

Methods of predicting and reducing potential damage by
stoats to takahe

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The paper contributed by Lavers & Mills to this seminar suggests that the occurrence of occasional peak populations of stoats may have serious implications for the survival of adult takahe, and perhaps also (P. Shaw, pers.comm.) of chicks. Although the evidence for these opinions is at present only circumstantial, it seems unnecessary and unwise to wait for further proof (which might be difficult to obtain) before taking action. This paper begins, therefore, with the assumption that predation by stoats is potentially significant at least in some circumstances, and it asks the two next most relevant questions: (1) can seasons of peak stoat populations be predicted in advance? and (2) during these seasons, what methods are currently available and feasible to attempt control over limited areas and periods of time?

1. Annual variations in the summer density of stoats

The annual cycle of density

The only index of the density of any stoat population studied so far has been the simple ratio of captures to trap-nights (the number of traps multiplied by the number of nights they were set). If conditions are standardised (baiting, spacing, frequency of inspections etc.) this can give a useful estimate of variations in density of stoats through the year. In our two main study areas, the Eglinton and Hollyford Valleys, the number of stoats caught shows a regular seasonal pattern: a peak of up to 9 stoats caught per 100 trap-nights during the summer months, declining often to nil during the winter (Fig. 1).

Other factors certainly may affect the "catchability" of stoats, but as the trapping was consistent and the annual peaks in trapping success coincide with the period of dispersal of the single annual crop of young, we think that changes in the index and in the actual density of stoats are reasonably well correlated.

The traps were baited and set only 10-14 days per month, but the same annual pattern occurs in the permanently set, unbaited traps at Mount Cook. However, sets of baited and unbaited traps probably sample the stoat population at different levels.

Superimposed on this regular annual cycle of density changes is an irregular variation in the size of the summer peak. In the three summer seasons 1974-75, 1975-76, and 1977-78, no more than 2.9 stoats per 100 trap-nights were caught in any monthly trapping session in the Eglinton Valley: but in 1976-77 the maximum was 9.0 per 100 trap-nights (Fig. 1). A similar pattern was repeated in the Hollyford Valley over the same period.

The highest catch of stoats occurred in a summer when there was a high population density of mice. In the Eglinton and Hollyford Valleys, mice were sampled four times a year during the years that the stoat traps were operating. During the winter of 1976, mice continued breeding, instead of stopping as usual in autumn (Fig. 2); by spring 1977, populations of mice in both valleys had reached an exceptionally high peak. Sample traps set in the Eglinton in February 1977 caught 24 mice per 100 trap-nights, well over three times the previous highest catch; and in the Hollyford in the same month, 25 mice per 100 trap-nights, nearly twice the previous highest catch. At Mount Cook, a non-forest habitat where mice are less frequently found as prey of stoats than in Fiordland (in 6% compared with 25% of guts examined: King, unpubl.), there was no unusual increase in stoats in 1976-77.

Predicting years of high stoat density

Regular monitoring of mouse populations therefore offers a possible method of predicting increases in stoats. However, mouse trapping is fairly laborious: two standard lines of 36 traps each take four full days per quarter to operate. A simpler method would be to monitor the major factor stimulating the winter breeding of mice, believed to be the periodic heavy falls of beech mast. This theory is based on observations of the population ecology of mice in beech forests elsewhere in New Zealand (Fitzgerald, in press). Beech seed was therefore collected monthly

in the Eglinton and Hollyford Valleys for the duration of the mouse trapping study.

The relationship between seedfall and the breeding and population index of mice is shown in Fig. 2. The amount of seed falling per month in 1976 was not much greater than in 1975 in either valley, but viable seeds were still falling as late as September or October 1976, whereas in 1975 no viable seeds fell after July. There was one year of total seed failure (1977) but no really major seed year such as last occurred in 1971. A monitoring programme to predict stoat numbers from seedfall cannot be designed until a longer series of observations establishes the relative importance of the variables, including monthly fall, total fall, length of season of fall, and the different sizes of seeds produced by the Nothofagus species. Further, it is important to analyse the diet of mice in Fiordland to identify other significant food resources which may need to be included in the monitoring programme.

2. The possibility of control of stoats

Definition of "control"

In discussing a management plan for stoats in the Takahē Area, distinction should be made between control of the overall population density of stoats, and prevention of potential damage done by them. In this context, population control means the reduction by artificial means of the average breeding stock of stoats; prevention of damage means the removal of individual stoats only when and where they could be a particular threat, whether or not the breeding stock is affected. In my opinion, population control is impossible, but damage prevention is not.

Control of the overall number of stoats in the Takahē Area is, in the foreseeable future, completely impracticable. The reasons for this are:

(a) A control programme would be effective only if an improbably high proportion (at least 80%) were killed every year. This intensity is rarely reached even in easily accessible habitats, in programmes for harvesting mammals by trapping in other countries. It would be prohibitively expensive. Such a high capture rate is necessary, because of the high reproductive capacity of stoats. Young females are extremely precocious and can be mated before leaving the nest. On the assumption that ovulation is induced by copulation, as found by Gulamhusein (Rowlands

1972), ovarian histology suggests that by the time the family disperses in mid-summer, 99% of females are already pregnant with blastocysts in delay, and the average litter size in New Zealand is 9 foetuses (King, unpubl.). This means that, even if every male is killed during the summer peak, the next generation is already assured. Trapping to control the population must therefore catch females in at least equal numbers with males, even though for half the year (May-November) females are less frequently trapped than males.

(b) Immigration from surrounding uncontrolled areas cannot be prevented. Intense trapping could not be applied over the whole Takahē Area, so even the surrounding arms of Lake Te Anau would not prevent immigration to the trapped area. Lavers & Mills point out that the trapping operation they describe (a large number of traps permanently set and infrequently checked) just in the Takahē Valley-Point Burn area apparently did not alter the distribution of stoats in 1972-73, showing that either a very small proportion of the population present was caught, and/or that captured stoats were quickly replaced. In theory, a small isolated area, such as Dana Basin, is different and could perhaps be kept clear.

On the other hand, prevention of potential damage done by a local population of stoats may be possible. Damage is likely to occur mainly in spring and summer when young stoats are demanding food and takahē chicks are still small. It could still be worthwhile to reduce the possibility of damage at this crucial time, even if the overall stoat population is unaffected.

Efficient operation of traps for damage prevention

Experimental field work in Fiordland in 1974-6 was designed to specify the most efficient method of using traps for damage prevention, and used the same traplines in the Eglinton and Hollyford Valleys referred to previously. The study examined three questions: the effect of bait on total capture rate; the relationship between cost (trapping effort) and benefit (number of stoats removed); and the effect of trap spacing on the sex ratio of the catch. The technique of setting killtraps for stoats, and the results of the baiting experiments have been published previously (King & Edgar 1977); the rest is being prepared for detailed publication later.

Baited traps catch significantly more stoats than unbaited traps (9 to 1), and traps with fresh bait slightly more than those in which the bait has gone stale (2 to 1), though we did not test whether stale bait was better than none. Hence the extra effort required to keep traps freshly baited is repaid by a higher capture rate per inspection round.

The cost of trapping is less in the purchase price of an adequate stock of traps than in the time (= wages) required to inspect them frequently enough. The closer the traps are set, the longer it takes to make one round of a line of a given distance (to check, clear and rebait). If, therefore, the traps are widely spaced and infrequently inspected, the cost of the operation is minimised, especially if the traps are not baited. However, our observations suggest that this is false economy. The wider the distance between traps, and the longer the interval between inspections, the lower the total catch. This is because the greater the distance between traps, the less are the chances of a stoat finding one; and as not all traps are equally well sited, and a trap which has been set off is ineffective until reset, regular resetting of the good ones is important in maintaining a high capture rate. The lower capture rate of unbaited traps has already been mentioned.

The best compromise between cost and benefit seems to be suggested by our observation that the highest catch per inspection is found on the first few days after setting the traps, and thereafter the capture rate steadily declines. If traps are set at about, say, 400 m intervals, baited and inspected on alternate days (or daily if possible) for only 7-10 days per month, the maximum number of stoats will be caught for the cost incurred.

Methods of controlling stoats other than by trapping have not been examined during this work. Shooting is impractical; poison is dangerous to ground-feeding birds unless laid as carefully (and as labour-intensively) as traps. We considered it important to understand more of stoat biology before working on control methods, though such work is needed. At present, trapping is a more useful method than poisoning, since the number of stoats and other animals killed can be counted, carcasses of all animals killed can be collected and much useful information obtained

from autopsies. However, populations of pest species are characteristically very resilient, and when killed in large numbers tend to increase their breeding rates. Much work is being done, on other pest species, to overcome such problems, and some of the results could in future be applicable to the control of stoats.

3. Stoat control in the Takahe Area

Trapping operations 1972-77

Lavers & Mills remark that their overall trapping rate in the Murchisons was low: indeed, the range of figures they give, when converted to captures per 100 trap-nights, is 0.07-0.41, compared with our 0-9.3. But this difference does not necessarily mean that stoats are fewer, or more shy of traps in the Murchisons than in the Eglinton and Hollyford Valleys. An important part of the reason for the low capture rate in the Murchisons might be that the traps were permanently set and inspected rather infrequently. When allowance is made for this and for other differences in trap operation, and for seasonal and annual changes in capture rate, the discrepancy between the figures is far less startling.

Stoats caught per 100 trap-nights

<u>Time intervals given by Lavers & Mills</u>	<u>Murchisons</u>	<u>Eglinton</u>	<u>Hollyford</u>
1977 - June-Dec	0.23 (Takahe Valley)	0.82	0.50
- Feb-Dec	0.41 (Dana Basin)	1.4	1.3
Average for May-Oct	0.14 (1972, Takahe Valley)	0.35 (1974-77)	0.34 (1975-77)

A further possible reason for the lower mean capture rate in the Murchisons compared with the two lowland valleys may be that, in winter, some of the Murchison traps may be frozen or obscured by snow, whereas this rarely happened in the Eglinton and Hollyford lines.

Trapping strategy in the Murchisons

In theory the best way to protect the takahe would be to remove all resident adult stoats from the nesting areas before the kits are born (by trapping from, say, June to September) and thereafter to continue to remove immigrating stoats as they

arrive. But in the Takahe Area this is not easily done. Trapping in winter at high altitude is likely to be very costly in terms of effort for benefit, and as this is the season when female stoats are most difficult to catch, many will escape and still produce their young. Access to and maintenance of traps is more difficult in winter, the overall capture rate is low and most of the stoats caught will be males, whose removal has no effect on the number of young born. Furthermore, work in Sweden has shown that males become more active and move further in spring (Erlinge 1977), so males removed at this time of the year are likely to be quickly replaced. The potential threat to takahe is therefore probably not reduced much by trapping at this season.

In practice, it is probably adequate to begin trapping in October or November. The sudden decline of takahe linked by Mills (this seminar) to the peak stoat population of 1976-77 presumably coincided with the appearance of an exceptionally large crop of young stoats in spring 1976. Perhaps the most practical approach is to remove as many as possible of these from the critical areas, as they appear. Traps set from October to late November may catch a few adult females lactating or foraging for dependent young, and might effectively kill the whole litter. Traps set from late November to March-April catch large numbers of newly independent young. Operation of traps at this season is physically easier and the ratio of catch to effort more satisfactory. Few trapping campaigns catch all stoats present at any season, so this and continued immigration ensure that any beneficial effect to takahe will be short-term only.

Recommendations for future trapping operations in the Murchisons

1. It is probably not worth setting traps between May and September inclusive since they can be operated only at very high cost in relation to the benefit gained.
2. Traps for general surveillance between October and April should be set about 400 m apart, kept freshly baited, and visited at least every other day for not more than 7-10 days per month.
3. In summers when high numbers of stoats are expected, seasonally available field assistants should be employed to operate an intensive trapping effort around selected known takahe territories during December-February inclusive. Since this

work is highly labour-intensive and the timing is critical, prior surveys with footprint tunnels (King & Edgar 1977) could help to identify areas where stoats are present.

4. These recommendations are based on the limited information available at present; further research on stoat control is urgently needed.

5. The management proposals put forward by Mills in this seminar should be regarded as the primary means of conserving the takahe; stoat control is probably a critical factor only rarely, perhaps in 1-3 years in every ten.

Summary

1. In two experimental traplines in Fiordland, most stoats were caught in the months of January to March inclusive, and very few in winter.

2. In a summer coinciding with high densities of mice, the summer peak in stoat captures was much higher than usual on both lines.

3. Although variations in the density of mice (and of stoats) were probably related to variations in the production of beech seed, the critical variables are not yet identified clearly enough to allow peaks in stoat populations to be predicted from monitoring beech seedfall.

4. Control of stoat populations with present methods is probably impossible; reduction in potential local damage by stoats to takahe, particularly in summers of peak density of stoats, is possible. The results of some experimental trapping studies have helped to define the most efficient use of traps, and made possible some preliminary recommendations for future trapping operations in the Takahe Area.

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Captions to Figures

- Fig. 1 Population indices (captures per 100 trap-nights) for mice (○) and stoats (⊙) in the Eglinton (a) and Hollyford (b) Valleys.
- Fig. 2 Relationship between the duration of fall of viable beech seeds and the population index for mice in the Eglinton (a) and Hollyford (b) Valleys. Encircled points indicate samples containing breeding female mice (this information not available for the last 4 points). Dotted portion of histograms, viable seeds; clear portions, total seeds; baseline, no seeds collected. The dominant species of beech in the Eglinton is Nothofagus fusca; in the Hollyford it is N. menziesii.



