FOREST RESEARCH INSTITUTE

# A WHITE-TAILED DEER POISONING TRIAL ON STEWART ISLAND

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## CONTENTS

## 6. CONCLUSIONS

- The trial was very successful, reducing initially high deer densities to very low levels. The trial confirmed foliage bait poisoning as an important tool in controlling ungulate populations. The very high kill in block C suggested it might be possible, in favourable circumstances, to eliminate all deer from an area with a "one hit" operation. The slightly lower kill in block A suggests that for similar habitats and deer density a bait density in excess of 2.5 baits/ha is required to put all deer at risk.
- The success of the trial can be attributed primarily to the scarcity of alternative foods in summer (when white-tailed deer on Stewart Island rely heavily on broadfleaf litterfall (Nugent & Challies 1988)), but also to the careful planning and field work which ensured all deer were put at risk. The technique may not work as well if alternative deer foods were plentiful, as deer can detect the poison carrier (Challies 1988, unpubl. report). On Secretary Island foliage bait poisoning trials have been only moderately successful, possibly because deer food is relatively plentiful, although other factors may also be involved (W. Chisholm, pers. comm).
- White-tailed deer moved freely between areas, both seasonally before the poison operation, and later in response to reduced densities resulting from the operation. The scale of the reduction in block D and the rapidity with which the population subsequently built up suggests that substantial numbers of female as well as male deer moved from this block and elsewhere into the poisoned areas. It also indicates that for white-tailed deer, at least, there is little point in one-hit local operations unless conducted on a much larger scale, as the trial gave only 1-2 years respite from moderate to high browse pressure.

## 7. RECOMMENDATIONS

- It is not essential that further developmental research be done before the foliage bait poisoning technique can be used against high-density ungulate populations. However, initial operations should contain a research component in order to determine the bait density and timing that maximise the kill and cost-effectiveness. Such operations should ensure all animals are put at risk and should be of sufficient scale to minimise the effect of re-invasion. Because the efficiency of the technique may decrease as food supply increases, foliage bait poisoning should be used at the start of control campaigns, rather than after other control techniques have lowered animal densities and food has become more plentiful.
- Before the technique is used against low-density ungulate populations, research is needed to determine the effect of per capita food availability on bait take, and the proportion of the population that take baits. Poisoning may be more effective if the population is allowed to increase until near carrying capacity. This research is needed only if foliage bait poisoning is likely to become a regularly used control tool.
- As part of contingency planning for outbreaks of exotic livestock diseases and control of Tb, other organisations may also be interested in foliage bait poisoning as a means of rapidly reducing wild ungulate densities. Local one-hit elimination of ungulates may also be the most cost-effective control strategy for long-term vegetation protection by DOC. In this context, the potential problems of bait

## 1. SUMMARY


### 1.1 PROJECT AND CLIENT

The Forest Research Institute investigations of natural bait poisoning of white-tailed deer on Stewart Island (conducted by Dr C.N. Challies) are summarised for the Department of Conservation.

### 1.2 OBJECTIVES

- To describe the 1981 trial on natural bait poisoning of white-tailed deer on Stewart Island.
- To identify aspects needing further research before this method can be used operationally.

### 1.3 METHODS

In 1981, two discrete coastal areas of eastern Stewart Island were poisoned with natural foliage baits smeared with carbopol gel containing 10% 1080, and distributed at two different densities. Deer densities and percentage kill were assessed by pellet counts and carcass searches.

### 1.4 RESULTS

- Most, if not all, the deer in the coastal strip of the high bait-density block (5 baits/ha) were killed, and over 80% of those in the low bait-density block (2.5 baits/ha). Deer densities in adjacent unpoisoned areas were also reduced substantially. Overall, about 400 deer were killed, and the poisoning appeared to be unselective with respect to age or sex.
- A year after the poisoning, deer were distributed evenly over the study areas at low density. Densities then increased quickly to near pre-poison levels within 3-4 years.

### 1.5 CONCLUSIONS

- The technique is an effective deer control tool. When deer are at high density and alternative foods are scarce (as in this trial) it may be possible to kill all deer present with a "one hit" operation.
- White-tailed deer moved freely between study areas, both seasonally and in response to reduced densities. The rapid population build-up over 3-4 years also suggests a high reproductive rate when food is plentiful, and indicates there is little point in small-scale one-hit poisoning operations on Stewart Island.

### 1.6 RECOMMENDATIONS

- It is not essential that further developmental research is done before the technique can be used to reduce high density ungulate populations to low numbers. However, initial operations should contain a research component to determine the bait density and timing needed to maximise the kill and cost effectiveness.
- Where one-hit local eradication of ungulates is the aim (either for disease control or as a cost-effective approach to vegetation protection), further research is needed to determine whether problems of bait detection and avoidance are significant and can be overcome.
- Before the technique could be used as a regular control method against low-density ungulate populations, the effect of food availability on bait take should be studied.
- The Department of Conservation should consider jointly or wholly funding the production of a field manual based on this and other recent work on the technique.

## 2. INTRODUCTION

During the late 1970s white-tailed deer (*Odocoileus virginianus*) were implicated in the die-back of coastal forests on Stewart Island, and there was pressure for "something" to be done (Purey-Cust & McClymont 1979). State-funded hunting on foot up till 1952 followed by private gound- and helicopter-based hunting did not prevent deer from continuing to degrade coastal forests (Veblen & Stewart 1980).

The Forest Research Institute therefore undertook a major interdisciplinary study in the early 1980s to evaluate the causes of the problem and possible solutions. As part of this project poison-carrying gels smeared on the foliage of favoured deer foods were used to attain a low deer density for associated vegetation studies. This also provided the opportunity to further develop and assess the foliage bait poisoning technique as a means of large-scale deer control.

Monitoring of the trial continued until 1986, and the write-up of the project was funded by the Department of Conservation under the transfer-funding arrangement. Unfortunately, the scientist in charge of the project (Dr C.N. Challies) was made redundant before the write-up was completed. This report summarises the published information available on the trial, and presents some previously unpublished data. Not all the information collected during the trial was available for this report.

## 3. OBJECTIVES

- To describe the 1981 trial on natural bait poisoning of white-tailed deer on Stewart Island.
- To identify aspects needing further research before this method can be used operationally.

## 4. METHODS

### 4.1 Study area and poisoning technique

The trial was conducted during February and March 1981 on the east coast of Stewart Island. The study area was divided into four 1-km wide blocks (A-D), each separated into a coastal zone (0-400 m from the coast), and an inland zone (401-1000 m from the coast; Fig. 1). Block D was not initially part of the poison trial design, but was intended to monitor the impact of unrestricted recreational hunting. However, results showed that the trial had a definite impact there, and so block D is treated as an integral part of the study.

Two of the four blocks were poisoned (A, C; New Zealand Forest Service 1981, 1984). A carbopol-based gel loaded with 10% Compound 1080 (sodium monofluoroacetate) was applied to the undersides of leaves on favoured food trees ("natural" baits). Non-toxic field trials had shown that of the formulations available this gel-and-poison mixture had the best combination of deer acceptance, weathering properties, and unattractivenss to non-target animals. The natural baits were branches of broadleaf (*Griselinia littoralis*) of 100-400 leaves placed upright in the ground, with the occasional branch of *Coprosma lucida* and *Pseudopanax* spp. Gel was applied at 0.15-0.25 g per leaf to about 20 leaves per bait.

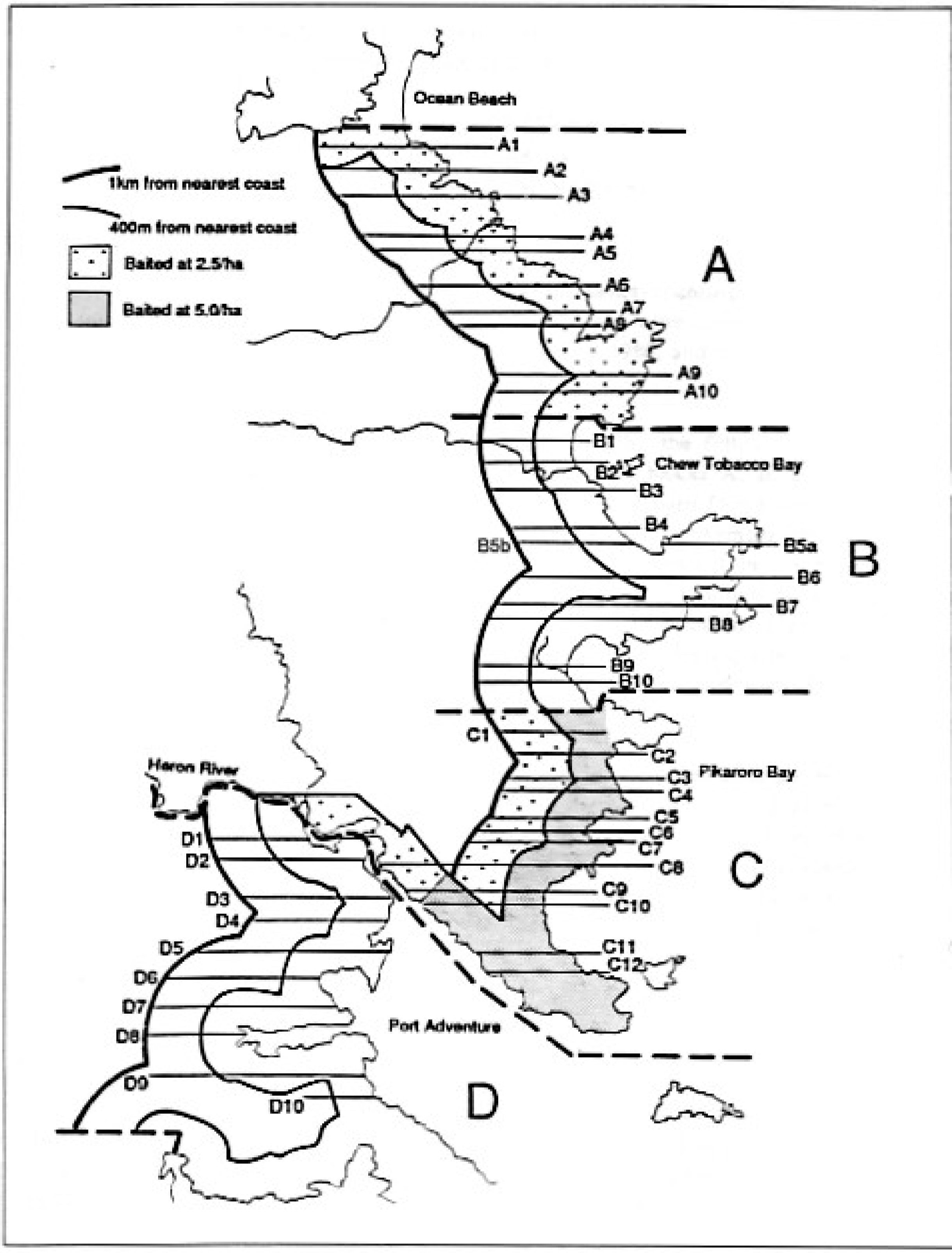


Fig. 1. Map of the study area, showing the location of pellet lines, the blocks, and the coastal and inland strips within each block.

In block A, the coastal strip only was poisoned with baits laid at a density of 2.5/ha (3-4 baits/100 m along transects spaced about 150 m apart). In contrast, block C was poisoned twice; baits were first laid at 2.5/ha in the coastal strip only, but 2 weeks later the whole of block C (up to 1 km inland) was poisoned, again at 2.5 baits/ha.

To assess patterns of bait take before poisoning, 100-150 non-toxic natural baits were made available to deer in blocks A and C in July, September, and December 1980, and February 1981. The percentage of the baits eaten within 5 days by deer was determined.

### 4.2 Monitoring

The poison operation was monitored using two different pellet-counting techniques on a series of transects (Fig. 1) along which plots of 2.5 m radius were permanently marked. The transects in Blocks A, B, and C were established in early 1980, and those in Block D in early 1981.

The immediate success of the poison operation was assessed by the following technique. From June 1980 to June 1981, all plots in the coastal strip of blocks A, B, and C were searched for pellet groups at 2.4-month intervals, and all pellet groups found were marked. The coastal plots in block B were also searched in September and November 1981 and in February 1982. After September 1980, the status of groups deposited in the preceding period was assessed each time plots were searched to determine a "new group disappearance rate". This was combined with the density of new groups to calculate a pellet-group recruitment rate. The year was divided into the following five seasons; late winter (the 2.4 months to early September), spring (to mid-November), summer (to early February), autumn (to mid-April), and early winter (to late June).

Longer-term trends in deer density were assessed using the point-distance technique (Baddeley 1985) to assess pellet-group density on the permanently marked plots in all blocks (including the inland strip) in the January/February 1981-1986, except that block D was not assessed in 1986. Disappearance rates were also assessed before each assessment of pellet-group density, but those data were not available for this report. The likely effect of disappearance rate on pellet-group density was therefore assessed from rainfall data (Appendix 10.1).

## 5. RESULTS

### 5.1 Pre-poison deer distribution and movement patterns

When the coastal strip was first searched in June 1980 pellet group density was highest in block C (847 groups/ha) with much lower densities in blocks A and B (287, 281 groups/ha, respectively). In general, this pattern was maintained until the poison was laid in February and March 1981, but there were some local changes in distribution.

Between late winter and spring, the number of new pellet groups found on the coastal plots declined overall, but increased locally in the centre of block C (Fig. 2a). Although the overall decline in the density of new pellet groups may simply be an artefact of changes in disappearance rate rather than in deer density (the disappearance rate for new groups was

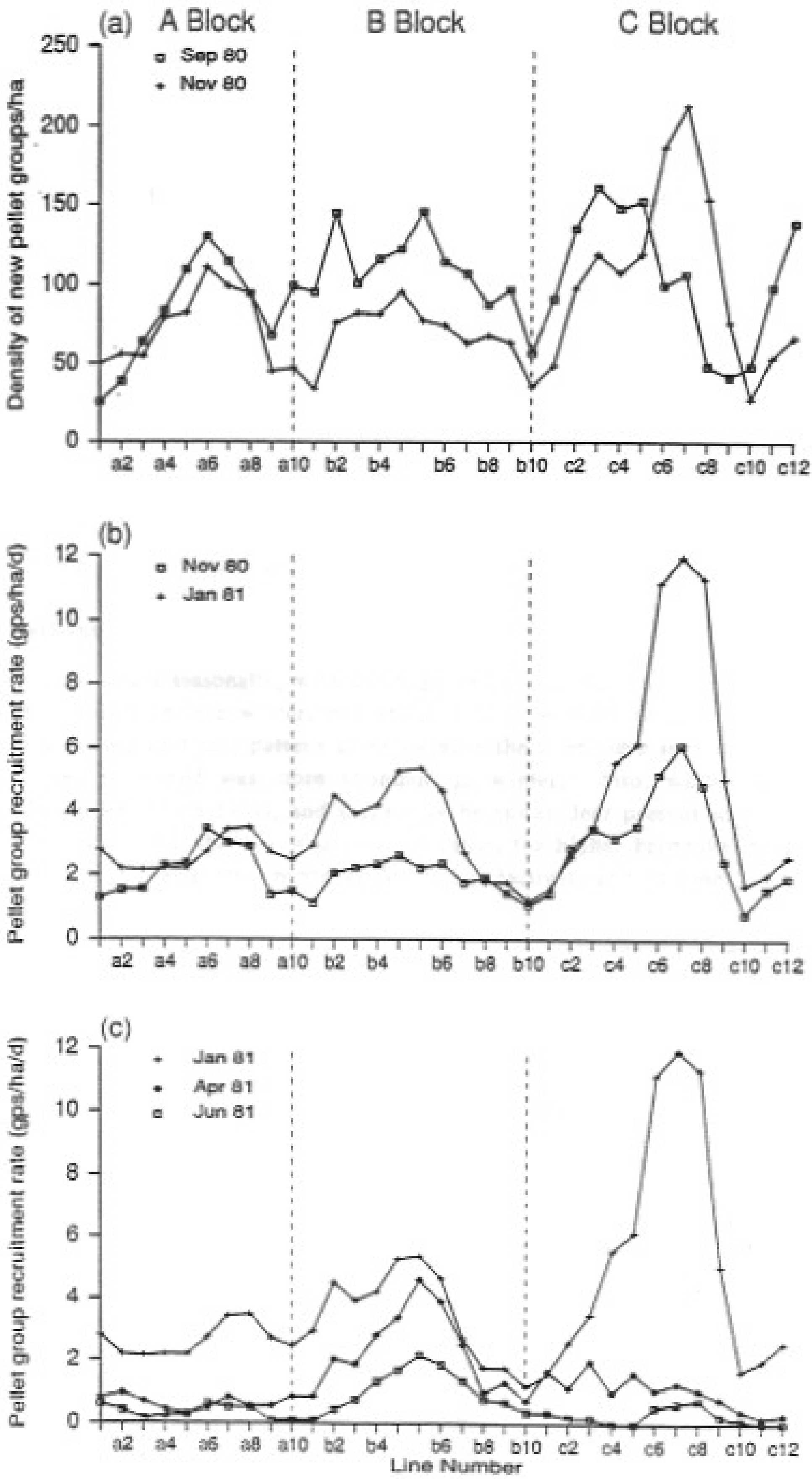


**Fig. 2.** Changes in the density of new pellet groups (Fig. 2a) or pellet-group recruitment rate (Fig. 2b-c) between successive 2.4-month periods 1980/81. Data points are the smoothed averages for three adjacent pellet lines (see Fig. 1 for line locations) in the coastal strips of block A, B, and C.

not determined for the late winter period), the uneveness of the change indicates that there was some movement of deer between areas.

Between spring and summer, recruitment rate in the coastal strip of blocks A, B and C increased by 47%, with most of the increase near the centre of blocks B and C (Fig. 2b). Some of this increase resulted from the addition of fawns to the population. However pellet-groups deposited by fawns comprised only 3.4% of the total "population" of pellet groups present February 1986, and in February 1981 only 60% of all pellet groups present had been deposited in the preceding 2.4 months. Combining these data, fawns probably accounted for 6% of the summer recruitment rate, equivalent to about one fifth of the observed increase between spring and summer. Some of increase might also have resulted from an increase in defecation rate in summer, but the differences between winter and summer defecation rates of deer species elsewhere (Smith 1964; Takatsuki *et al.*, 1981) seem too small to explain all of the increase not attributable to fawning. It is likely then that there was some movement of deer toward selected areas of the coastal strip in summer, consistent with the beliefs of hunters and others (Harris 1981).

### 5.2 Bait-take patterns

Consumption of baits varied seasonally, with less than half of the non-toxic broadleaf baits being eaten within 5 days in late winter, but about 80% in summer (Fig. 3). Nugent & Challies (1988) speculated that this pattern arose because the deer were relying mainly on litterfall, which they presumed was more abundant in winter. Also, white-tailed deer usually eat less in winter (Moen 1978), and there may be fewer deer present in the coastal strip in winter (see section 5.1 above). Whatever the cause, the higher bait-take in summer indicates that deer on the coastal strip probably feed less selectively at that time.

The baits laid during the poison operation varied in their effective life, depending on factors such as siting, the types of branches and tree species used, and the care exercised in their preparation. Rainfall was also an important determinant of effective life, with 90% of the 1080 in baits being leached by 81 mm of rain in one trial, and by 207 mm in another (Batcheler & Challies 1988). Most baits remained toxic for 15-30 days, with only 2% still retaining enough poison to kill a deer 4 months later.

There was a surplus of baits laid on both poison blocks. Only 46% of baits in the low bait-density block A and 32% of baits in the high bait-density block C showed sign of deer browse. Only 4% (11 baits) of the monitored baits laid in the second baiting of block C were taken by deer, and 10 of these 11 were more than 600 m inland.

Some deer appeared able to detect and reject either the poison or some chemical in the gel (or both), as it was not uncommon to find leaves with gel that had been bitten off by deer then spat out (R. Henderson, pers. comm). Also, some baits were observed in which most of the leaves without gel had been eaten, but few or none of those with gel (R. Henderson, pers. comm.). The ability of deer to detect and reject carbopol gel was subsequently confirmed in an independent trial (Challies 1988, unpubl. report).

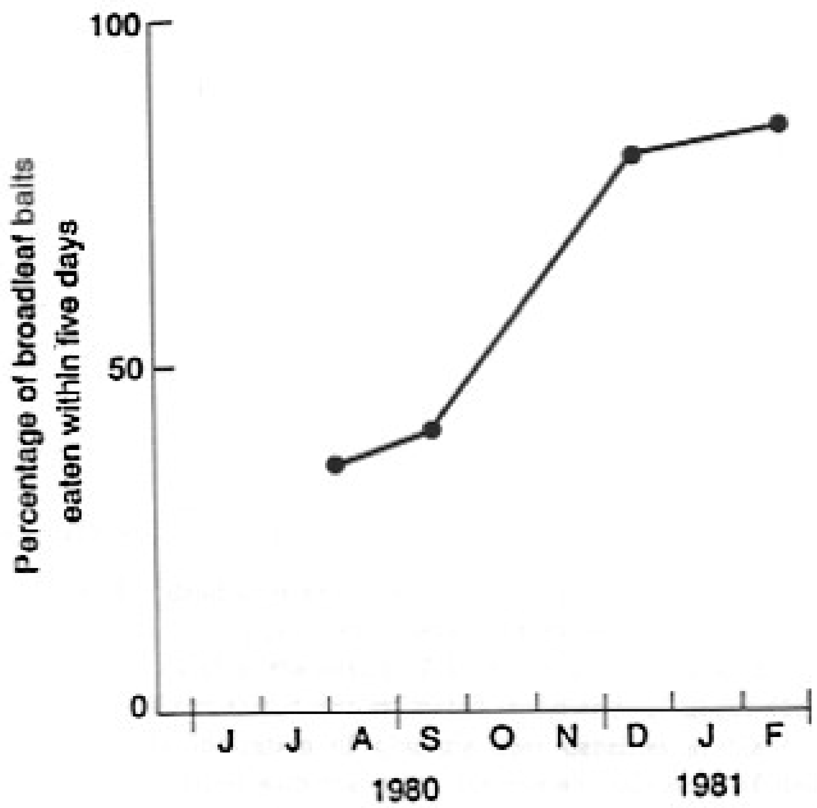


Fig. 3. Changes in the consumption of broadleaf baits between seasons.

All foliage baits surviving in late June were pulled out and left to lie on the ground. Any gel-covered leaves were removed and buried.

### 5.3 Success of the operation

After poisoning, pellet recruitment rate on the plots in the coastal strip dropped dramatically in autumn 1981; by 75% in the low bait-density block A, 36% in the unpoisoned block B, and 85% in the high bait-density block C (Fig. 2c). During early winter recruitment rate for the whole coastal strip (blocks A, B, and C) declined further still to about a third of that observed in autumn, with the greatest absolute reduction in block B, but the greatest relative reduction in block C (Fig. 2c).

Estimates of percentage kill and associated 95% confidence limits were obtained by comparing pellet group recruitment rates on a line-by-line basis (after Fraser 1989) between summer and early winter 1981. Overall deer density in the coastal strip of blocks A, B, and C was reduced by 86.0 ± 6.5%, with the greatest reduction in block C (95.8 ± 3.6%), followed by block A (84.8 ± 14.9%) and block B (70.3 ± 13.9%).

It is not clear whether all the deer present in blocks A and C at the time of the poisoning were killed. Six fresh deer carcassess (dead less than 6 weeks) were found in the course of other work in June 1981. As there were no intensive carcass searches at that time it is certain that more (probably most) of the deer killed in early winter were not found. All six were young males, usually the most wide-ranging age-sex class, suggesting they may have been immigrants. Thus although some deer were obviously present in the coastal strips of blocks A and C between April and June, these may well all have been immigrants from block B or elsewhere. As most baits were ineffective by this time, any immigrants would have taken a long time to find a lethal bait (or baits), and their presence could easily account for the observed recruitment rate. In the coastal strip of block C, for example, the observed recruitment rate equates to a density of about 1.5 deer/km$^2$, or a total of about three deer present in the block, on average, for the whole early winter period. As at least some of the recruitment was due to immigrants, no more than one or two resident deer appear to have survived the operation in this area, and quite possibly none.

### 5.4 Carcass searches

Systematic searches for dead deer resulted in 243 carcasses being located, 77 and 163 in or adjacent to blocks A and C, respectively. Several of these carcasses were found in block B. The high value for block C is the result of both the higher initial density of deer and a greater search effort. From this it was estimated that a total of about 400 deer were killed. These data provided an indication of absolute deer densities at the time of the poison operation, and in conjunction with the pellet surveys an indication of deer defecation rate (c. 14.5 groups/deer/day: C.N. Challies, unpubl. data cited in Lovelock 1987).

There were no obvious disparities in the age and sex composition of the deer found dead. There were 106 males and 124 females (the sex of 10 fawns was not determined, and no data was available for three animals). Of the 66 adult females (>2 years) found, 82% appeared to be lactating (based on 38 animals found soon enough after death for lactation status to be assessed). This suggests there were about 53 lactating among the deer killed, similar to the number of fawns found (48). These data, and the very low number of deer remaining in the poisoned blocks in June 1981 suggest the poisoning was unselective.

### 5.5 Population recovery

Only block B was monitored continuously through the late winter, spring, and summer after the poison operation. In late winter, recruitment rate there declined further, despite no poison remaining, to about 10% of the pre-poison level. Deer were moving out of this block, presumably into the adjacent largely deer-free areas. In spring and summer, however, recruitment rate in block B increased to about double the late winter level.

From 1982 the population recovered rapidly (Fig. 4). At least some of this recovery was a result of deer moving into the area from block D, as the pellet-group density there declined substantially during 1981. The reduction in block D is overstated, as the 1981 value for this block was assessed as lines were established, which sometimes produces a higher estimate than that obtained when lines are established before the first assessment. Also some of the decline probably resulted from a 20% increase in hunting pressure in 1981 (291 permits issued cf. 246 in 1980). However, these factors alone are not sufficient to explain the large decline in density.

The movement of deer from block D appeared to continue through 1982, as pellet-group density there remained unchanged, despite reduced hunting pressure (219 permits issued in 1982) and the herd almost certainly having a positive rate of increase, as observed in the following year.

In the coastal strip of blocks A, B, and C, pellet-group density increased by between 200% and 530% during 1982, with the greatest increase in block C, the block with the highest pre-poison deer density. Inland the rate of increase was slower, but it still exceeded 40% in each block. These rates of increase are probably all as high or higher than the reproductive rate of white-tailed deer on Stewart Island, an indication that most of the increase in 1982 was due to immigration from block D and elsewhere.

In 1983, pellet-group densities increased in all blocks, and in the coastal strip of block A exceeded the pre-poison level. In blocks B and C the increase continued through 1984, but did not quite reach pre-poison levels before declining in 1985. The cause of the decline in 1985 is not clear, but is unlikely to be an artefact of a higher disappearance rate in 1985, as rainfall before the survey in February 1986 was lower than that for the preceding year (Appendix 10.1). By 1985 interest in hunting the study area had increased after the lull which had followed the poison operation, so the decline is probably attributable to hunting.

The general pattern then was a rapid reinvasion of the poisoned areas, particularly those in which deer densities were initially highest, followed by a rapid build-up within 4 years to near pre-poison levels.

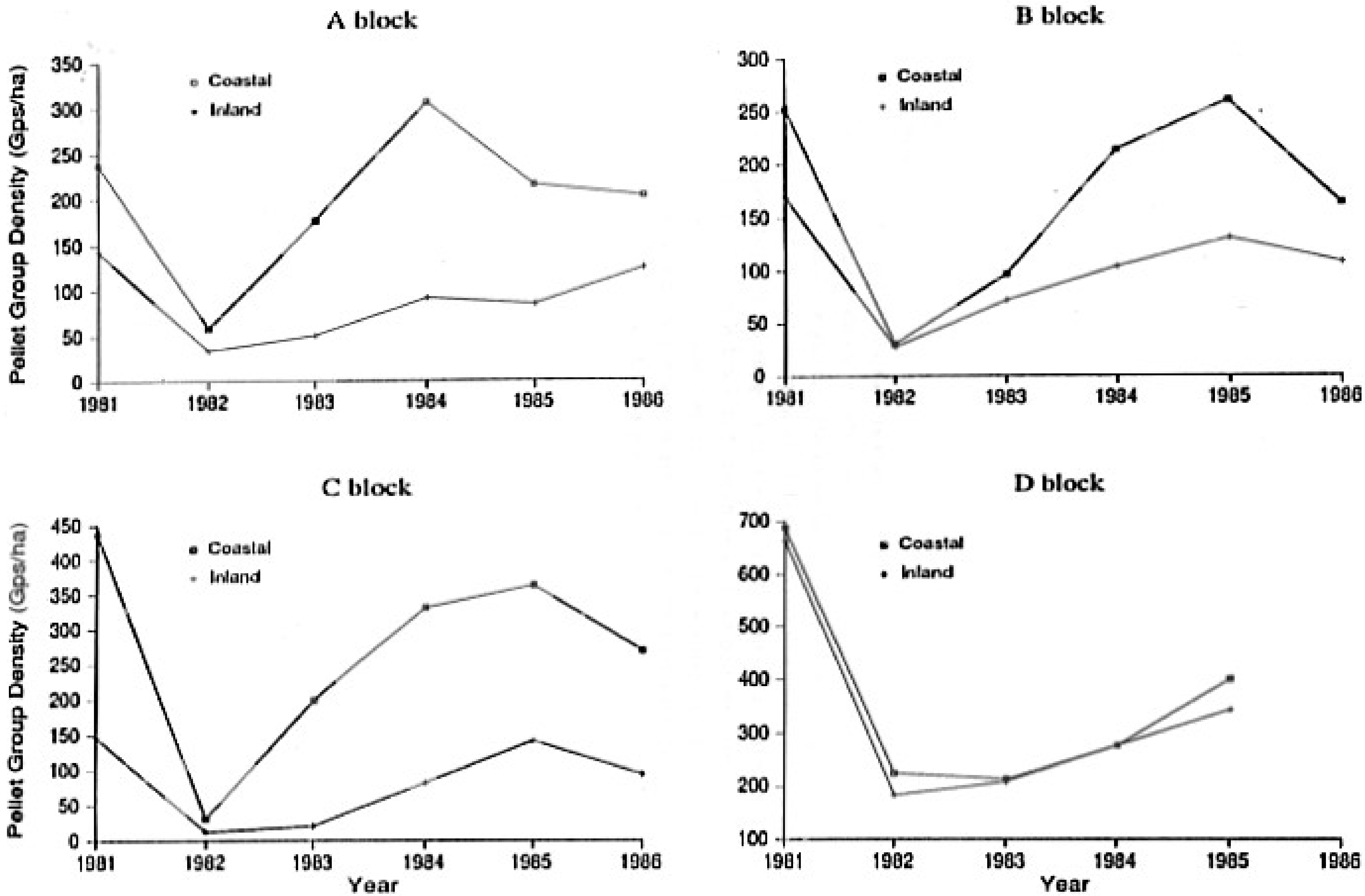


Fig. 4. Changes in pellet-group density in January/February 1981-86. Block D was not surveyed in 1986.

detection and avoidance and their solution need investigating further. DOC should consider jointly or wholly funding such investigations, and also the production of a field manual based on this trial and other recent research on the technique.

## 8. ACKNOWLEDGMENTS

I thank Dr C.N. Challies for his help with this report, and R.J. Henderson and C. Thomson for other background information they provided. Dr J.D. Coleman and J. Orwin commented on the manuscript.

## 9. REFERENCES

Baddeley, C.J. 1985. Assessments of wild animal abundance. *New Zealand Forest Service, Forest Research Institute Bulletin 106.* 46 p.

Batcheler, C.L.; Challies, C.N. 1988. Loss of compound 1080 (sodium monofluoroacetate) from carbopol gel smeared on foliage to poison deer. *New Zealand Journal of Forestry Science 18:* 109-15.

Challies, C.N. 1988. Foliage bait poisoning of ungulates. 1. Palatability of petrolatum and carbopol gel to white-tailed deer. Unpublished Forest Research Institute report to the Department of Conservation.

Fraser, K.W. 1989. Assessment of incidental mortality of deer during a possum control operation using aerial 1080 poisoning. Unpublished Forest Research Institute report to the Department of Conservation.

Harris, L.H. 1981. White-tailed deer in New Zealand. Supplement to *New Zealand Wildlife 8:* 12 p.

Lovelock, B.A. 1987. Northern Stewart Island wild animal survey 1986. Department of Conservation (Invercargill), New Zealand.

Moen, A.N. 1978. Seasonal changes in heart rates, activity, metabolism, and forage intake of white-tailed deer. *Journal of Wildlife Management 42:* 715-738.

New Zealand Forest Service, 1982. Report of the Forest Research Institute for 1 January to 31 December 1981. New Zealand Forest Service, Wellington. Pp. 54-58.

New Zealand Forest Service, 1984. Deer control and vegetation response on Stewart Island. *What's New in Forest Research No.126.* 4 p.

Nugent, G.; Challies, C.N. 1988. Diet and food preferences of white-tailed deer in north-eastern Stewart Island. *New Zealand Journal of Ecology 11:* 61-71.

Purey-Cust, J.R.; McClymont, R.B. 1979. Stewart Island : Land mangement study. New Zealand Forest Service and Department of Lands and Survey, Wellington. 208 p.

Smith, A.D. 1964. Defecation rates of mule deer. *Journal of Wildlife Management 28:* 435-444.

Takatsuki, S.; Kanomata, K.; Suzuki, K. 1981. Defecation rates of sika deer and Japanese serow. *Japanese Journal of Ecology 31:* 435-439.

Veblen, T.T.; Stewart, G.H. 1980. Comparison of forest structure and regeneration on Bench and Stewart Islands, New Zealand. *New Zealand Journal of Ecology 3:* 50-68.

## 10. APPENDICES

**Appendix 10.1.** Rainfall preceding each survey (1981–86)

Cumulative total rainfall (in mm) recorded at Halfmoon Bay for 1-6 months preceding each of the point distance surveys in early February.

| Months before survey | Cumulative rainfall totals 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
|---|---|---|---|---|---|---|
| 1 | 138 | 246 | 322 | 227 | 174 | 167 |
| 2 | 217 | 393 | 446 | 344 | 330 | 248 |
| 3 | 404 | 457 | 706 | 415 | 432 | 407 |
| 4 | 507 | 677 | 848 | 499 | 568 | 507 |
| 5 | 723 | 928 | 893 | 638 | 625 | 512 |
| 6 | 883 | 994 | 1069 | 719 | 752 | 589 |