain some outcrops that are known to have skinks and except for the lack of tussock the two areas should be as similar as possible. Within each area either all outcrops should be measured or a random selection of outcrops should be measured. If outcrops are to be randomly selected from within an area then they should be selected in advance, and an appropriate protocol for pre-selecting outcrops would be:

   i identify the area to be sampled on an aerial photograph.
   ii number all the outcrops in the area to be sampled.
   ii use a table of random numbers to pick the required number of samples.

3. Since observers cannot be absolutely sure whether skinks are present in an outcrop, for the purposes of analysis "presence" and "absence" of skinks will have to be defined in advance. Searching for skinks can be confined to good weather and certain times to day to enhance the likelihood of finding animals. Presence of skinks might appropriately be defined as having found a skink within half an hour at the outcrop, and absence as not finding a skink within half an hour. Even if skinks are known to be present at an outcrop, they should be regarded as being absent for the purposes of analysis if none are detected.

4. At each rock outcrop being sampled skink presence/absence and the full range of habitat features already described by Whitaker and Loh should be measured. Samples with any missing habitat data cannot be used in the complicated analysis.

5. Habitat features can be measured either on continuous scales or simply placed in classes. For example, crevice density might be measured as on a continuous scale such as the number of crevices per cubic metre of outcrop, or it might be put into classes such as none, few, average, lots. Multivariate analysis is equally amenable to either.

Recording of data

For the purpose of analysis each rock outcrop is regarded as a "record" and measures of the skink density and habitat features are regarded as variables. Recording the data in the following format in a spreadsheet (Excel for preference) on a PC would greatly facilitate later analysis.

Rock outcrop no.	Pasture or tussock	Skinks	Habitat variable 1	Habitat variable 2	...
1	pasture	yes	1	0	
2	tussock	no	4	2	

Data analysis

Contingency table analysis (the simple approach) can be carried out easily even on a hand held calculator, but the complicated approach is more difficult. Maximum likelihood estimation can be carried out using several statistical packages that run on PCs (e.g. Systat, Statistix), but all require extensive interference from somebody who knows what they're doing.

METHODOLOGY FOR POPULATIONS STRUCTURE

During the studies outlined above it will not be necessary to handle any skinks and assessment of differences in skink population structure between outcrops in tussock and pasture will have to be carried out as a separate exercise.

The number of skinks that will need to be measured will depend on the variability in population structure between outcrops and cannot be determined in advance. An appropriate sampling regime to start with would be:

1. select 5 similar outcrops all in either tussock or pasture.

2. Measure a random sample of skinks from each outcrop and assign animals to the four size classes already outlined by Graeme Loh.

3. Use contingency table analysis to assess variability between rock outcrops and assess the need for further sampling on the basis of this preliminary analysis.