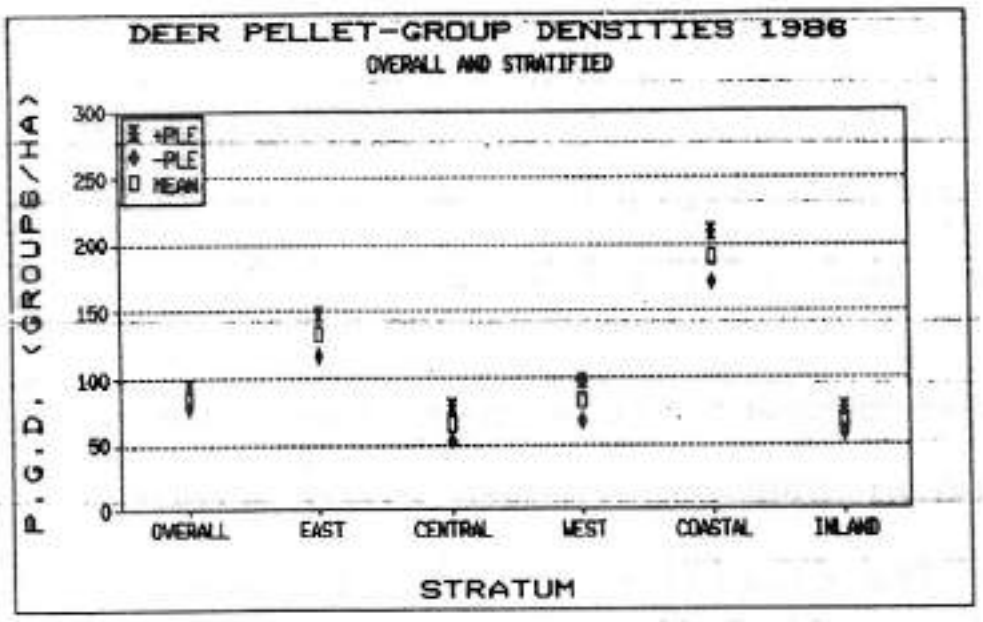
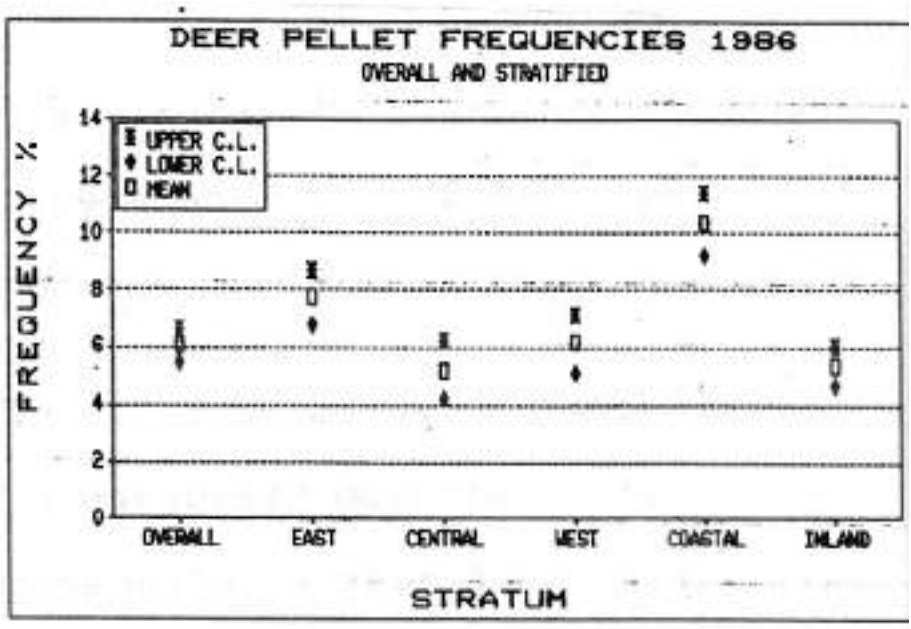
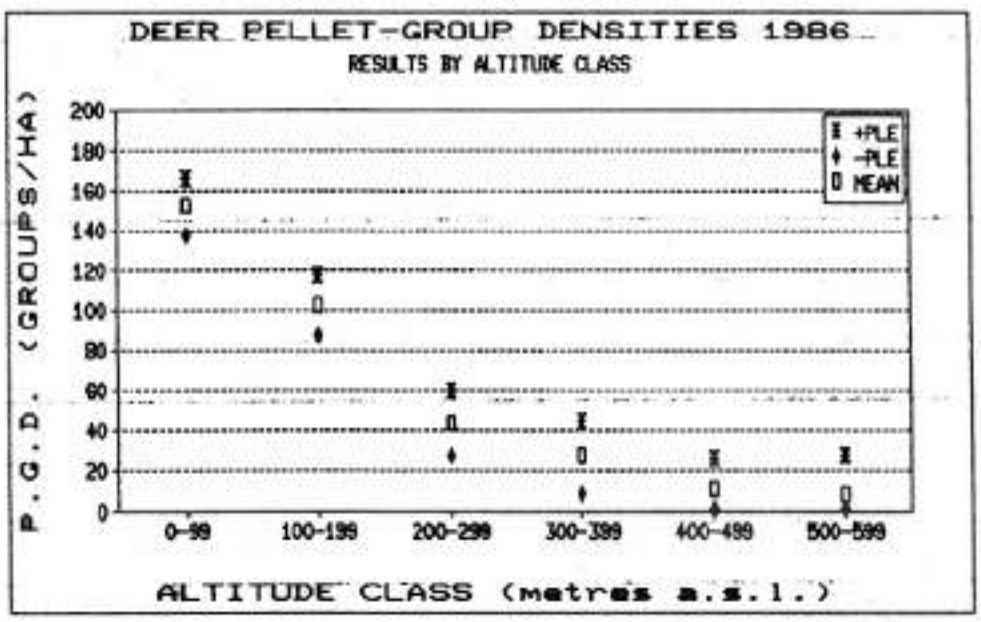
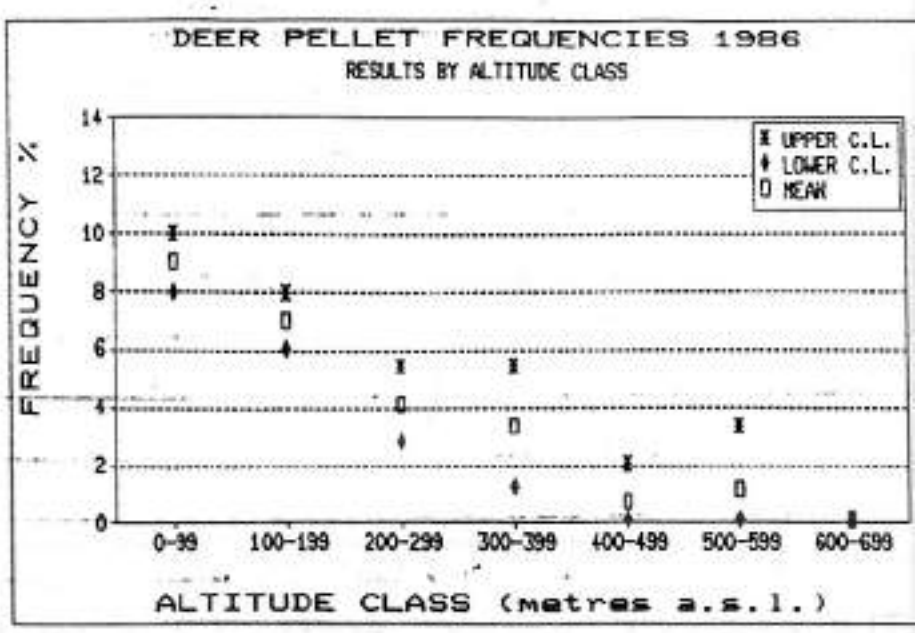


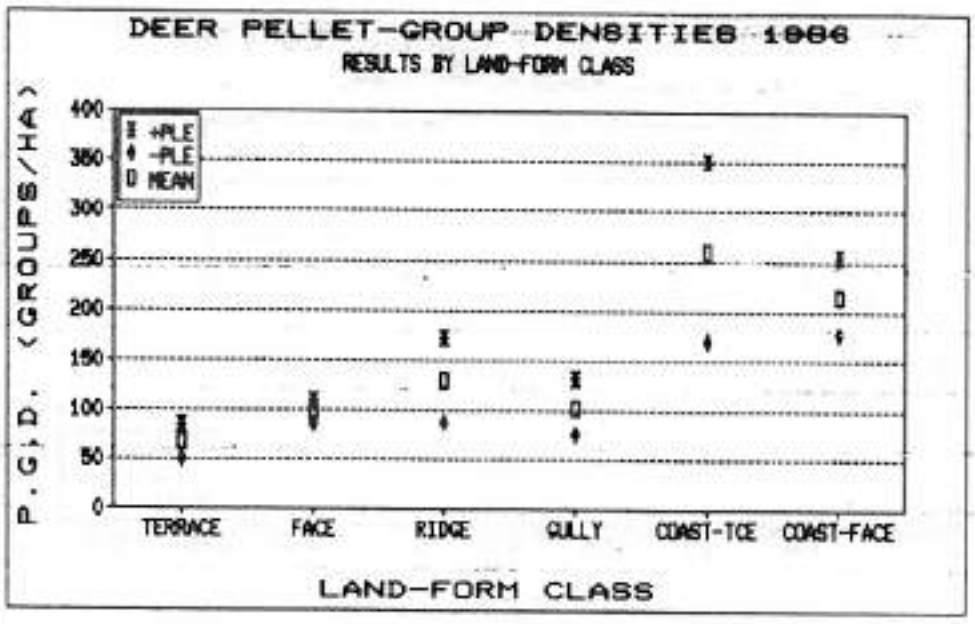


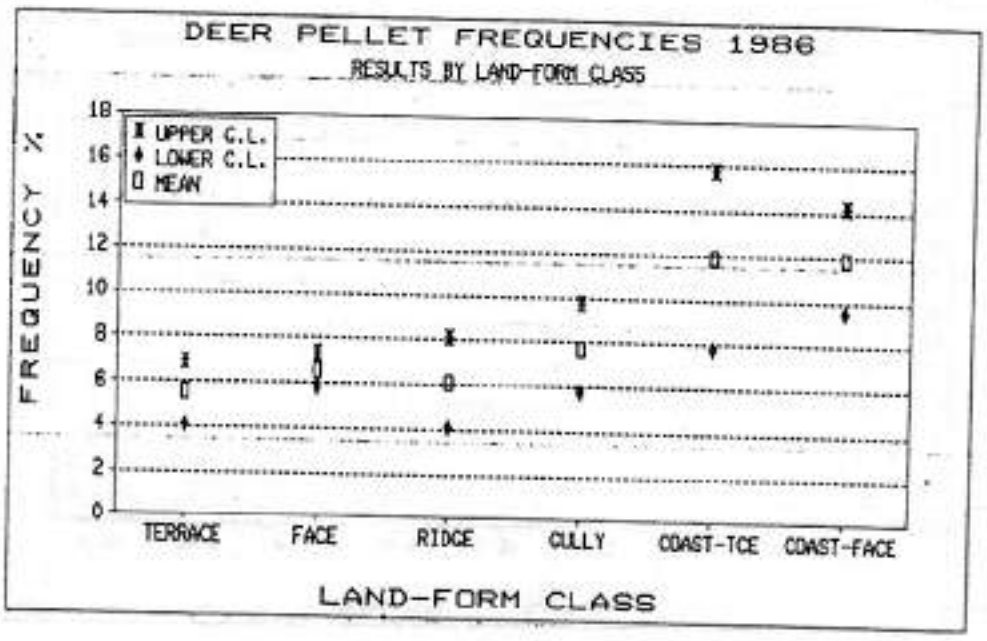
6.2.1 Altitude - Deer showed a distinct preference for the lower altitude forest. Highest pellet densities were found from sea level to 100m a.s.l. , with densities progressively decreasing with increase in altitude. Above 200m, no large difference in pellet densities were observed. Above 400m, densities were very low. Only two pellet groups were found above 400m altitude.





6.2.2 Aspect - Highest pellet densities were found on slopes having a northerly aspect. The south-east to south aspect showed a significantly lower pellet density.

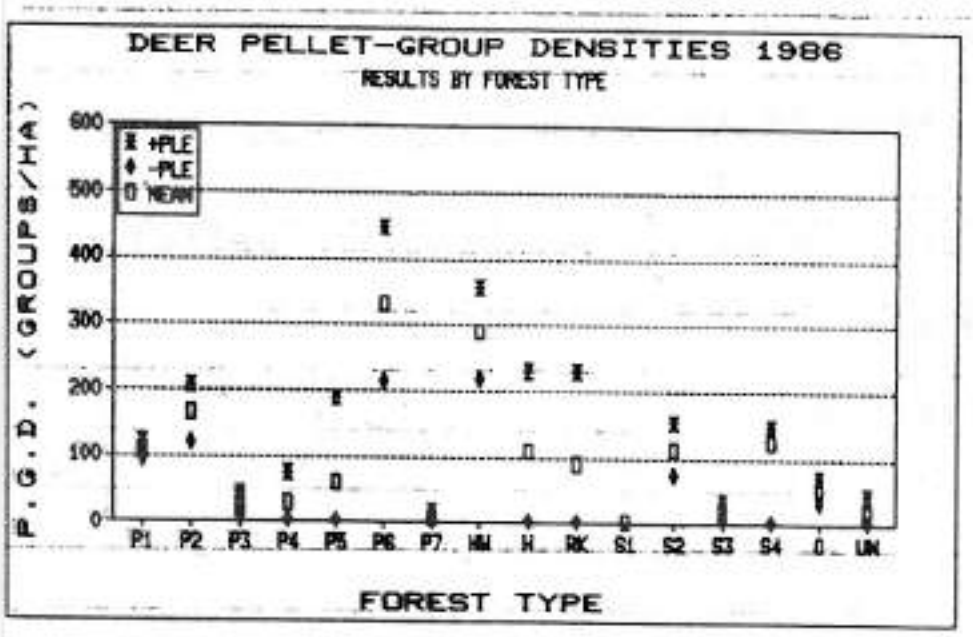


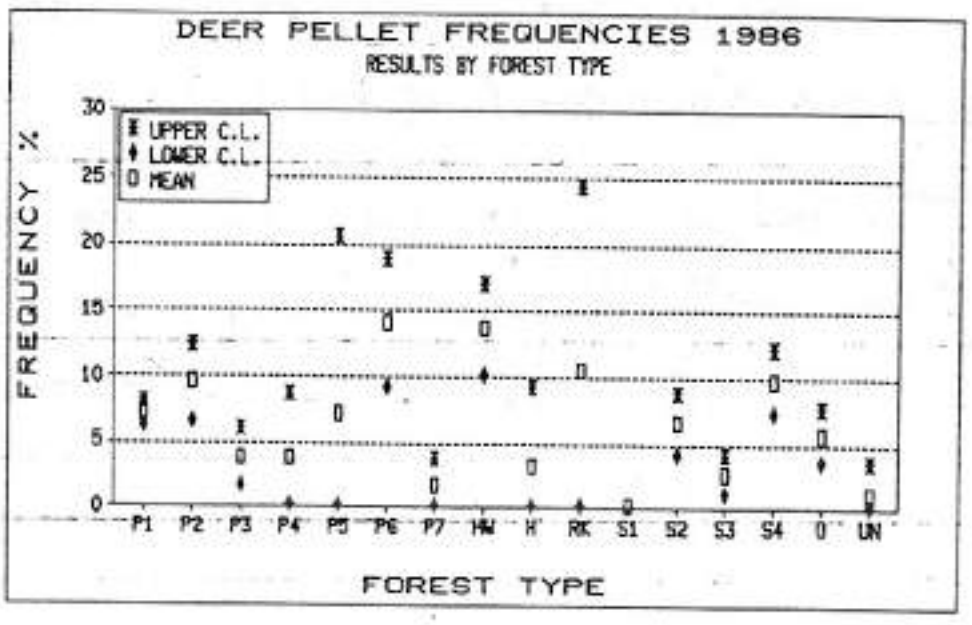


6.2.5 Vegetation Type - Pellet densities implied that deer preferred the Hardwood and Rimu-kamahi-broadleaf-myrsine forest types above most others. Vegetation types with lower pellet densities were Yellow-silverpine, short manuka scrub, the higher altitude rata-kamahi-podocarp-manuka forest and sub-alpine scrub.

The major type sampled by far was Podocarp-hardwood forest. Cutover Podocarp and Coastal scrub (other major types) showed barely higher densites than Podocarp-hardwood.

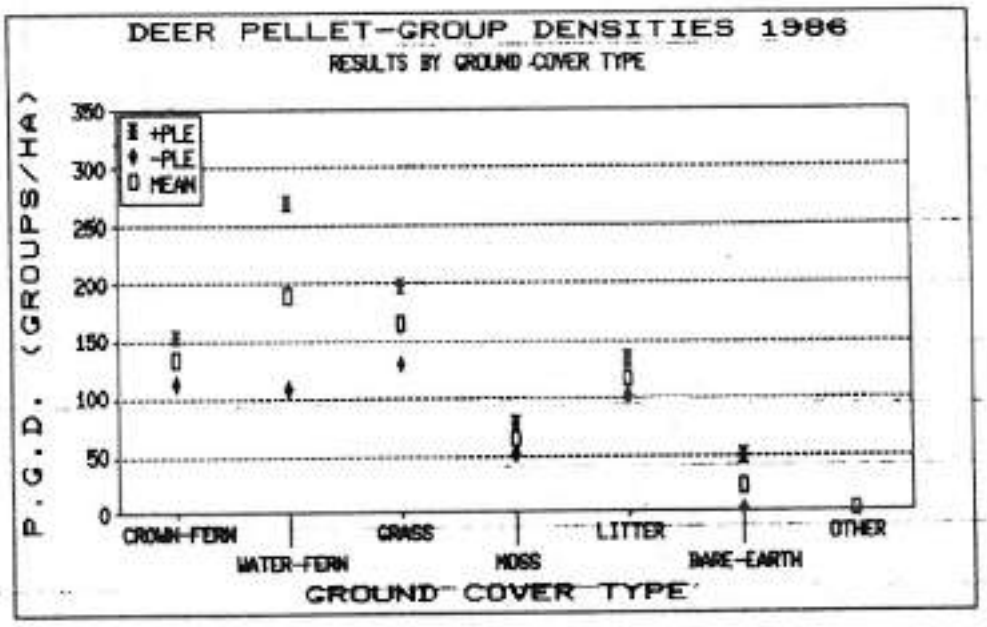
The Open type (without canopy) found along coastal areas had a low pellet density.

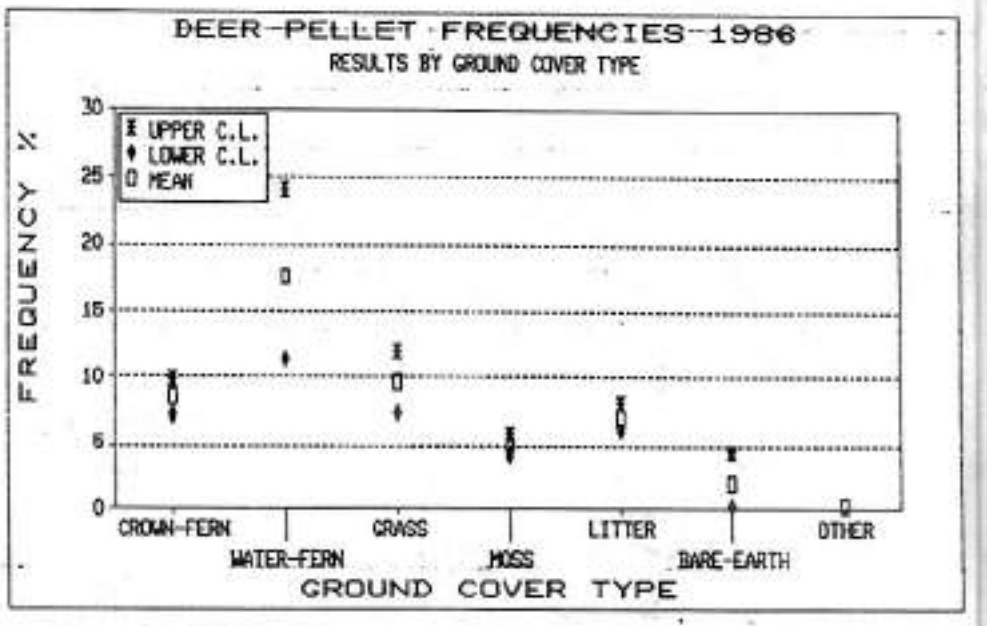




6.2.6 Ground Cover - Pellet densities were higher on a ground cover of water fern (Histiopteris incisa) than all other ground-cover types other than grass.Both of these ground-cover types were common beneath the Coastal scrub vegetation type.

Pellet densities were low on moss and bare-earth.

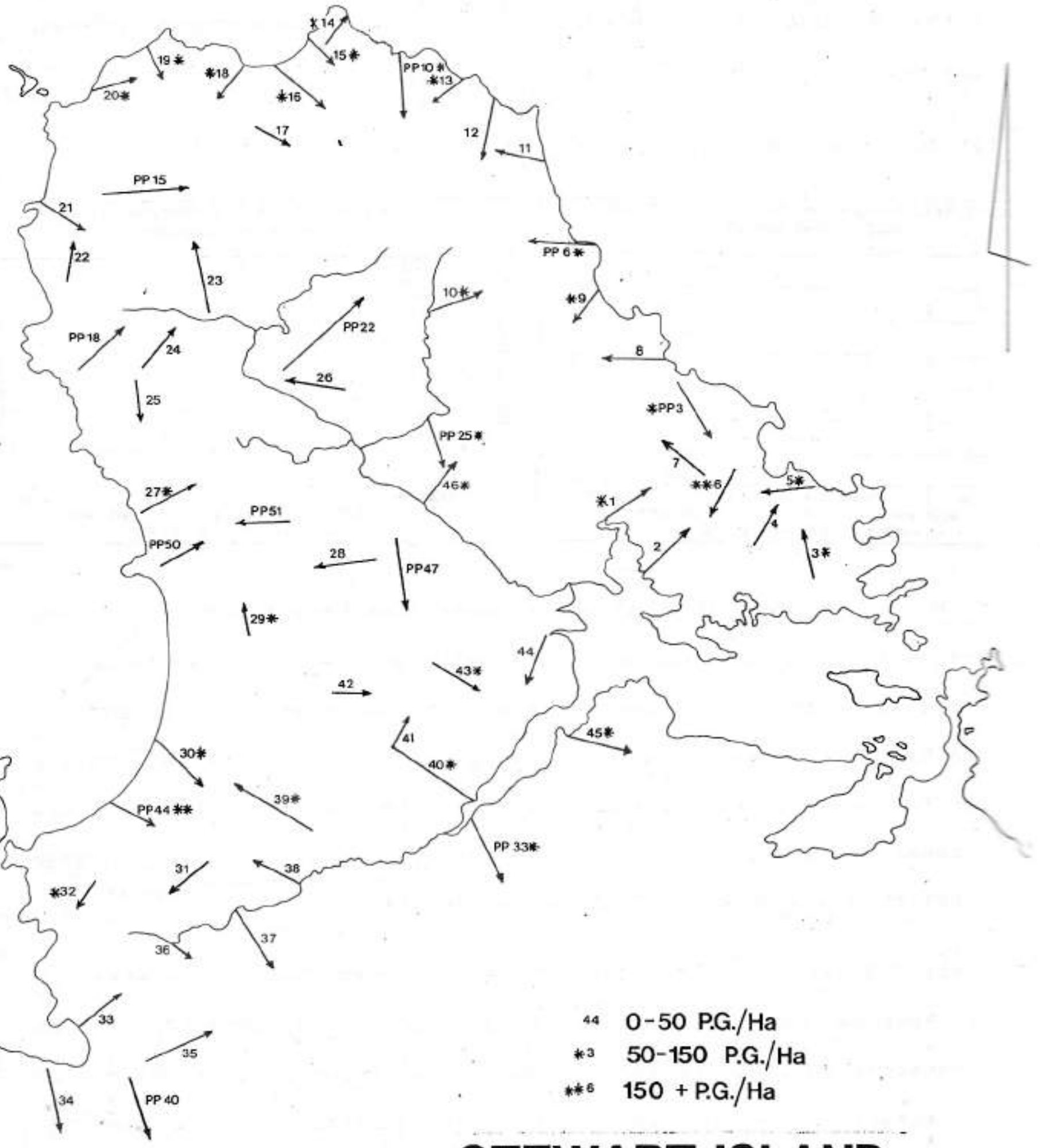




6.2.7 Hunting Block - Highest pellet densities were found along the north-eastern coast. Maximum PGD being at the Lucky-Yankee block. Densities along this coast were generally higher than the inland or western blocks, although the Mason Bay block returned a pellet density similar to the north-eastern blocks. Densities for the inland blocks were consistantly low, especially for Benson Peak. The Freshwater block returned a moderately high pellet density.

Deer pellet density for transects that crossed Nature Reserve or Scenic Reserve was low, at 86 +- 15 groups/hectare, compared to that from transects in State Forest and Unoccupied Crown Land at 122 +- 12 groups/hectare. Note that pellet transects generally only crossed the lower parts of the Nature and Scenic Reserves, and the true pellet density for this land classification is likely to be considerably lower than the figure given above.

FIG. 5 Pellet Group Density for Transects



44 0-50 P.G./Ha

*3 50-150 P.G./Ha

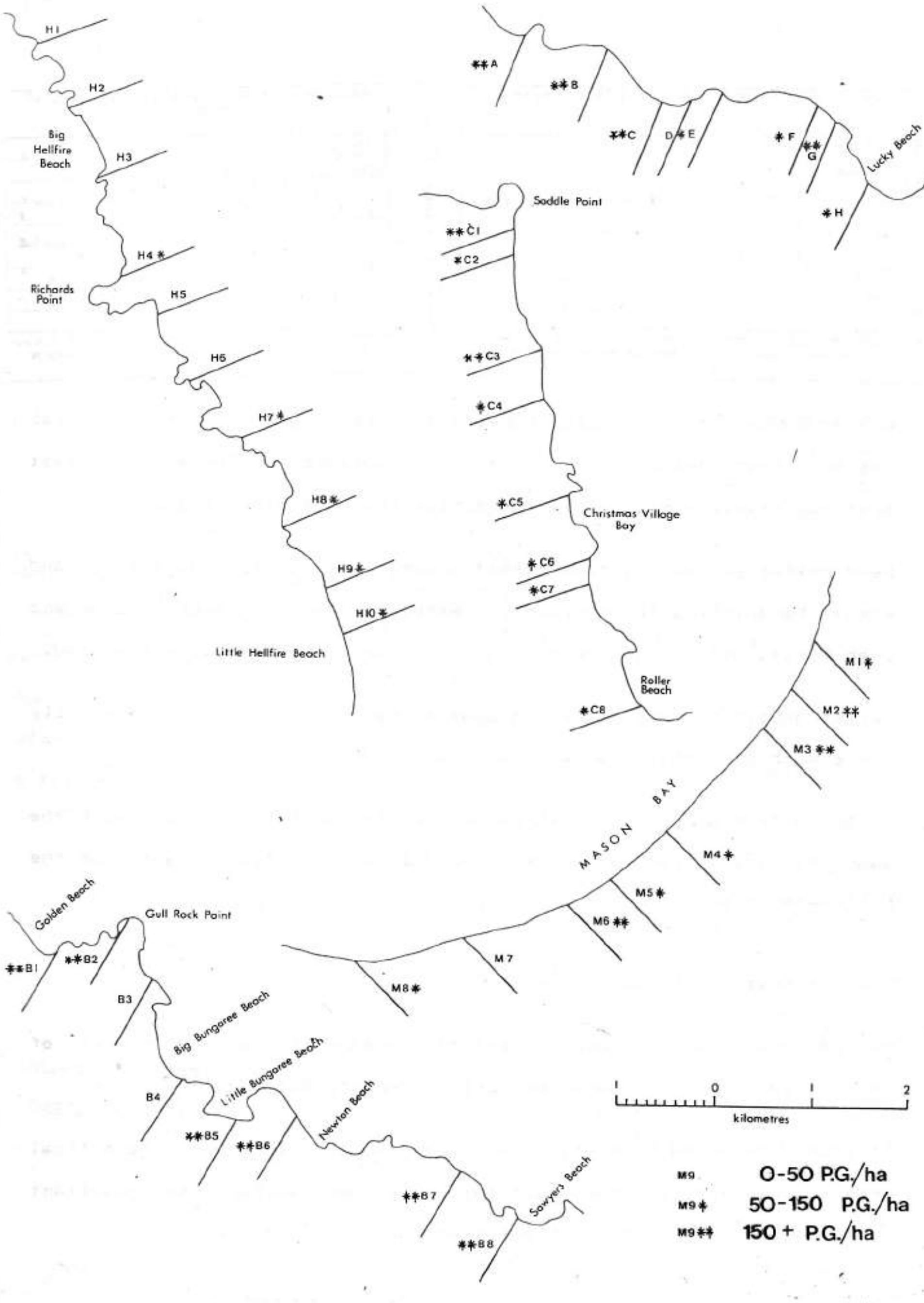
**6 150 + P.G./Ha

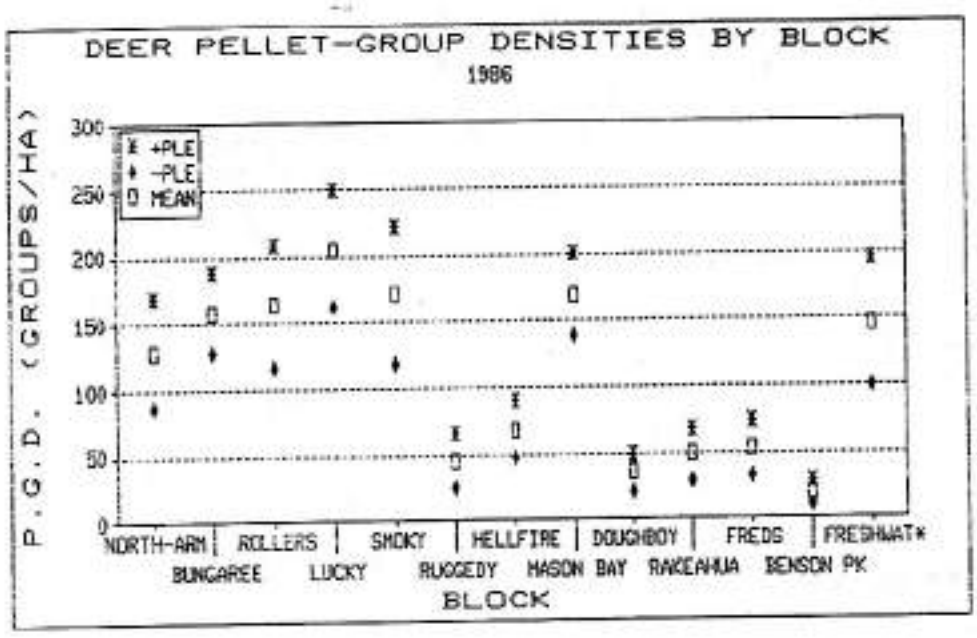
STEWART ISLAND

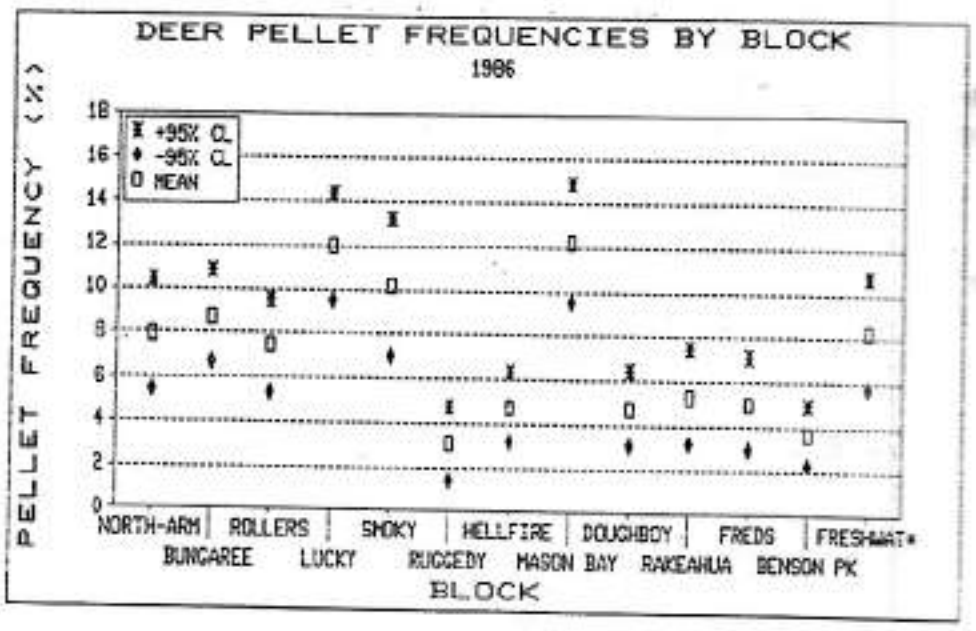
0 5 10

kilometres

FIG. 6 Pellet Group Density for Coastal Transects







6.2.8 Summary - Deer pellet densities were higher in the coastal region (over twice the PGD of the inland region). The eastern coast also had significantly higher densities than the other regions.

Deer preferred low altitude forest types, particularly Hardwood, and Rimu- kamahi-broadleaf-myrsine. Associations of coastal scrub and open forest with a waterfern or grass groundcover were also favoured.

Pellet densities were higher on coastal faces and terraces, especially those with a northerly aspect.

North-eastern blocks returned highest pellet densities, along with the Mason Bay area. Central blocks showed lower densities, apart from the Freshwater block.

6.3 Estimation Of Deer Numbers

An estimate of actual deer numbers can be made from a combination of deer pellet decay data and deer pellet density data.

It should be noted however, that due to the inherent statistical errors involved in the calculation of deer numbers, the resultant confidence limits on these figures are wide.

The recruitment rate (G),as calculated from the above, is a measure of the number of deer pellet groups appearing on the ground per day.

Recruitment rates for coastal and inland strata differed considerably, requiring separate calculation of deer numbers for each of these strata.

$$G = \frac{D * LOGe\ (k1/k2)}{T}$$

where D = overall PGD
k1= total deer groups marked
k2= total deer groups remainin after T days

G = 0.7371 groups/ha/day (INLAND)
G = 2.4816 " " (COASTAL)

Now, assume that the total deer population for the survey area consists of 20% red deer and 80% whitetailed deer (from previous survey data), and that defaecation rates for the two species are 12.5 and 14.5 groups/day (Challies pers.comm.) respectively. Then overall defaecation rate = 14 groups/day and number of deer (n) is estimated as follows;

$$n = \frac{G * A}{d}$$

where d = overall defaecation rate
A = inland area (62,845 ha)#
A = coastal area (11,870 ha)
(# area not covered by survey tran-sects has been deducted)

INLAND n = 3406 animals (95% CL = 1122 animals)
COASTAL n = 2165 " (95% CL = 143 ")
5571

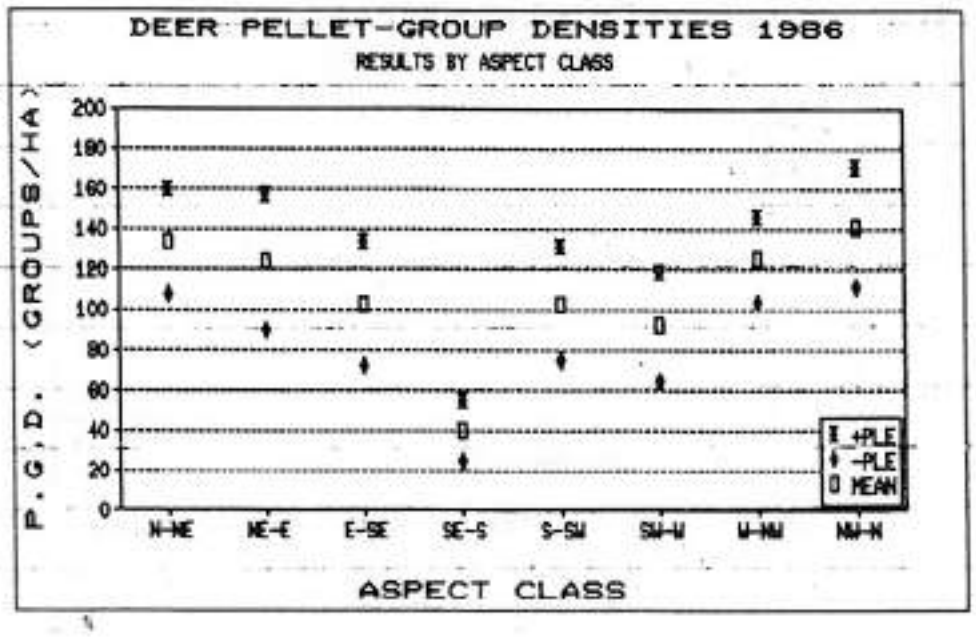
When translated to a density of deer per hectare, the density of deer for the coastal area is over three times greater than the density of deer for the inland area (coastal=1 deer/5.5 ha compared with inland= 1 deer/18.5 ha).

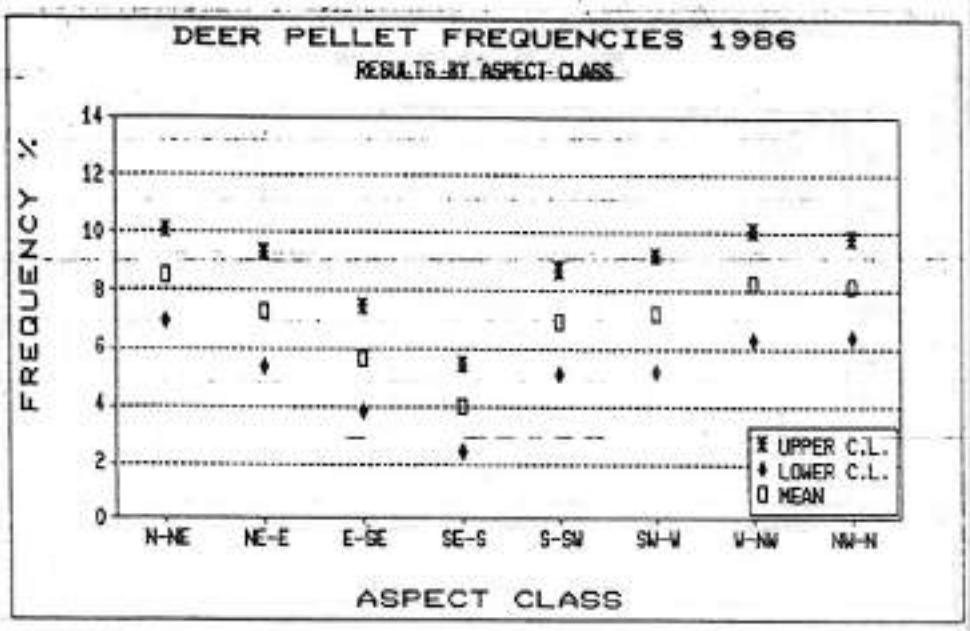
6.4 Distribution And Abundance Of Possums

Possums were present throughout the entire surveyed area in moderate densities. Overall possum pellet frequency was 17.6%.

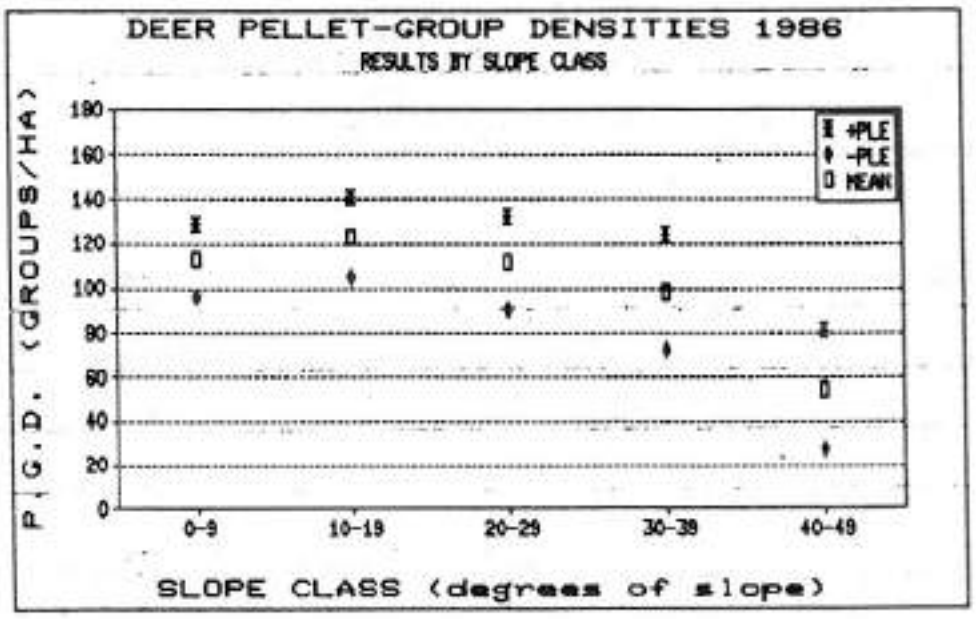
STRATUM	PELLET FREQUENCY %	95% CL
OVERALL	17.6	1.0
EAST	19.5	1.6
WEST	17.2	1.7
CENTRAL	17.3	1.7
COASTAL	19.7	1.5
INLAND	17.2	1.1

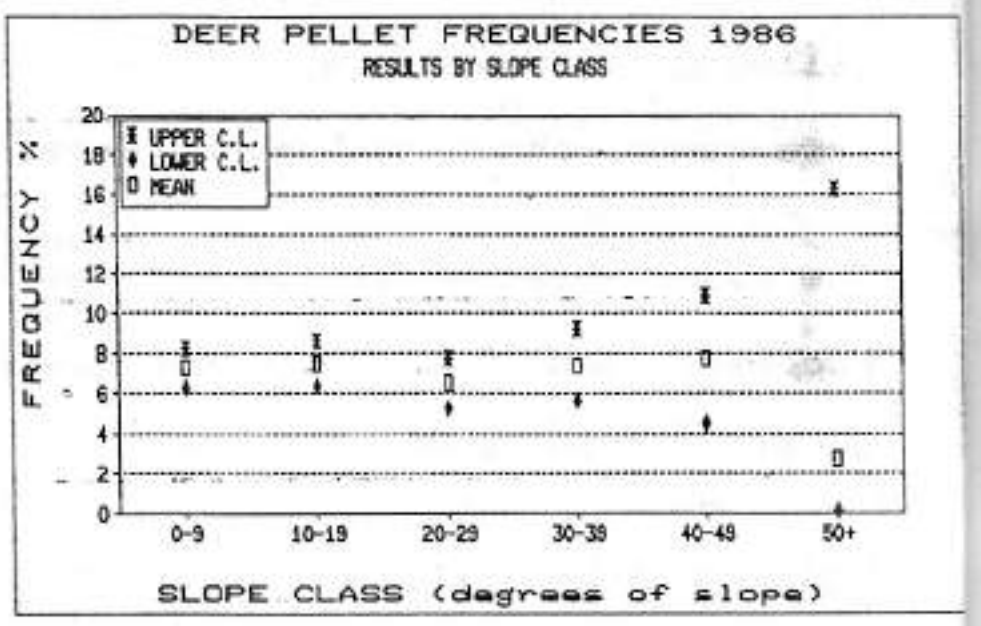
Over the survey area, pellet distribution did not vary greatly. The eastern and coastal regions contained higher densities than the other regions, but these were not statistically significant margins.





6.2.3 Slope - From pellet density, no preference was shown for any particular slope class.





6.2.4 Landform - Coastal faces and coastal terraces returned the highest pellet densities. These were significantly higher than for the non-coastal face and terrace counterparts inland.

Of the non-coastal landforms, the gully showed the highest pellet densities, followed by face,ridge and terrace. Statistically, none of these had a significantly higher pellet density though.

Previous pages dealing just possums not included.

6.4.8 Summary - Overall, there were no statistically significant differences in possum pellet distribution by region. However, it appeared that coastal areas were preferrred , especially the forest types of Coastal Scrub and Hardwood. Possums were widely distributed however, the only unpopular habitat being short manuka scrub of the inland valleys and Open canopy of the coastal areas. Northerly aspects were favoured on moderately steep slopes, within the lower altitude range of sealevel to 200m a.s.l.

Highest frequencies were found on the north-eastern blocks, as well as Hellfire on the west coast and the central block of Benson Peak.

6.5 Co-association Of Deer And Possums

A correlation of deer with possum pellet frequency was carried out. The coorelation coefficient (r), is a measure of the relationship between deer and possum pellet frequencies. It always lies between -1 and +1. Positive values of r indicate a tendency for the variables tested to increase together.

For the entire survey area, r = 0.56. ie. possum and deer pellet frequencies increased together. This implies that habitats favourable to possums were also favourable to deer. It is likely that deer and possums act together in improving the forest habitat for their mutual benefit.

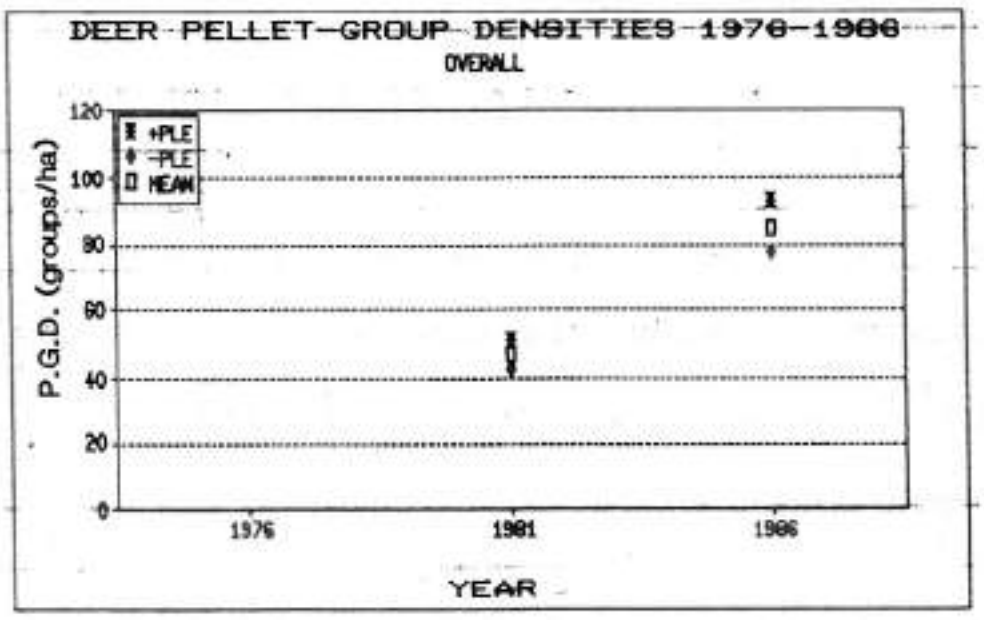
7 DISCUSSION

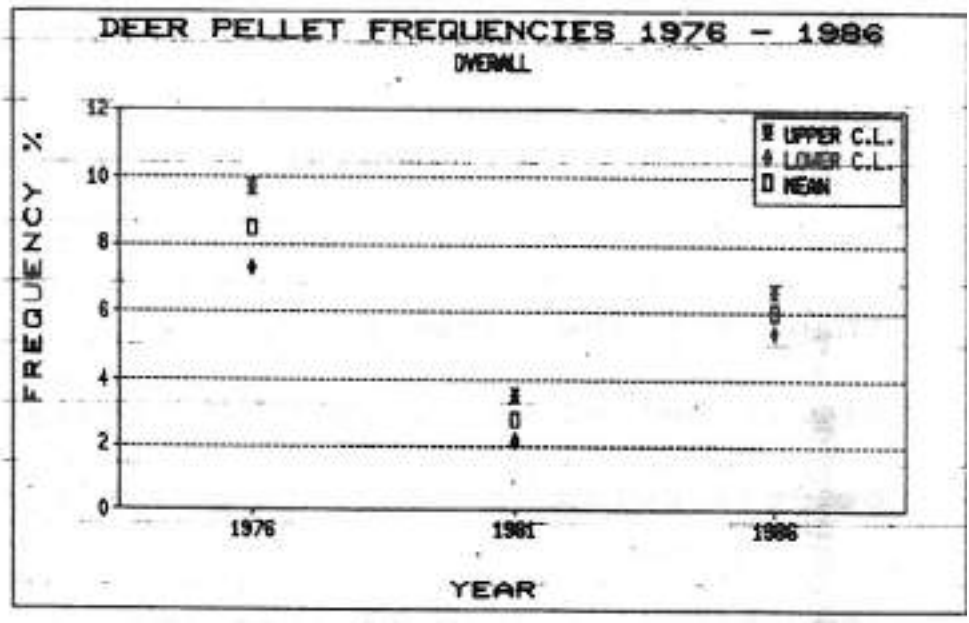
7.1 Trends In Deer Pellet Density 1976-1986

Both pellet frequency and pellet-group density illustrate the same trend in deer pellet density ;

(i) From 1976 to 1981, deer pellet density decreased.

(ii) From 1981 to 1986, deer pellet density increased.





Both of these changes are statistically significant at the 95% confidence level. All regional strata (east, west and central) also show this trend of decrease, followed by increase in pellet density.

However, this pattern is complicated by the lack of pellet decay data for the first two surveys. Pellet decay is a significant factor of pellet density. Rainfall is probably the greatest influence on pellet decay.For this reason, rainfall data for the 3 months prior to each survey (1976,1981,1986)is compared. Subsequently, subjective corrections for rainfall can be made on the pellet density data for the three surveys.

RAINFALL DATA

FOR 3 MONTH PRE-SURVEY PERIOD

YEAR	RAINDAYS	MM RAIN
1976	NA	328
1981	79	499
1986	59	364

Rainfall was significantly higher over the 1980 pre-survey period, than for the other pre-survey periods. This would likely result in a higher pellet decay rate and therefore a lower proportion of intact pellets being found during that survey.

The effect of this is that the decrease in pellet densities observed from 1976 to 1981 overestimates the decrease in actual animal numbers.

Similarly, the increase in pellet densities observed from 1981 to 1986 overestimates the increase in actual animal numbers.

In summary, it is apparent that deer pellet density, and consequently deer numbers may have risen slightly since 1981.

Overall, the pellet count data suggests that deer numbers remained little changed over the longer 1976-1986 period . Any change would be in the direction of a slight decline in numbers.

7.1.1 Distribution - Distribution of deer appears to have changed little since 1976, pellet densities being higher in a relatively narrow coastal strip for all surveys.

Deer pellet frequencies and PGD's have been arbitrarily divided into "low" , "medium" and "high" density classifications as follows.

CLASS	PELLET GROUP DENSITY (groups/ha)
"LOW"	0 - 50
"MEDIUM"	50 - 150
"HIGH"	150 +

On this system, deer density is mapped (see fig.7). It should be noted that boundaries between areas of different densities are totally artificial and not pertaining to the natural state. Densities mapped are an average for the block. The map is a simplification of actual deer distribution.

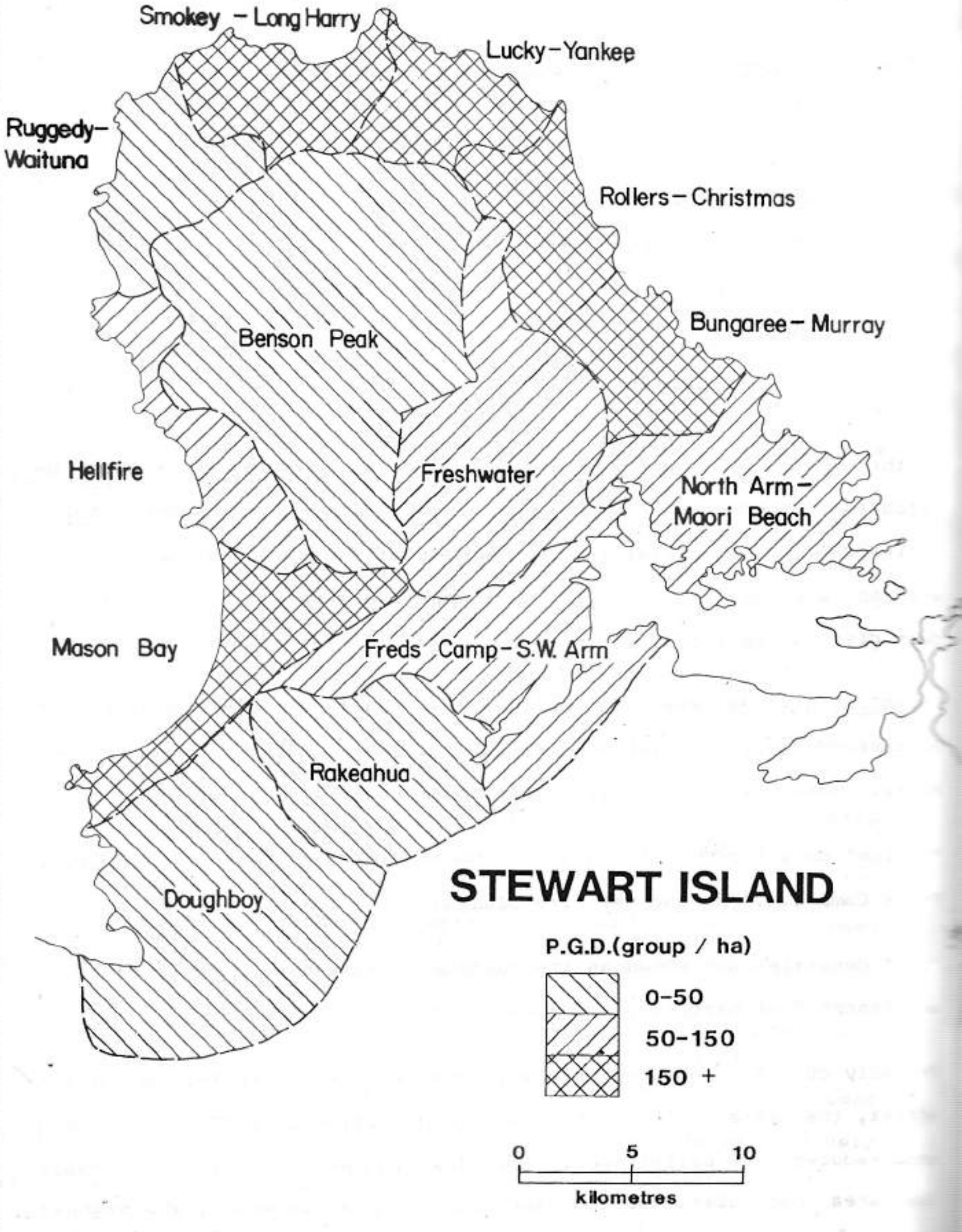
"High" densities are shown in the north-eastern blocks of Bungaree-Murray, Rollers-Christmas, Lucky-Yankee, and Smoky-Long Harry. Mason Bay on the west coast also shows a "high" density.

"Medium" densities are found in the North Arm-Maori Beach, Freshwater, Freds Camp-S.W.Arm, and Hellfire blocks.

"Low" densities are shown on the Doughboy, Rakeahua, Ruggedy-Waituna and Benson Peak blocks.

Probably due to enhanced access, and resultant increased hunter effort, the western blocks showing high densities in 1976 and 1981 now show reduced deer pellet densities. Trapping pressure in the Mason Bay area has also reduced deer numbers. Consequently, the highest

FIG. 7 Deer Distribution by Pellet Group Density



deer numbers now occur on the north-eastern coast.

There has been debate on the matter of seasonal movements of whitetailed deer on Stewart Island. A commonly held theory is that the deer tend to make higher use of the coastal zone over the summer months, and migrate inland for the winter period. The seasonal distribution of whitetailed deer has remained unexamined in the survey area to date, as all surveys have been carried out in the summer.

7.1.2 Distribution Of Red And Whitetailed Deer - The deer population on Stewart Island is predominantly of whitetailed deer.

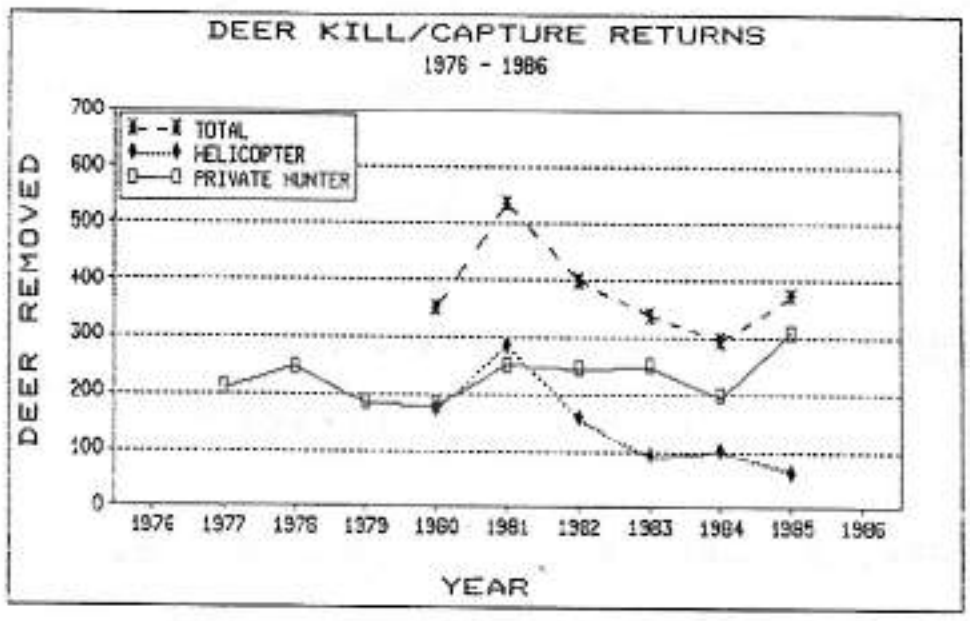
The 1976 and 1981 pellet surveys showed that red deer pellet frequencies were approximately one-quarter to one-third those of whitetailed deer.

Sightings of red deer were very limited on the most recent survey.The only sightings were made at Island Hill, Rakeahua and Kilbride. These areas have traditionally been red deer habitat as identified by the previous surveys. It has been suggested that red deer cannot compete with whitetailed deer in the Stewart Island habitat. Hence they are found in habitats less favoured by whitetailed deer.

Less than 2% of private hunter kill returns are of red deer (compared to 33% of commercial helicopter kill/capture returns). Since the advent of helicopter deer recovery, the proportion of red deer in the total deer population has decreased, since this industry has concentratated on the more profitable larger bodied red deer, for farming and carcase recovery.

7.1.3 Kill/capture Returns - Deer kill returns for the survey area show that for the last four years an average of about 250 animals have

been killed by private hunters (red and whitetailed together) per year. A further 100 animals have been removed by helicopter operators. Therefore a total of about 350 animals are harvested each year from the survey area. This is less than 5% of the population estimated from pellet counts.

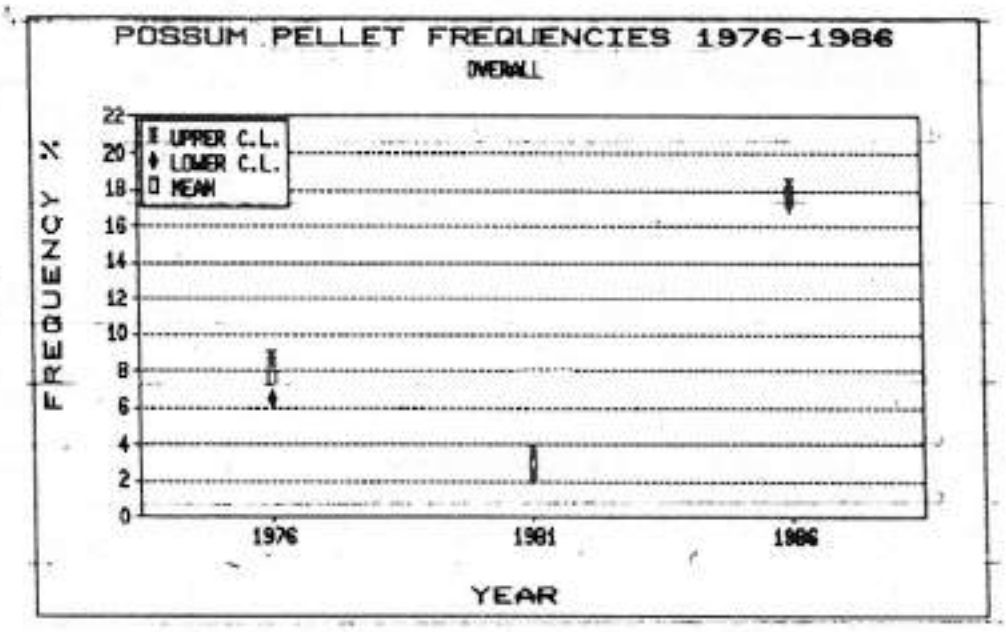


By far the most deer are taken from the eastern blocks from Maori Beach to Smoky. Over twice the number of deer are killed by private hunters in the eastern stratum than in either the western or central strata. But in terms of hunter effort per kill, man-days per kill are lower on almost every western block. Big Hellfire and North Doughboy stand out as blocks with a markedly lower hunter effort required per kill (see appendix C).

For red deer, Rakeahua and the Ruggedy blocks have shown the highest returns over the last ten years.

7.2 Trends In Possum Pellet Density 1976-1986

Possum pellet frequency dropped by 50% between 1976 and 1981. In 1981, pellet frequencies were low at an overall 2.9%.



However, pellet frequencies have increased substantially to an overall average of 17.6% this survey. On the surface, this is a dramatic increase, but two factors moderate this increase. Firstly, criteria for acceptance of a possum pellet was modified slightly for the recent survey ie. the pellet must have been recognizable as having been voided by a possum, rather than the old criterion of the pellet retaining its sausage-like shape . This would result in higher pellet frequencies this survey. Secondly, as for the deer pellets, the higher rainfall over the 1980 pre-survey period would result in a higher decay-rate for possum pellets and a lower frequency of pellets for the 1981 survey. ie the decrease in pellet frequency from 1976 to 1981 would overestimate the decrease in actual possum numbers, and similarly, the increase in pellet frequency from 1981 to 1986 would overestimate the increase in actual posssum numbers.

Possum trapping and poisoning returns show that the number of possums removed varies greatly from year to year, and between areas. Fluctuating market prices for possum skins, combined with and access problems, especially to the more remote areas, may cause difficulties with maintaining a constant trapping/poisoning pressure on the population throughout the survey area. Appendix E shows that possum returns have varied much between years and areas, but generally less

possums are removed from the central stratum. Possum pellet frequencies areslightly lower for these central blocks (apart from Benson Peak), indicating a less favourable habitat.

In summary, overall, possum numbers are likely to have risen since the previous surveys but not by as great a magnitude as represented by the rise in possum pellet frequencies, because of the moderating factor of rainfall mentioned above.

8 CONCLUSION AND RECOMMENDATIONS

Overall deer and possum pellet densities are low to moderate throughout the survey area. Pockets of high density of deer occur, particularly on the north-eastern coast. These areas continue to receive much attention from private hunters however.

RECOMMENDATIONS

(i) Reassess pellet transects in 1991, and also at that time remeasure all permanent vegetation plots.

(ii) Every effort should be made to assess deer condition in the survey area. ie hunters should be issued with instructions on the collection of samples for analysis of animal condition.

(iii) Possum trappers should continue to be directed towards area of highest possum usage.

(iv) These survey results be made available in a simplified form to all hunters at time of permit issue.

(v) A study of the seasonal movements of whitetailed deer with regard to coastal-inland migration be initiated on the eastern coast of the survey area.

ACKNOWLEDGEMENTS

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Especial thanks to Neil Bolton who helped organize the survey.

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Thanks to Graham Nugent for his help in data analysis, and much constructive criticism. Chris Challies, Mike Slater, Chris Main and Lou Sanson also commented on the draft report.

Julie Campbell and Ian Young did the draughting.

Finally, thanks to all the deer who contributed their breakfasts, lunches and dinners, thereby making this survey possible.

REFERENCES

BADDELEY,C.J. 1985: Assessments of wild animal abundance. FRI Bulletin no 106

COCKAYNE,L. 1909: Report on a botanical survey of Stewart Island. Dept Lands Wellington.

DOONE,T.E. 1924: The game animals of New Zealand. John Murray, London.

PIPER,K. 1961: Geography of Stewart Island. Unpub. thesis for M.Sc degree University of Canterbury.

PRACY,L.T. 1974: Introduction and liberation of the opossum into New Zealand. N.Z.Forest Service, Wellington.

SLATER,M.J.& CUDDIHY,M.J. 1982: Density and distribution of wild animals in northern Stewart Island AND proposal for the establishment of a northern Stewart Island R.H.A. N.Z.F.S. Southland Conservancy (unpub.)

SLATER,M.J. 1983: Forests of northern Stewart Island. New Zealand Forest Service, Southland Conservancy (unpub.).

WILLIAMSON,M.J. 1976: Resource survey of northern Stewart Island - part two: Forests and introduced animals. New Zealand Forest Service, Southland Conservany (unpub.).

WODZICKI,K.A. 1950: Introduced mammals of New Zealand. D.S.I.R. Bulletin no. 98.

WOOLMORE,C.B. 1982: Stewart Island regeneration survey 1980/81. N.Z.F.S. Southland Conservancy (unpub.).

APPENDIX A

CRITERIA FOR "INTACT" PELLETS AND PELLET-GROUPS

. DEFINITION OF AN INTACT DEER PELLET

To be intact, a deer faecal pellet must be WHOLE, with a COMPLETE OUTER COATING. A pellet is no longer intact if any of the following is observed.

DISINTEGRATION OF SOME PART OF THE PELLET

The upper surface of a pellet is frequently intact but the underneath, which is in contact with the damp ground, may have disintegrated.

NOTE: that the growth of fungi, moss or algae ON THE SURFACE of a pellet does not invalidate that pellet.

OR FLAKES LOST FROM THE OUTER COATING

The dark coating of a pellet may have some abrasion and roughness, but must not have begun to flake or have been worn completely away

OR CRACKS (other than drying cracks)

With the exception of the fine network of cracks sometimes caused by rapid drying of the coating, an intact pellet must not be cracked.

OR HOLES

Small holes, such as those caused by burrowing invertebrates, invalidate a pellet.

OR COVERED BY WATER

OR MOVED FROM THE POINT OF DEPOSITION

A pellet is no longer intact if it has clearly been washhed or blown from its original location.

2. DEFINITION OF AN INTACT DEER PELLET-GROUP

Six or more intact pellets which are visible without disturbing the ground litter and which are judged to have been voided at the site by one animal in one defaecation.

3. DEFINITION OF AN INTACT POSSUM PELLET

To be defined as intact, a possum pellet must only be recognized as having been voided by a possum.

APPENDIX B

DEER AND POSSUM PELLET DENSITY BY BLOCK

BLOCK	P.G.D.	DEER PLE	DEER %FREQ.	DEER 95%CL	POSSUM %FREQ.	POSSUM 95%CL
NORTH ARM-MAORI BCH	127	41	7.9	2.5	13.8	3.2
BUNGAREE-MURRAY	158	29	8.7	2.1	19.2	2.9
ROLLERS-CHRISTMAS	163	46	7.4	2.1	20.9	3.3
LUCKY-YANKEE	205	44	11.9	2.4	24.4	3.1
SMOKY-LONG HARRY	170	51	10.1	3.1	16.6	3.8
RUGGEDY-WAITUNA	45	20	3.0	1.7	18.0	3.8
HELLFIRE	68	22	4.7	1.6	23.6	3.2
MASON BAY	169	31	12.1	2.7	12.1	2.7
DOUGHBOY	35	14	4.7	1.6	13.4	2.7
RAKEAHUA	48	20	5.3	2.1	14.9	3.4
FREDS CAMP-SW ARM	53	21	5.0	2.1	14.5	3.4
BENSON PEAK	19	9	3.6	1.4	21.4	3.0
FRESHWATER	147	48	8.2	2.5	13.9	3.2

APPENDIX C

DEER KILL AND CAPTURE RETURNS

YEAR	HELICOPTER KILL/CAPTURE	PRIVATE HUNTER KILLS	TOTAL DEER REMOVED
1977	NA	209	NA
1978	NA	245	NA
1979	NA	182	NA
1980	170	178	348
1981	285	250	535
1982	156	244	400
1983	90	248	338
1984	99	195	294
1985	63	308	371

APPENDIX D

PRIVATE HUNTER KILL RETURNS BY BLOCK 1982-1985

STRATUM	BLOCK	ANIMALS KILLED RED	WHITETAILED	TOTAL	MANDAYS/KILL
EAST	NORTH ARM		15	15	21.9
	MAORI BEACH	1	74	75	8.2
	BUNGAREE	1	65	66	12.8
	MURRAY		69	69	10.8
	ROLLERS		32	32	15.3
	CHRISTMAS		19	19	21.3
	LUCKY		39	39	11.9
	YANKEE		45	45	15.0
	SMOKY		76	76	8.6
	TOTAL	2	434	436	12.0
WEST	LONG HARRY	1	61	62	7.6
	EAST RUGGEDY	3	52	55	7.7
	WEST RUGGEDY		36	36	8.1
	WAITUNA	4	23	27	7.0
	BIG HELLFIRE	1	14	15	4.2
	LITTLE HELLFIRE	1	44	45	9.3
	NORTH DOUGHBOY		88	88	5.7
	SOUTH DOUGHBOY		33	33	14.8
	TOTAL	10	351	361	7.9
CENTRAL	RAKEAHUA	10	55	65	7.6
	S.W.ARM		44	44	14.8
	FREDS CAMP		56	56	17.3
	FRESHWATER		12	12	10.2
	BENSON PEAK			0	-
	TOTAL	10	167	177	12.7