Waterfowl Management in North Canterbury, New Zealand.

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by

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GENERAL INTRODUCTION

The basic goal of this thesis is to contribute to the knowledge of aspects of the waterfowl resource in North Canterbury, New Zealand for the purpose of improving its management. Every year in North Canterbury, seven species of waterfowl are subjected to a recreational and cultural hunt. In order to actively manage their populations to achieve a balance between differing user groups (e.g. hunters, birdwatchers, farmers), two things must be known:

1. The hunter's preferences and impacts.
2. Ecology of the target species.

To address the first issue, a questionnaire was sent to area hunters (Section 1). It was designed to be a general questionnaire, covering most issues concerned with gamebird hunting in North Canterbury and providing information on where hunting pressure is most concentrated, in terms of species and areas hunted. Its analysis gives a great deal of insight into the attitudes, idiosyncracies, and motivations of the North Canterbury hunter. In addition to the questionnaire, an analysis of the hunter diary scheme from the New Zealand Wildlife Service was done in order to examine the effect of bag limits and season lengths on the numbers of birds harvested (Section 2).

Sound management practices cannot be initiated based on human surveys only; ecological studies of the targeted species are also needed. In a study of this type it would be impossible, and

highly foolish, to attempt an ecological study of all concerned target species. Therefore, one species (Black Swan, Cygnus atratus) was pinpointed as the study species.

The black swan was chosen because it is the only gamebird in North Canterbury whose status has changed from gamebird to protected species and then returned to gamebird. It is the subject of much controversy in regard to damage of the lake weed beds and to depredation on farmers' grazing lands during times of food shortage. The swan population in North Canterbury has suffered severe population fluctuations and has had no recent productivity studies done on it. An intense productivity study was carried out and the implications of its findings related to the findings from the previous analyses for the purpose of future black swan management (Section 3).

1.1 INTRODUCTION

Wildlife management has been defined by Giles (1978) as "the science of decision making in order to manipulate the structure, dynamics, and relations of wildlife populations, habitats, and people to achieve specific human objectives through the wildlife resource". (In order) to be effective, wildlife managers must have some understanding of wildlife-people interactions. Questionnaires may be used to obtain data relevant to these interactions. Surveys of this type can help discover the attitudes, preferences, satisfactions, and motivations of the wildlife users and, as such, can be used in resolving specific management problems (Filion 1980).

To this end, a questionnaire was designed (Appendix 1) and sent to randomly selected gamebird licence holders in the North Canterbury Acclimatisation Society (hereafter referred to as NCAS). The aim of this questionnaire was to gather information about gamebird hunting in the North Canterbury District. Cheyne (1979) used a similar type of questionnaire for the Whangamarino Swamp, but due to its inherent specialized purpose, comparisons with his study were deemed inappropriate. The only other detailed survey comparable to the one discussed here, was done by Ian Buchanan in 1984 for the Wellington Acclimatisation District (Buchanan 1985), and, where identical questions were used, the responses from these two questionnaires have been compared.

1.2 MATERIALS AND METHODS

In October 1985 the questionnaire was drafted and mailed, along with a self-addressed, stamped envelope, to 800 semi-randomly selected NCAS gamebird licence holders. The questionnaire consisted of nine sections: Demography; Species Hunted and Hunter Preference; Grey Teal; Hunting Pressure; Canada Goose Hunting Seasons; Hunting Methods; Hunting Expenditures; Management Policies; and Additional Comments.

The receipents of a questionnaire were selected from the gamebird licence sales tabs kept at the NCAS in Christchurch. The method used was to select every third licence holder from books of licence butts chosen at random. This was continued until 800 addresses were accumulated. The questionnaires were analysed using the BMDP Statistical Software Package on the Burroughs b6900 computer.

1.3 RESULTS

1.3.1 Returns

The 800 hunters surveyed represented 35.6% of the total 2246 gamebird licence holders in the NCAS District for 1985. A total of 420 questionnaires were returned; however, 8 of these were unuseable (i.e. address unknown, etc.), thus a useable total of 412 or 51.5% of the questionnaires were returned and analysed in this study. Overall, 18.3% of the total number of 1985 licenced hunters are represented in this analysis.

1.3.2 Hunter Demography

The aim of this section was to obtain background information on the gamebird hunters, i.e. age, salary, etc.

Of the 412 respondents, there were 409 male and 3 female. The majority of the respondents were between the ages of 21 and 30 (Fig. 1.1). Over 85% of the hunters had an income in excess of $10 000 (Fig. 1.2). Table 1.1 gives the income levels for each age group.

Most of the hunters (48.1%) have held a licence for 10 or fewer years, while only 24.3% have held a licence for 11 to 20 years, and 27.6% have held a licence for more than 20 years. Over 95% of the hunters have never hunted on their own property and, of the remainder, 2.4% hunted on their own property for 1 year, 0.5% for 2 years; 0.7% for 3 years; and 0.7% for 4 years.

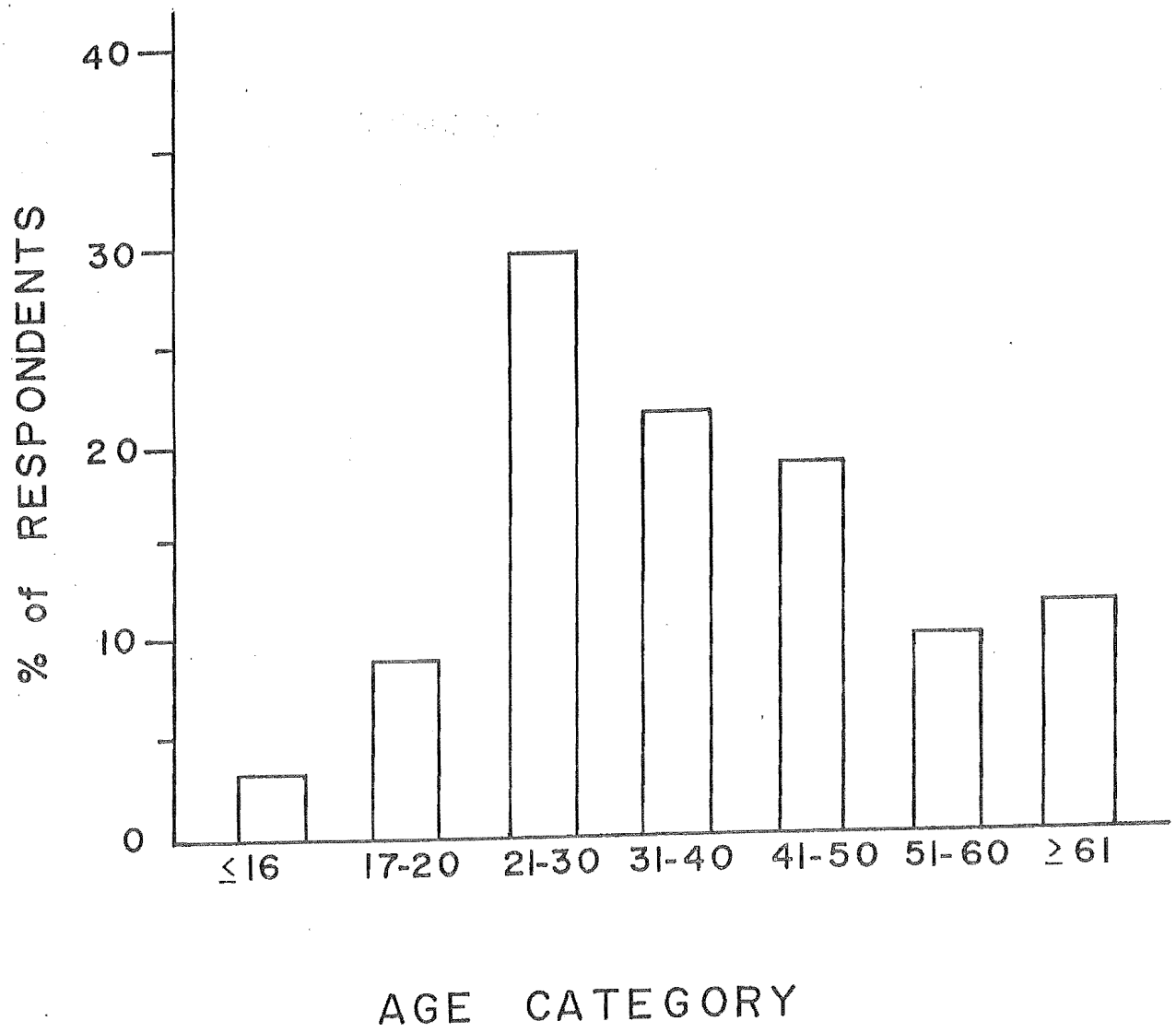

Fig. 1.1 Percentage of respondents in each age category.

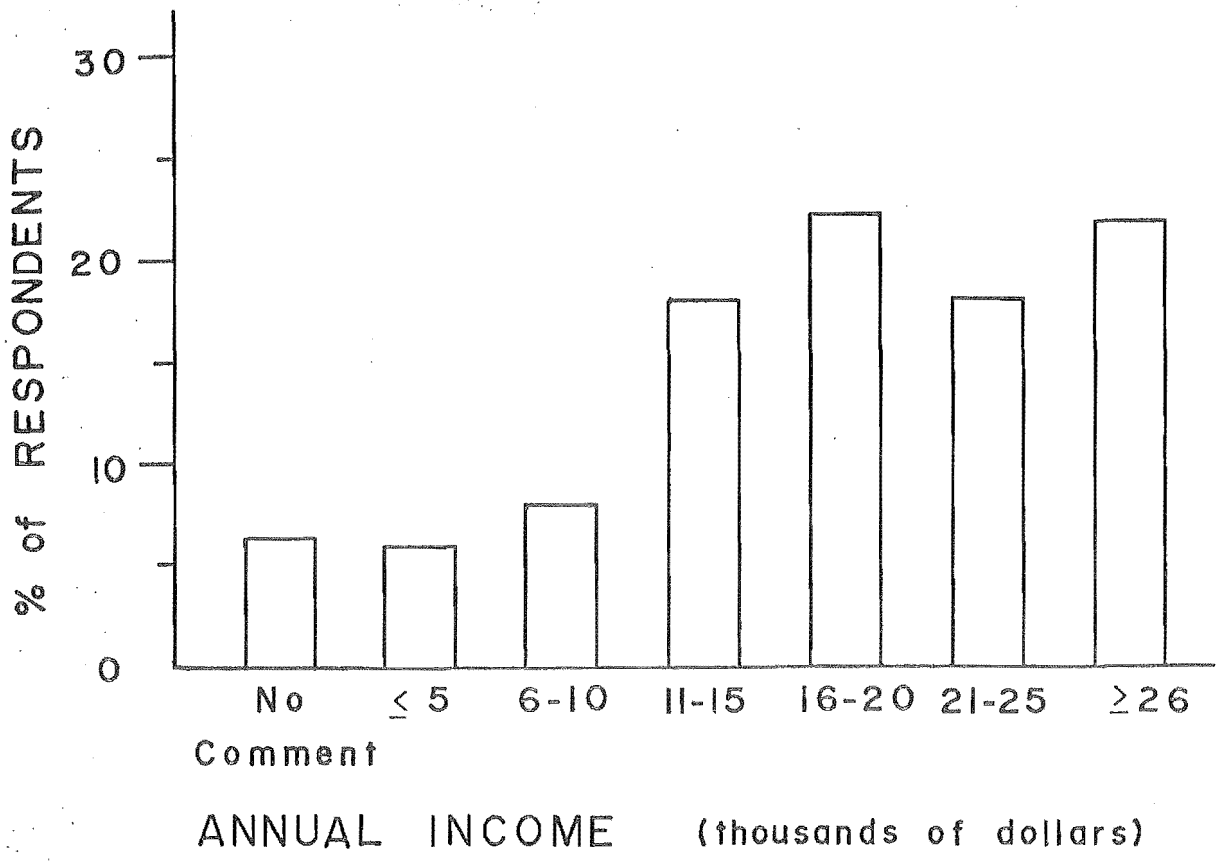

Fig. 1.2 Percentage of respondents in each income bracket.

Table 1.1. Percentage of respondents in each age category for each income bracket.

INCOME	AGE						
	≤16	17-20	21-30	31-40	41-50	51-60	>60
≤5000	75%	26.5%	6.7%	-	-	2.7%	3.2%
5001-10000	12.5%	32.4%	1.7%	2.4%	4%	2.7%	45.2%
10001-15000	-	26.5%	26.9%	14.5%	8.1%	18.9%	19.3%
15001-20000	-	-	33.6%	21.7%	25.7%	24.3%	6.5%
20001-25000	-	11.7%	21%	26.5%	23%	21.6%	6.5%
>25000	12.5%	2.9%	10.1%	34.9%	39.2%	29.8%	19.3%
Total respondents in each group	13	36	123	86	75	37	42

1.3.3 Species Hunted and Hunter Preference

The aim of this section was to discover the hunters' preference for various species because this is valuable information when assigning the amount of management effort which might be appropriate for each species.

The mallard (Anas platyrhynchos) was the most hunted species; 98.1% of the hunters replied that they hunted it. The second most hunted species was grey duck (Anas superciliosa) and the third was Canada goose (Branta canadensis). The chukor (Alectoris chukar) was the least hunted species, followed closely by pukeko (Porphyrio melanotus). In general, more respondents hunted each of the waterfowl species than the upland game species (Fig. 1.3).

Preference was first determined by assessing only the rankings of #1 (most preferred) given to each species. By this method, mallard was the most preferred species to hunt, with 48.7% of the hunters ranking it first. The second most preferred species was Canada goose with 23.2% ranking it first. The black swan (Cygnus atratus), pukeko, and chukor were all least preferred species with only 0.8% of the hunters ranking them first (Fig. 1.4).

In the same manner, the least preferred species were determined by assessing only the rankings of #10 (least preferred) given to each species. By this method, the chukor was the least favoured species to hunt with 19.8% of the respondents ranking it tenth. The pukeko was next with 18.3% ranking it tenth (Fig. 1.5).

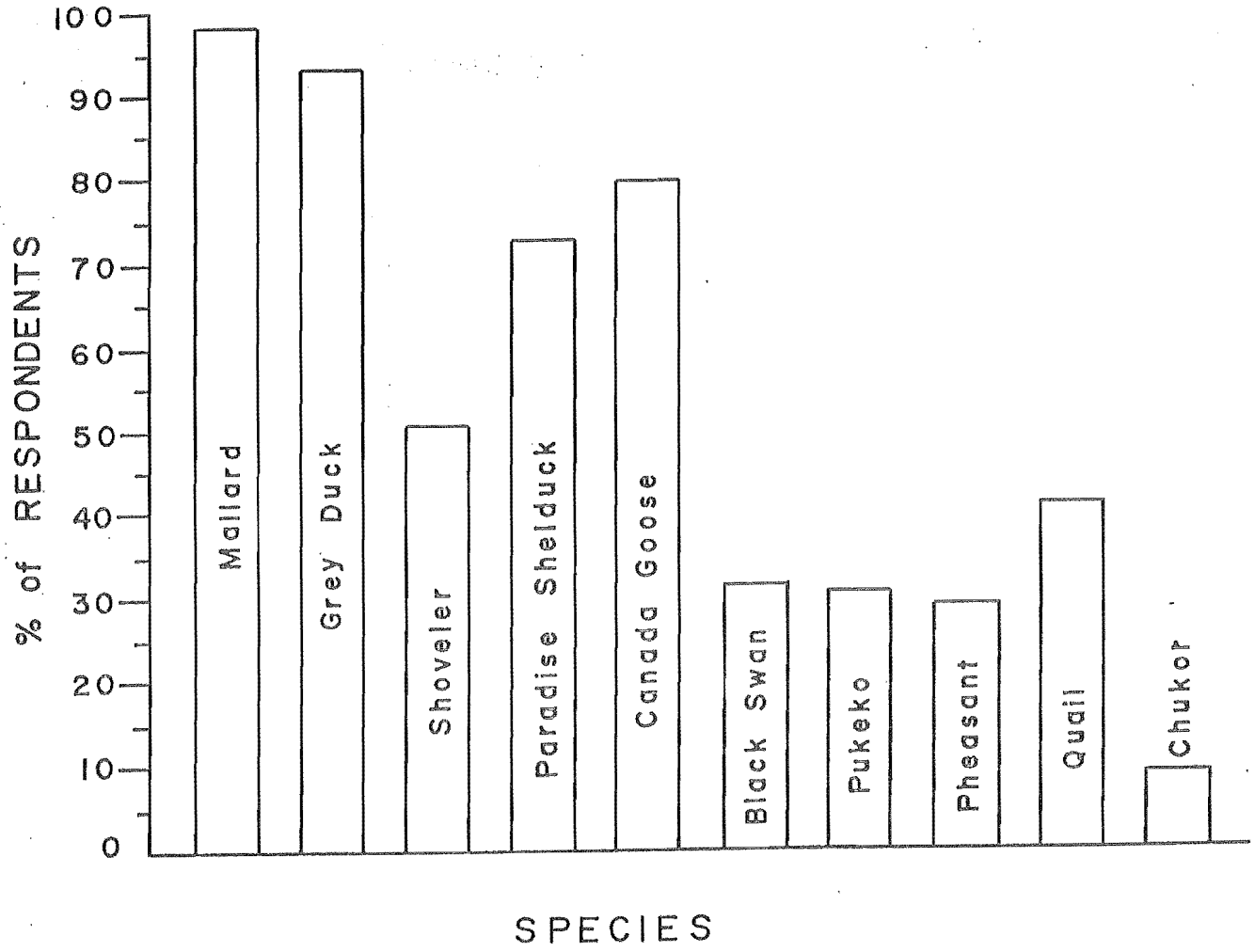

Fig. 1.3 Percentage of respondents who hunt each species.

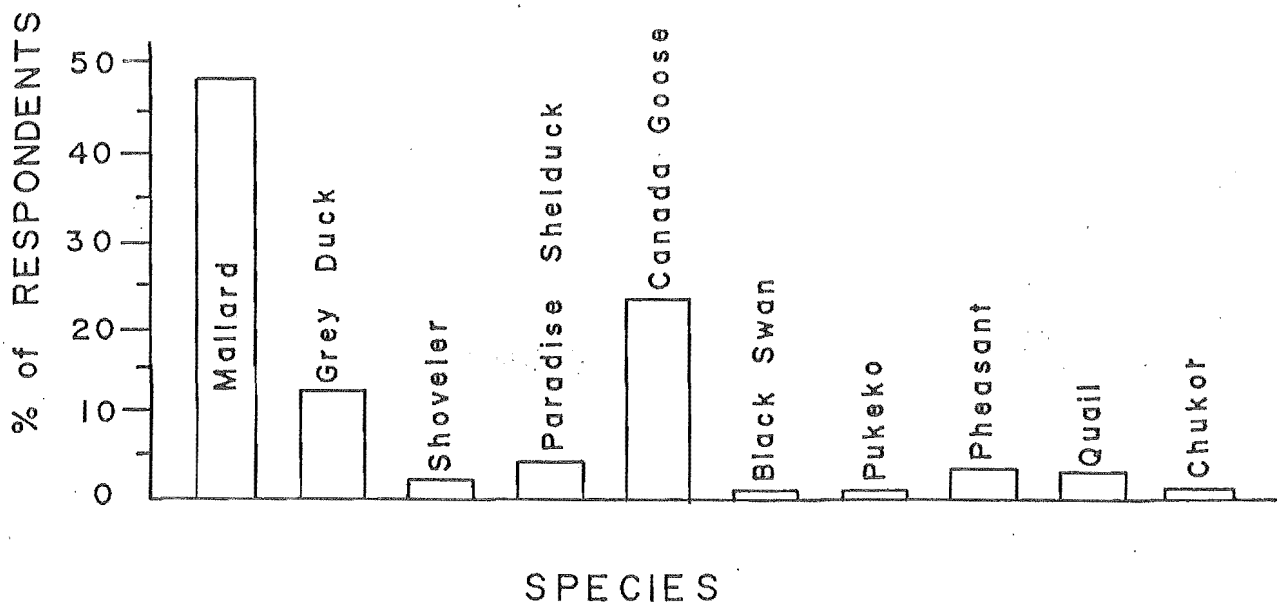

Fig. 1.4 Percentage of respondents who ranked a species as #1, most preferred.

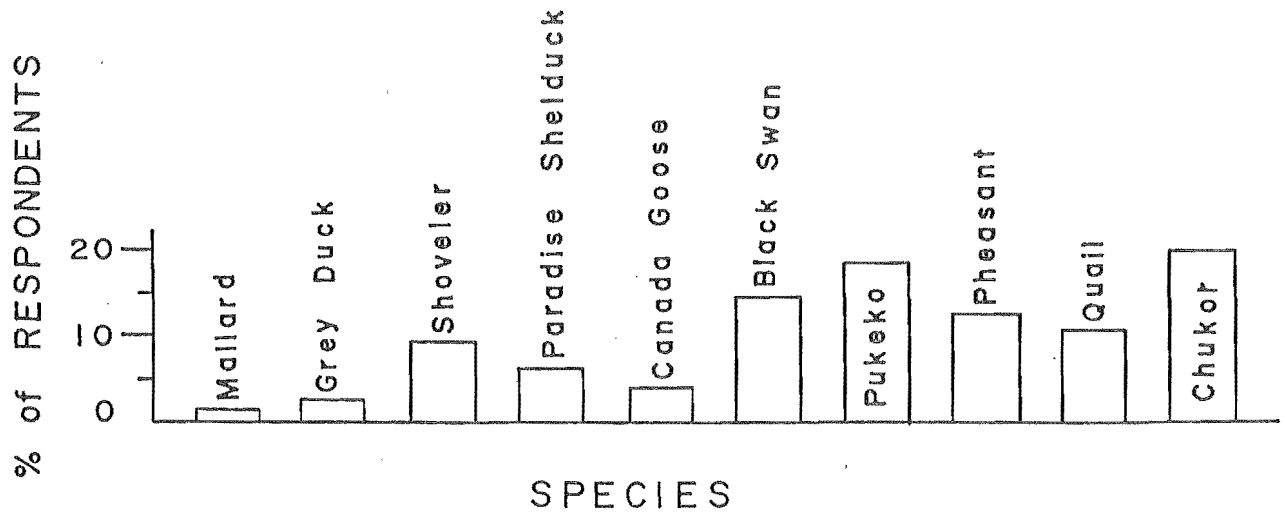

Fig. 1.5 Percentage of respondents who ranked a species #10, least preferred.

To test the validity of this method, all preference rankings for each species were analysed through an independent variable analysis, in order to determine the overall most and least preferred species. In this method a ranking of #1 equalled 9; #2 equalled 8; #3 equalled 7; etc. and ended at #10 equalling 0.

Thus, the species with the highest score would be most preferred and the species with the lowest score would be the least preferred. These results vary substantially from the first method (Table 1.2) and are considered a more valid assessment of the hunters' true species preference, as they incorporate all rankings for each species, not just the top and bottom. Table 1.3 compares the results of the two methods.

A stepwise discriminant analysis was used to discover which species were preferred by each age group. The rankings for each species were encoded in the same manner as above, with the results being split into their respective age classes. Table 1.4 gives the results of this analysis.

The reasons for a hunter ranking any species as most or least preferred were also evaluated. The most important reason for ranking any species as most preferred was "hunting challenge", with almost twice as many hunters considering it more important than any other reason (Fig. 1.6). Mallard, grey duck, and Canada goose were considered the three most preferred species, and the hunters' reasons for this preference are given in Figure 1.7a-c. Table 1.5 gives the percentage of hunters for the reason which they considered was the most important factor in ranking any species as first.

Table 1.2. Means, standard deviations and subsequent preference ranking of all species.

Species	Mean	Rank
Mallard	8.05 ± 1.87	1
Grey Duck	6.81 ± 2.28	2
Shoveler	3.63 ± 2.69	5
Paradise Duck	4.57 ± 2.73	4
Canada Goose	6.22 ± 2.81	3
Black Swan	1.87 ± 2.07	8
Pukeko	1.59 ± 2.07	9
Pheasant	2.84 ± 2.70	7
Quail	3.06 ± 2.69	6
Chukor	1.24 ± 1.87	10

Table 1.3. Comparison of the preference ranking results from independent analysis and #1 ranking methods.

SPECIES	PREFERENCE RANKING: INDEPENDENT ANALYSIS METHOD	PREFERENCE RANKING: #1 RANKING METHOD
Mallard	First	First
Grey Duck	Second	Third
Shoveler	Fifth	Seventh
Paradise Shelduck	Fourth	Fourth
Canada Goose	Third	Second
Black Swan	Eighth	Eighth
Pukeko	Ninth	Ninth
Pheasant	Seventh	Fifth
Quail	Sixth	Sixth
Chukor	Tenth	Tenth

Table 14. Stepwise discriminant analysis means ± standard deviations and overall preference of each species for each age group.

Species	AGE GROUPS						
	<16	17-20	21-30	31-40	41-50	51-60	>60
Mallard	7.31±2.66 1	8.00±2.11 1	7.91±2.13 1	8.22±1.79 1	8.23±1.30 1	7.89±2.02 1	8.19±1.55 1
Grey Duck	6.77±2.55 2	6.14±2.79 2	6.73±2.34 2	6.81±2.18 2	6.76±2.15 3	7.30±1.97 2	7.29±2.23 2
Shoveler	3.15±2.54 7	2.81±2.64 7	3.67±2.65 5	4.23±2.69 5	3.57±2.48 6	3.08±2.49 5	3.69±3.28 5
Paradise Shelduck	5.08±3.20 4	4.86±2.85 4	4.72±2.70 4	4.69±2.63 4	4.20±2.58 4	4.35±2.67 4	4.33±3.14 4
Canada Goose	6.15±2.88 3	5.03±3.56 3	6.38±2.56 3	6.35±2.48 3	6.77±2.57 2	6.35±3.12 3	5.40±3.21 3
Black Swan	1.46±1.85 9	1.81±2.16 9	1.84±1.88 8	2.05±2.11 8	1.89±2.13 9	2.16±2.35 7	1.48±2.21 8
Pukeko	1.85±1.72 8	2.69±2.44 8	1.46±1.93 9	1.55±2.25 9	1.39±1.77 10	1.62±1.98 9	1.40±2.23 9
Pheasant	3.46±3.26 6	2.92±2.99 6	3.50±2.72 6	2.56±2.66 6	2.84±2.56 7	2.03±2.28 8	1.90±2.25 7
Quail	3.92±2.66 5	2.94±2.89 5	3.38±2.74 7	2.45±2.31 7	3.64±2.60 5	2.32±2.54 6	2.76±3.07 6
Chukor	1.23±1.79 10	1.03±1.92 10	0.93±1.36 10	1.38±2.09 10	1.91±2.21 8	0.78±1.06 10	1.21±2.30 10

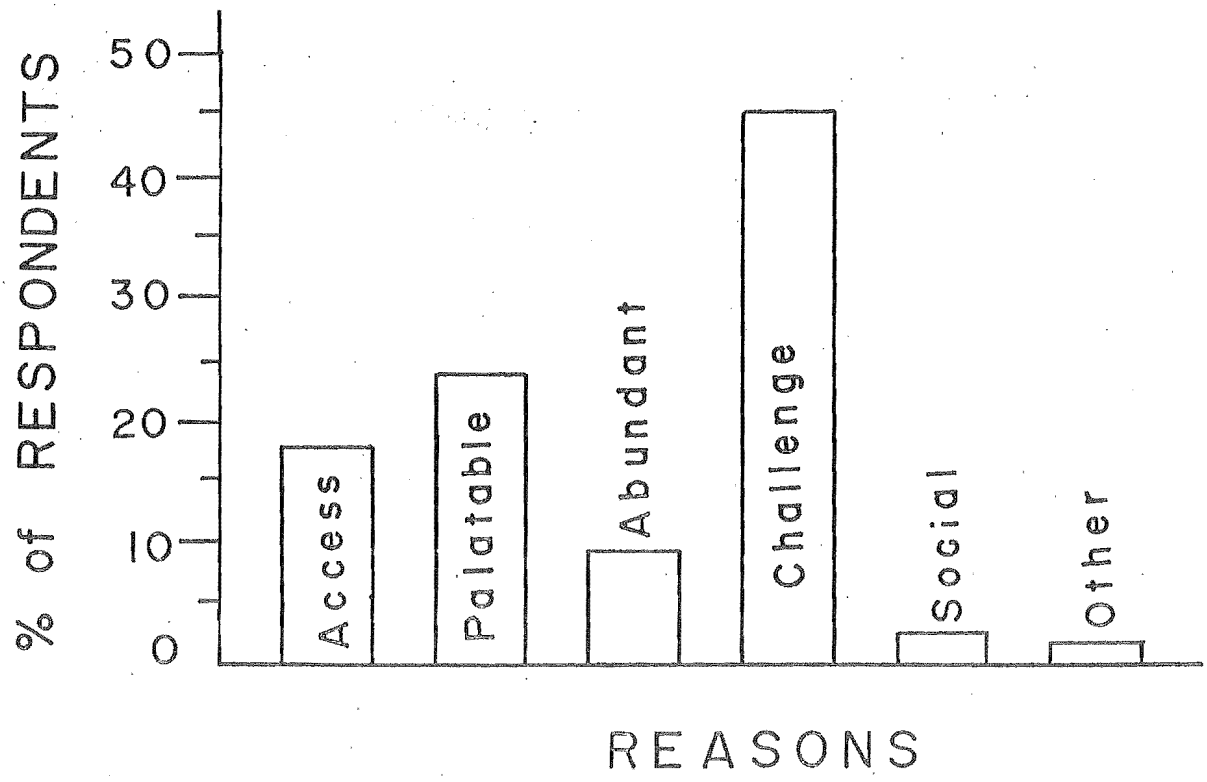

Fig. 1.6 Percentage of respondents who ranked a reason as #1, most important, for hunting their preferred species.

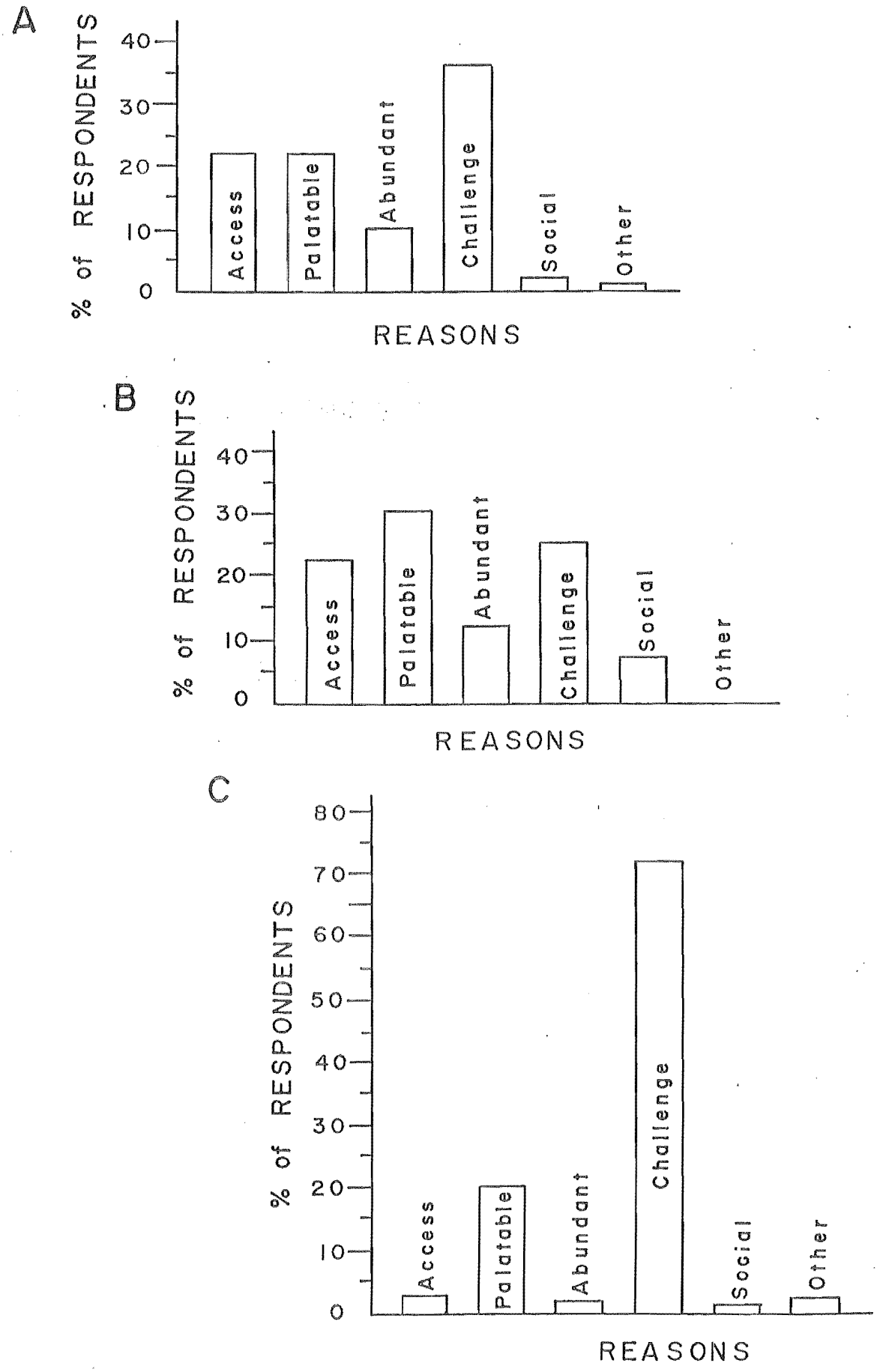

Fig 1.7A, B, & C Percentage of #1 rankings of reasons for preferring to hunt:

A - Mallard

B - Grey Duck

C - Canada Goose.

Table 1.5. Percentage of #1 rankings of all respondents for their species preference.

SPECIES	REASONS					
	Access	Taste	Abundance	Challenge	Social	Other
Mallard	12%	12%	5.4%	18.1%	1%	0.5%
Grey Duck	2.3%	3%	1%	2.5%	0.7%	-
Shoveler	0.5%	0.3%	0.3%	0.7%	-	-
Paradise Duck	0.7%	1.5%	0.7%	0.9%	0.3%	-
Canada Goose	0.7%	0.5%	0.5%	18.1%	0.3%	0.5%
Black Swan	0.5%	0.3%	0.3%	0.5%	-	-
Pukeko	0.3%	0.3%	0.5%	0.3%	-	0.3%
Pheasant	0.5%	1%	0.5%	0.9%	-	-
Quail	0.3%	-	0.3%	2.3%	0.3%	-
Chukor	-	0.3%	-	0.7%	-	-

Scarcity and unpalatability were the most important reasons for ranking any species as least preferred (Fig. 1.8). The three least preferred species were black swan, pukeko, and chukor, and the reasons given for each are seen in Figure 1.9 a-c. Table 1.6 gives the percentage of hunters for the reason they felt was the most important factor in considering any species as least preferred.

1.3.4 Grey Teal

The aim of this section was to determine the hunters' attitude to the issue of allowing hunting of grey teal.

Just over 63% of the hunters did not regularly see grey teal, and only 34% had accidently shot them. Overall, the vast majority of the respondents did not want to see the grey teal on their hunting licence (Fig. 1.10).

1.3.5 Hunting Pressure

The aim of this section was to determine where the majority of the hunters' effort is located--in terms of days spent hunting; areas hunted; and species hunted.

Hunting pressure was first assessed in terms of days spent hunting either wetland or upland gamebirds. Table 1.7 gives the percentage of hunters who pursue the birds for varying periods of time. In order to determine from which age group the majority of the hunting pressure came, the number of days spent hunting was compared between age groups (Table 1.8).

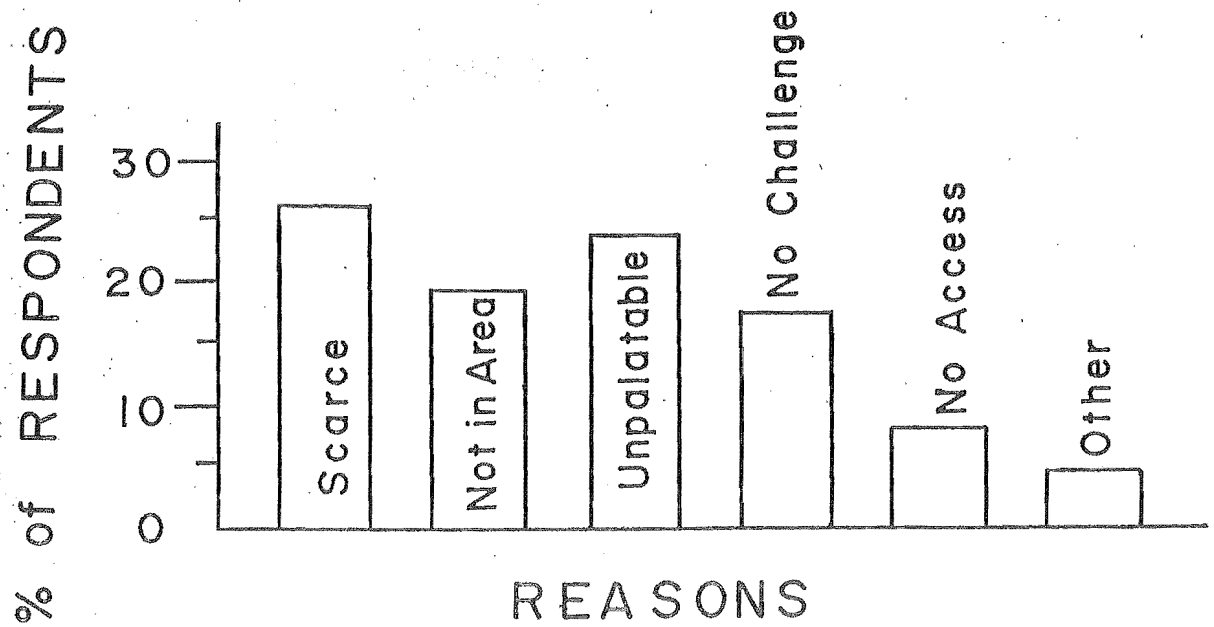

Fig. 1.8 Percentage of respondents who ranked a reason as #1, most important, for not hunting their least preferred species.

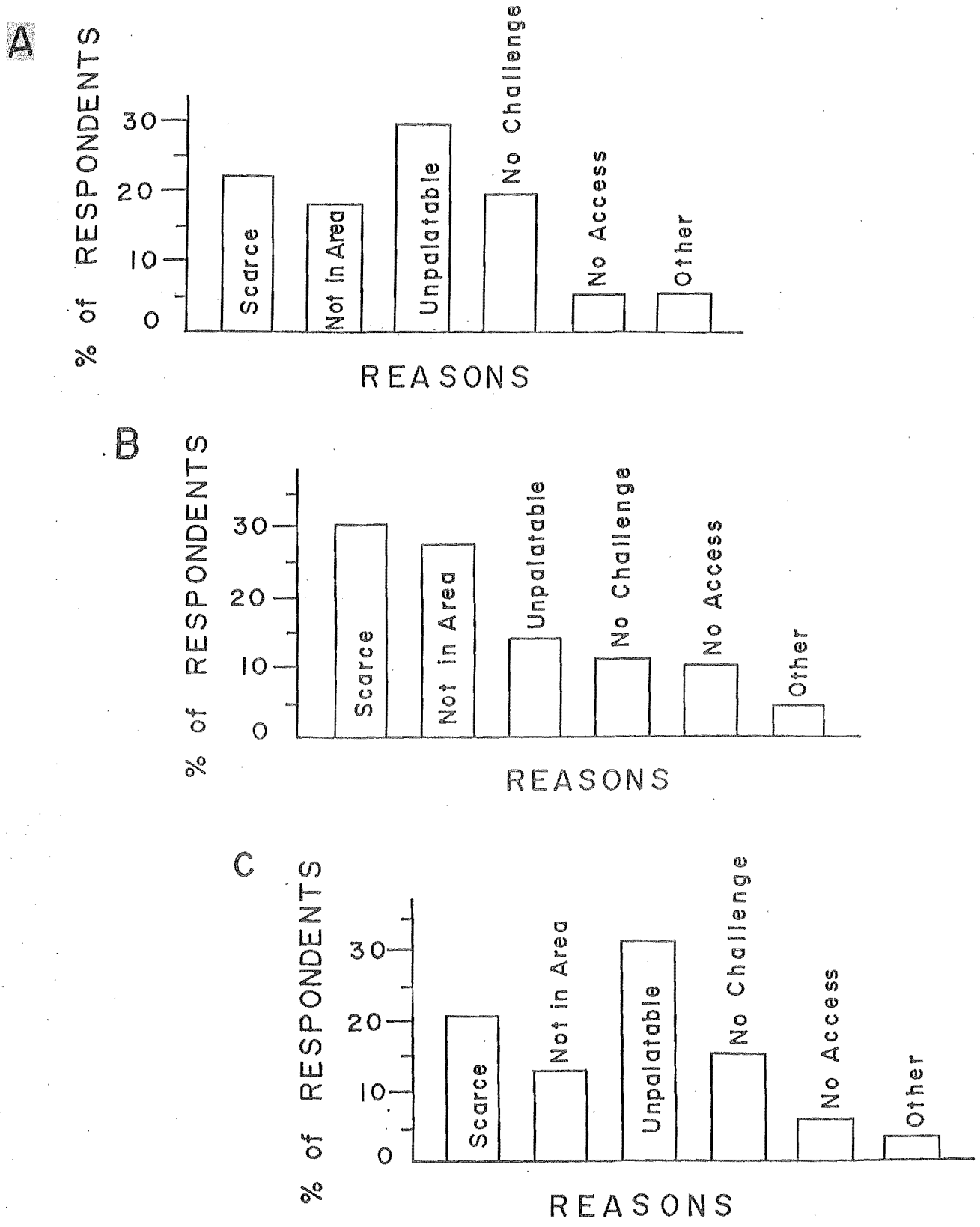

Fig. 1.9 A, B, & C Percentage of #1 rankings of reasons for not hunting:

A - Black Swan

B - Pukeko

C - Chukor.

Table 1.6. Percentage of #1 rankings of all respondents for their species non-preference.

SPECIES	REASONS					
	No.s Scarce	Not in Area	Unpalatable	No Challenge	No Access	Other
Mallard	0.4%	-	-	0.1%	0.1%	0.1%
Grey Duck	0.7%	0.1%	0.4%	0.1%	0.4%	-
Shoveler	2.6%	1:5%	1.9%	0.9%	0.7%	0.4%
Paradise Duck	1.2%	0.9%	1.8%	0.9%	0.3%	0.1%
Canada Goose	0.6%	0.6%	1%	0.3%	0.1%	0.3%
Black Swan	3.5%	2.9%	4.7%	3.1%	0.9%	0.9%
Pukeko	4.5%	2.8%	6.7%	5.5%	1.4%	0.7%
Pheasant	4.1%	2.3%	2.3%	2%	0.9%	0.4%
Quail	2.5%	2.2%	1.9%	2.3%	0.7%	0.3%
Chukor	6.6%	6.1%	3.2%	2.5%	2.3%	1%

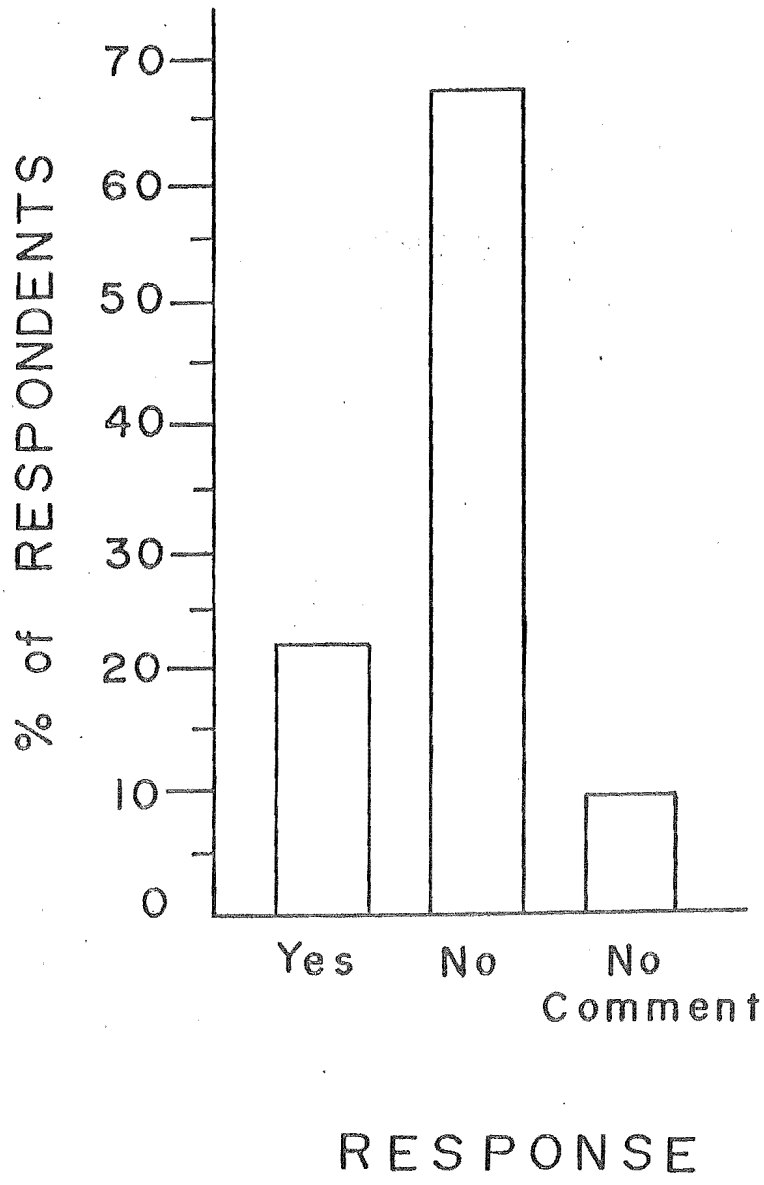

Fig. 1.10 Hunters' responses to question on licencing of Grey Teal.

Table 1.7. Percentage of respondents who hunt Wetland/Upland gamebirds for varying numbers of days.

Days Spent Hunting	Gamebirds	
	Wetland	Upland
0	2.4%	38.6%
1-5	16.5%	35.5%
6-10	25.5%	12.6%
11-15	15.8%	5.6%
16-20	13.6%	2.4%
<20	26.2%	5.3%

Table 1.8a. Percentage of respondents in each age group who hunt Wetland/ Upland gamebirds for varying numbers of days.

Age Groups	Wetland Gamebirds						Total % of those who hunt one or more days
	None	1-5	6-10	11-15	16-20	>20	
≤16	-	0.2%	0.7%	0.2%	0.5%	1.5%	3.1%
17-20	0.5%	1%	2.7%	1%	1.2%	2.4%	8.3%
21-30	0.2%	5.3%	6.3%	5.8%	3.6%	8.5%	29.5%
31-40	-	4.1%	5.3%	3.6%	2.9%	4.9%	20.8%
41-50	0.5%	2.9%	5.6%	2.2%	2.7%	4.4%	17.8%
51-60	0.5%	1%	1.9%	2.2%	0.7%	2.7%	8.5%
≥ 61	0.7%	1%	2.9%	0.7%	1.9%	1.9%	8.4%

Table 1.8b. Percentage of respondents in each age group who hunt Wetland/ Upland gamebirds for varying numbers of days.

Age Groups	None	1-5	6-10	11-15	16-20	>20	Total % of those who hunt one or more days
≤16	1%	0.7%	0.7%	0.2%	0.2%	0.2%	2%
17-20	2.4%	2.4%	2.4%	0.7%	-	0.7%	0.7%
21-30	10%	12.4%	3.4%	1.2%	1%	1.9%	19.9%
31-40	8.3%	7.5%	2.7%	1.5%	0.5%	0.5%	12.7%
41-50	7%	7%	2.2%	0.5%	0.5%	1%	11.2%
51-60	4.1%	3.4%	0.2%	0.7%	-	0.5%	4.8%
≥61	5.8%	1.9%	1%	0.7%	0.2%	0.5%	4.3%

Of those 406 respondents who actively hunt wetland gamebirds, over 50% hunt on public lands. The same trend was seen in the 224 upland gamebird hunters (Fig. 1.11). Over 79% of the wetland gamebird hunters drove less than 50 kms to their usual hunting area, while over 60% of the upland gamebird hunters drove less than 50 kms (Fig. 1.12).

Many more hunting trips were made for wetland gamebirds than for upland gamebirds. Over half of the upland gamebird hunters made 5 or fewer trips in the 1985 season, while over 60% of the wetland gamebird hunters made between 6 and 20 hunting trips in 1985 (Table 1.9).

68% of the hunters responded that they hunted away from their usual area, while 29.8% replied that they never hunted away from their usual area; the remaining 2.2% had no comment on this section. Of those who hunted away from their usual area, 58.1% stayed within North Canterbury, while 17.2% went outside North Canterbury, and the remaining 24.7% hunted both within and outside the North Canterbury District.

Those hunters staying within the North Canterbury borders usually did not travel further than 100 kms one way (63.5%), while 35.1% travelled between 100 and 200 kms, and only 1.4% travelled over 200 kms. As expected, those hunting outside of North Canterbury travelled much further: 40.5% travelled less than 200 kms; 33.7% travelled between 200 and 400 kms; 18.2% travelled between 400 and 600 kms; and 7.6% travelled over 600 kms.

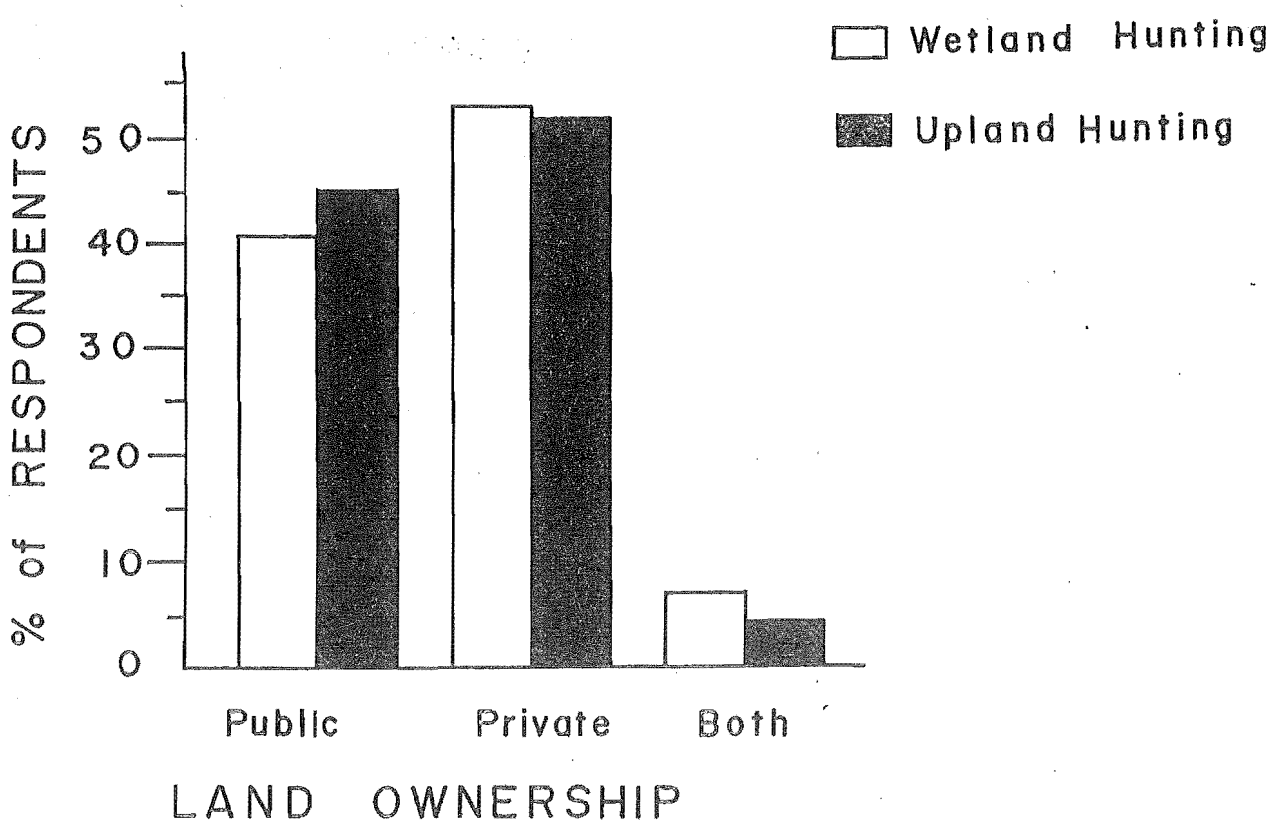

Fig. 1.11 Percentage of respondents who hunt either wetland or upland gamebirds on public and/or private lands.

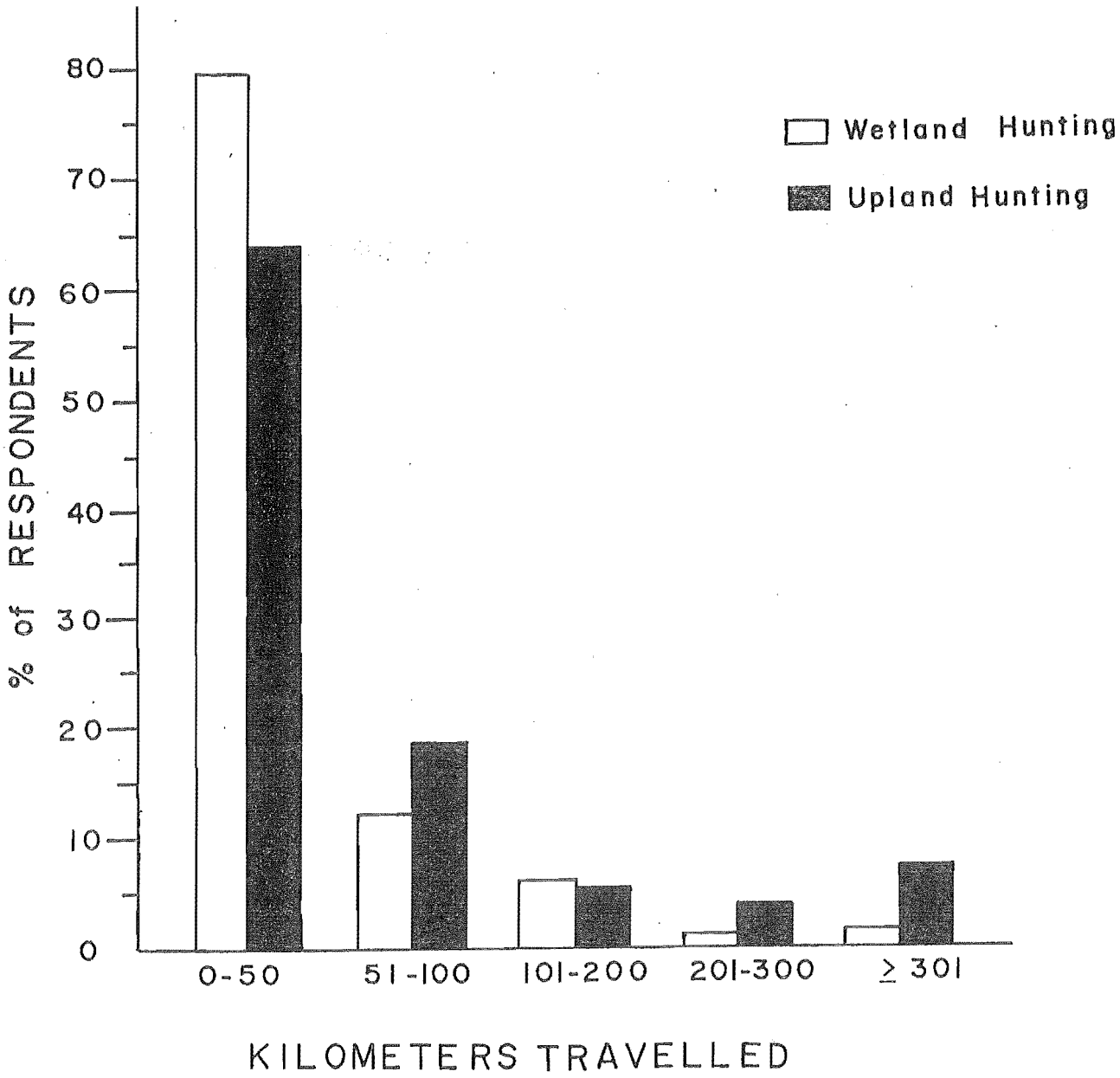

Fig. 1.12 Distances travelled by wetland and upland gamebird hunters.

Table 1.9. Percentage of hunters who made varying numbers of hunting trips for Wetland/Upland gamebirds.

Number of hunting trips	Game Birds	
	Wetland	Upland
0	7.1%	54.1%
1-5	14.8%	29.6%
6-10	28.6%	12.4%
11-20	33%	2.4%
over 20	16.5%	1.5%

The two most popular birds to hunt when going away from the usual hunting area were the mallard and Canada goose, with the grey duck and paradise shelduck (Tadorna variegata) close behind (Fig. 1.13).

1.3.6 Canada Goose Hunting Seasons

This section was designed to discover the hunters' use of the four Canada goose hunting seasons in North Canterbury.

Generally, more hunters utilized the low country goose seasons (Fig. 1.14), and Table 1.10 gives the percentage of hunters in each age group who hunt during the different goose seasons. The majority of the respondents hunted during more than one of the seasons; however, greater use of the more accessible low country can be seen in almost every age group.

Figure 1.15 shows the number of years hunters have hunted the various Canada goose seasons. The number of hunting trips made during each season was also examined, and figure 1.16 gives the number of trips made to both the high and low country. In order to determine which age group was using the high and low country seasons most, the number of trips that each age group made to an area was found. These results are given in Table 1.11.

Over four times as many hunters felt that the extended seasons increased their chances of bagging a goose (71.4%) than either those who didn't feel chances were increased (16.3%) or had no comment (12.4%).

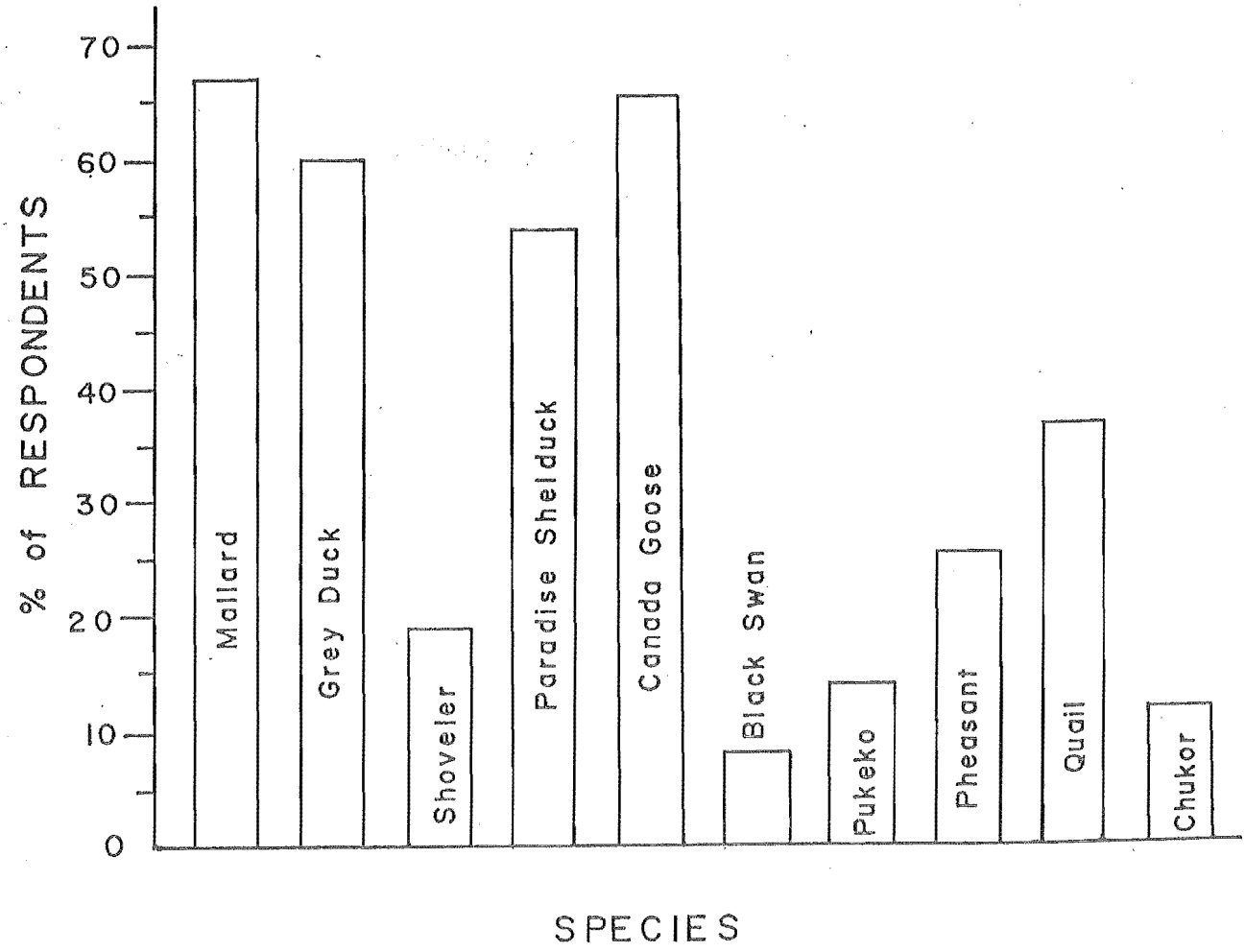

Fig. 1.13 Percentage of hunters who hunt each species when they travel away from their usual area.

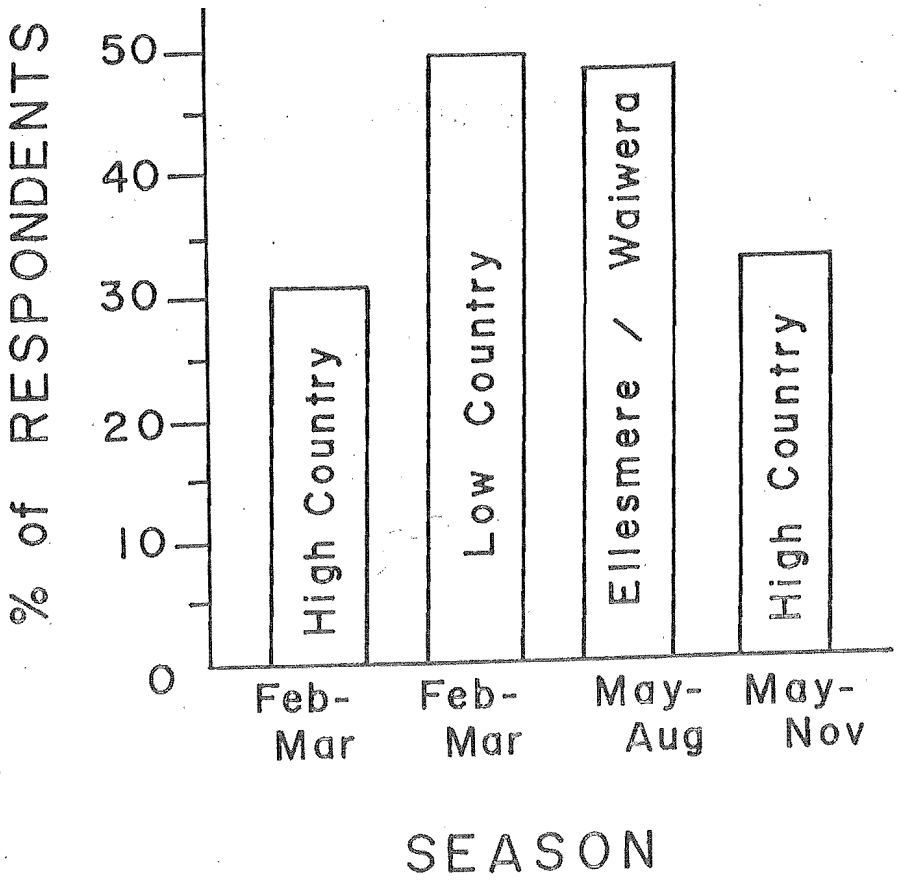

Fig. 1.14 Percentage of respondents who hunt during the special Canada Goose seasons.

Table 1.10. Percentage of hunters in each age group who hunt during the different Special Goose Seasons.

SPECIAL GOOSE SEASONS	AGE GROUPS						
	≤16	17-20	21-30	31-40	41-50	51-60	≥60
Feb-Mar High Country	3.2%	7.2%	32.5%	18.3%	23%	7.9%	7.9%
Feb-Mar Low Country	1.5%	7.3%	34.1%	21%	19.5%	7.8%	8.8%
May-Aug Low Country Ellesmere & Waiwera	2%	8.4%	29.9%	21.4%	18.9%	9%	10.4%
May-Nov High Country	3.7%	7.4%	31.9%	17.8%	24.4%	7.4%	7.4%

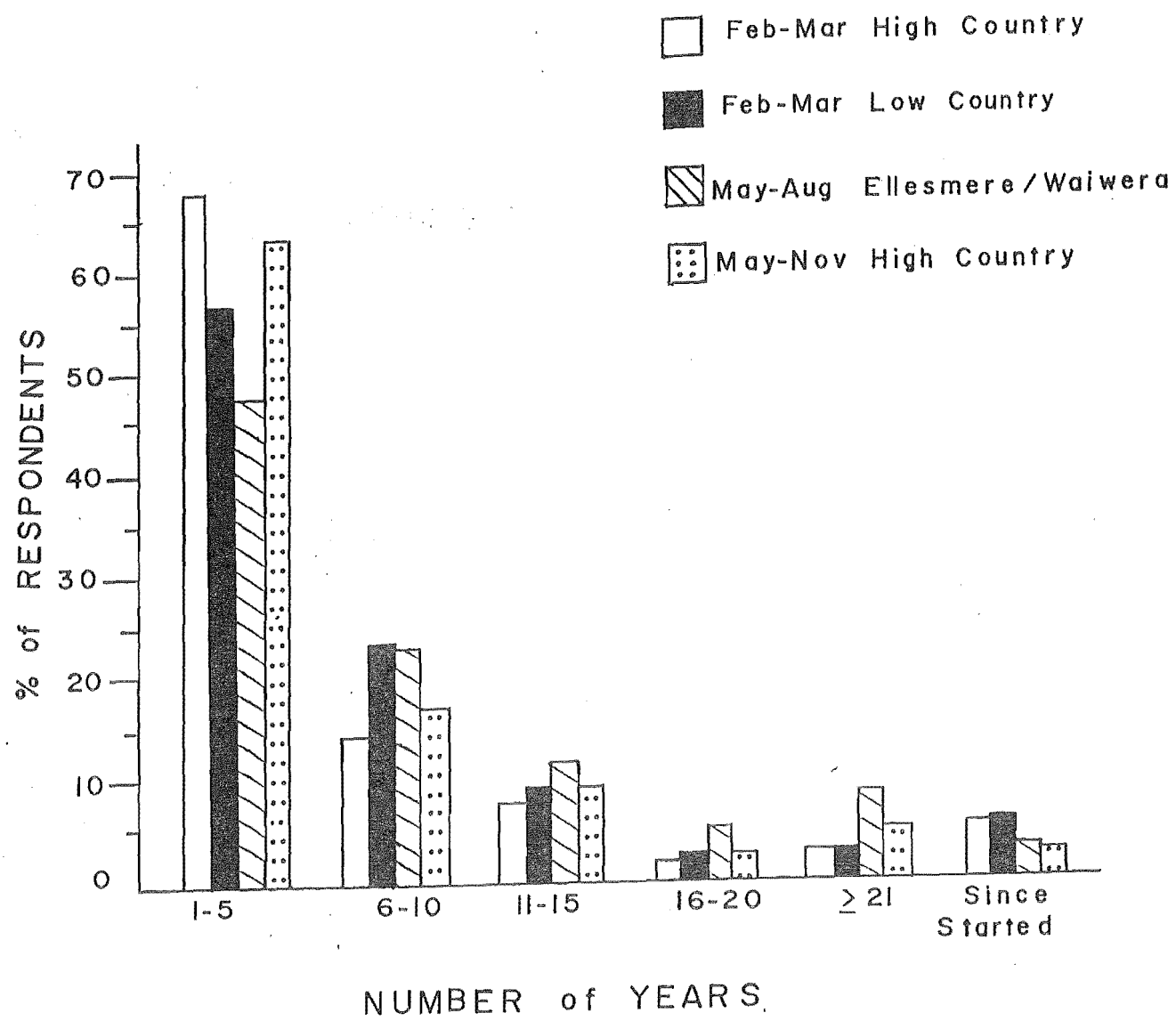

Fig. 1.15 Number of years respondents have hunted various Canada Goose seasons.

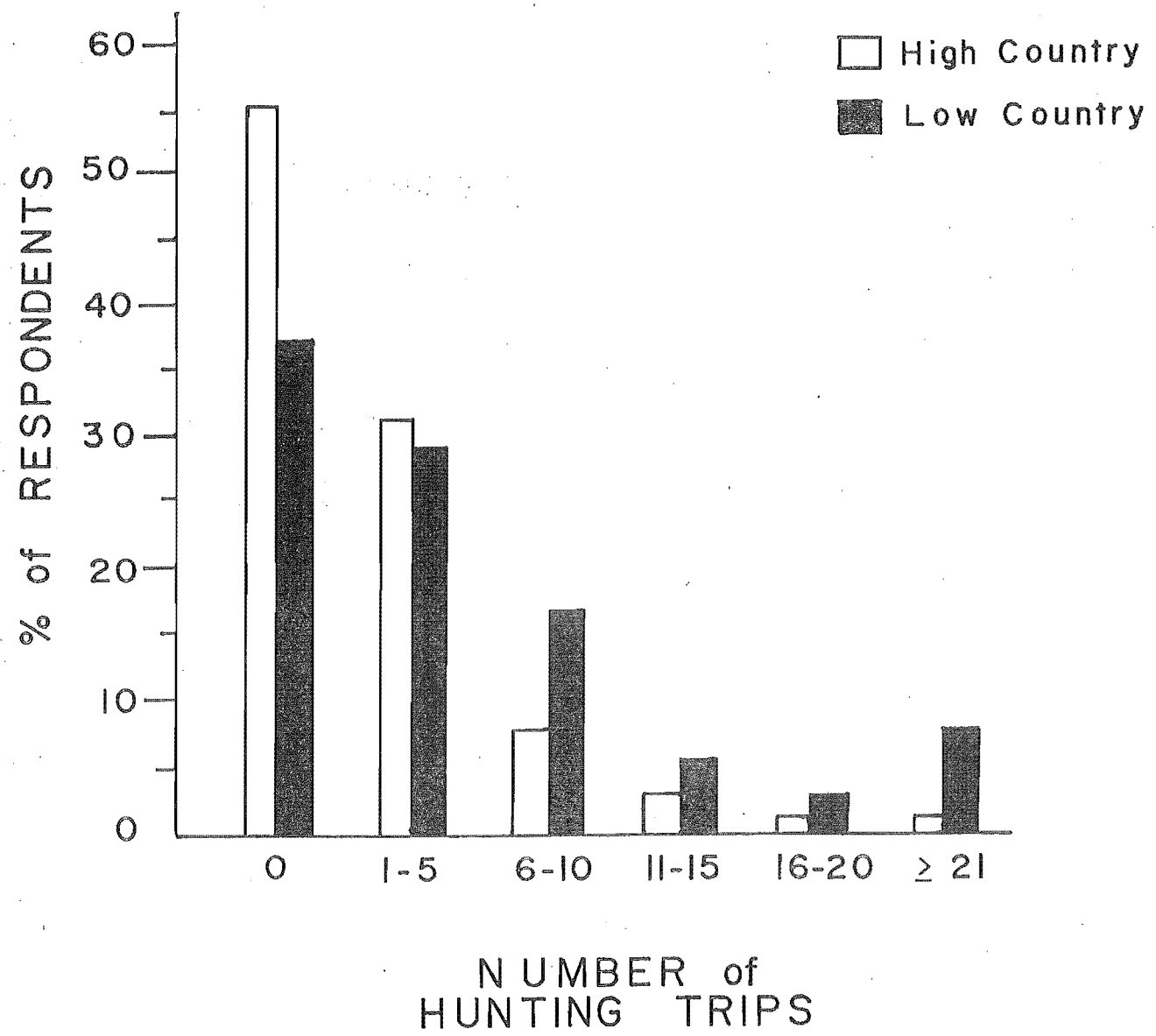

Fig. 1.16 Number of hunting trips to high and low country made by Canada Goose shooters.

Table 1.11a. Percentage of respondents in each age group who take varying numbers of goose hunting trips in the High and Low country.

Age Groups	High Country Trips					
	None	1-5	6-10	11-15	16-20	>20
≤16	1.7%	1%	0.2%	-	0.2%	-
17-20	4.6%	2.7%	1%	0.2%	-	0.2%
21 30	14.8%	11.4%	2.7%	0.2%	0.2%	0.5%
31-40	12.9%	5.1%	1.5%	1.2%	0.2%	-
41-50	8%	7.8%	1.5%	0.7%	0.2%	-
51-60	5.8%	1.9%	0.7%	0.5%	-	-
≥61	7.8%	1.7%	0.5%	-	-	0.2%

Table 1.11b. Percentages of respondents in each age group who take varying numbers of goose hunting trips in the High and Low country.

	Low Country Trips					
Age Groups	None	1-5	6-10	11-15	16-20	>20
≤16	1.9%	1%	-	-	0.2%	-
17-20	3.4%	2.2%	1%	0.7%	0.2%	1.2%
21-30	8.5%	9.5%	6.1%	1.7%	1.5%	2.7%
31-40	8.7%	6.1%	4.6%	0.5%	-	1%
41-50	6.6%	5.6%	3.9%	0.5%	0.7%	1%
51-60	3.4%	2.7%	1.2%	1%	-	0.7%
≥61	5.1%	2.7%	0.2%	1%	0.2%	1%

1.3.7 Hunting Methods

The aim of this section was to discover which kinds of hunting methods the hunters use most often.

Many of the hunters use a dog either all or some of the time, and well over half of them thought a dog made the hunt more successful (Fig. 1.17). The most popular method of hunting was in a mai mai, with 84% of the hunters responding that they used one (Fig. 1.18 and Table 1.12).

1.3.8 Hunting Expenditures

The aim of this section was to give a cursory overview of some of the expenses occurred by gamebird hunters.

The hunting expenses considered in this questionnaire were: Shotgun; Shells; Boat; Decoys; Dog; Mai Mai; Other; and Maintenance. The hunters were asked to give the replacement value of their equipment when possible.

The average value of a hunter's shotgun(s) was \$961.06 $\pm$ \$86.03. 42.7% of the hunters had a shotgun(s) worth \$500 or less, and 35.2% had a shotgun(s) valuing between \$500 and \$1000, with the remaining 22.1% valuing their gun(s) in excess of \$1000. The average cost of shells for the hunters was \$113.10 $\pm$ \$6.22. 39.3% of the hunters spent less than \$50 on shells for a year, while 31.1% spent between \$50 and \$100; 21.1% spent between \$100 and \$200; and 8.5% spent over \$200.

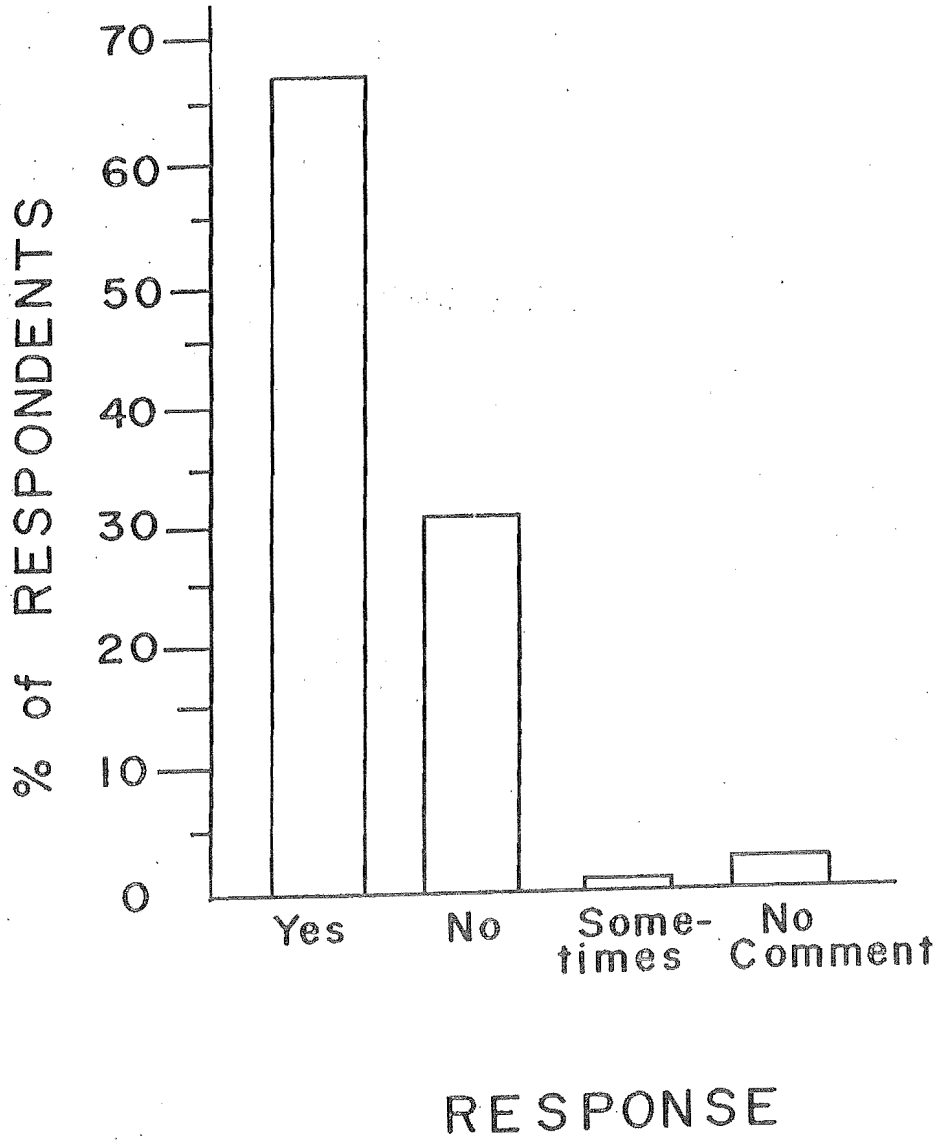

Fig. 1.17 Percentage of respondents who felt a dog made the hunt more successful.

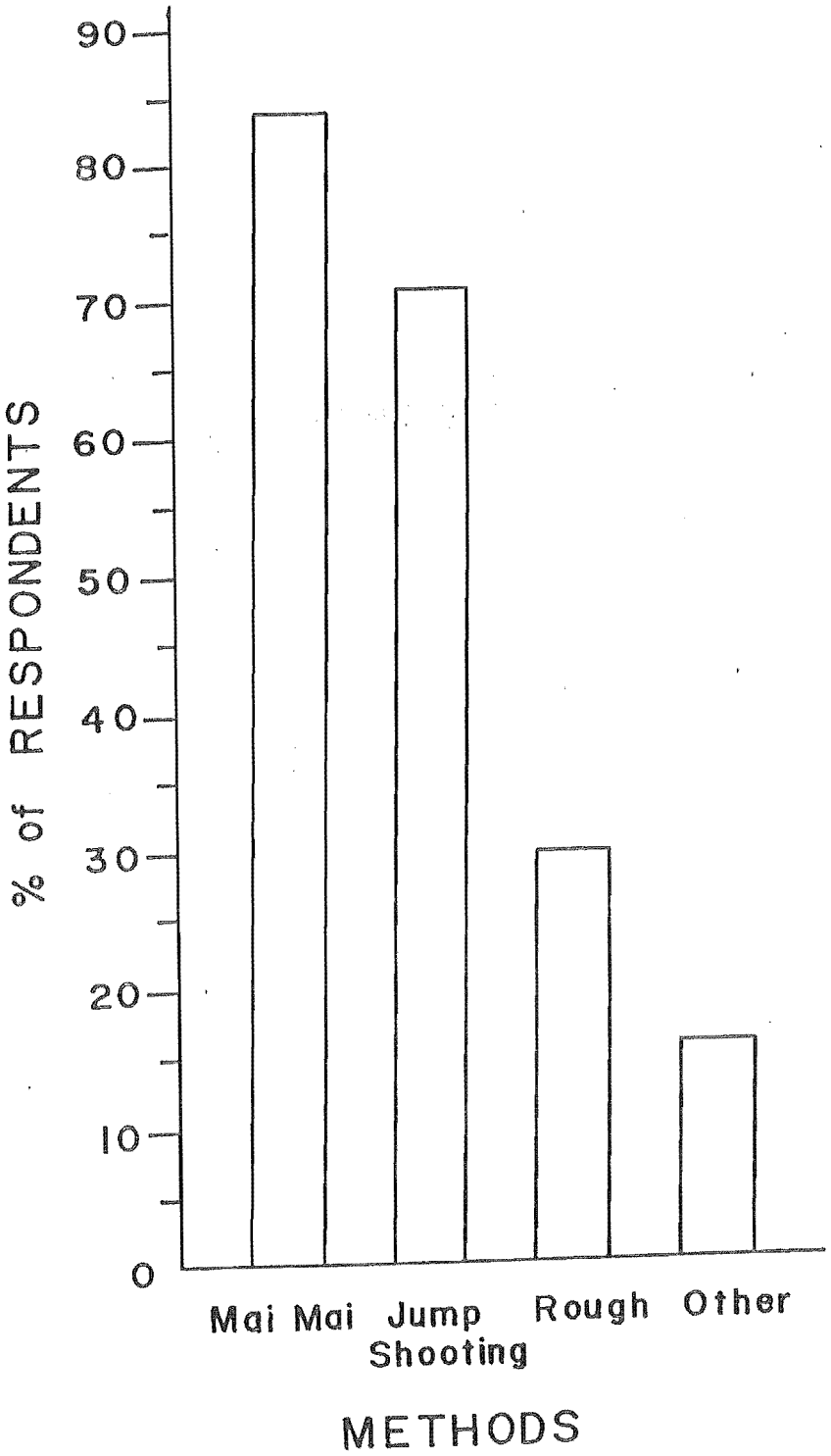

Fig. 1.18 Percentage of hunters who use each hunting method.

Table 1.12. Percentage of time hunters spend on each hunting method.

% of time spent	METHOD			
	Mai Mai	Jump Shooting	Rough Shooting	Other
0	16%	29.4%	70.6%	84.5%
1-25%	15%	25.2%	17%	9.5%
26-50%	18.9%	18%	4.6%	1.9%
51-75%	10.4%	6.1%	1.9%	1%
76-100%	24.1%	9.5%	1.4%	1.2%
Used but no specific % given	15.5%	11.9%	4.4%	1.9%

The majority (84.7%) of the hunters did not own a boat. Of the 63 respondents who did own a boat, the average value was $2,724.68. 47.6% had a boat which was worth less than $1000; 17.5% valued their boat between $1000 and $2000; 7.9% valued it between $2000 and $3000; and the remaining 27.9% had a boat worth in excess of $3000.

For the hunters who had them, the average cost of decoys was $124.31. 25% of the hunters responded that they did not own any decoys. Of those hunters who did have them, 65.1% valued their decoys at less than $100, while 22.3% valued them at between $100 and $200, and 12.6% valued them in excess of $200.

Most hunters who had a dog found it impossible to place a value on their "best friend". Therefore, the most common response was "priceless". However, of those who could place a value on their dog, 27.6% responded that it was worth under $100; 38.8% valued it between $100 and $200, and the remaining 33.6% gave a value in excess of $200.

The average cost for making a mai mai was $13.92 $\pm$ $1.70. Most mai mais (67.2%) cost nothing to construct, while 26.5% cost under $50, and only 6.3% cost in excess of $50. The average cost of other equipment (waders, clothing, etc.) was $233.63 $\pm$ $17.85. The average maintenance cost for the hunting equipment (including dog) was $130.77 $\pm$ $10.73.

1.3.9 Management Policies

The aim of this section was to determine the hunters' attitudes towards various management ideas and practices.

The vast majority of the hunters (79.8%) responded that landowners should not be allowed to charge for hunting access. In contrast; however, many hunters were willing to pay an access fee for hunting on private land managed as a game preserve (Fig. 1.19). Most of the hunters (58.6%) thought that the raising of crops for feed for waterfowl was a good management technique, while 36.5% disagreed, and 4.9% had no comment.

51% of the hunters felt that the Canada goose seasons should remain as at present, and 48.8% wanted to see the ordinary duck season extended even more (Fig. 1.20). Table 1.13 compares when the hunters who wanted an extension of the Canada goose and/or duck seasons, would like to see the extension occur.

Over half of the hunters (59.5%) felt that their licence fees were adequate. 35.4% felt that the fees were too high, 3.4% felt they were too low, and 1.7% had no comment about their licence fees.

The final question concerning management policies dealt with the allocation of funds for various activities. Eight choices were given for the hunters to rank. These choices were:

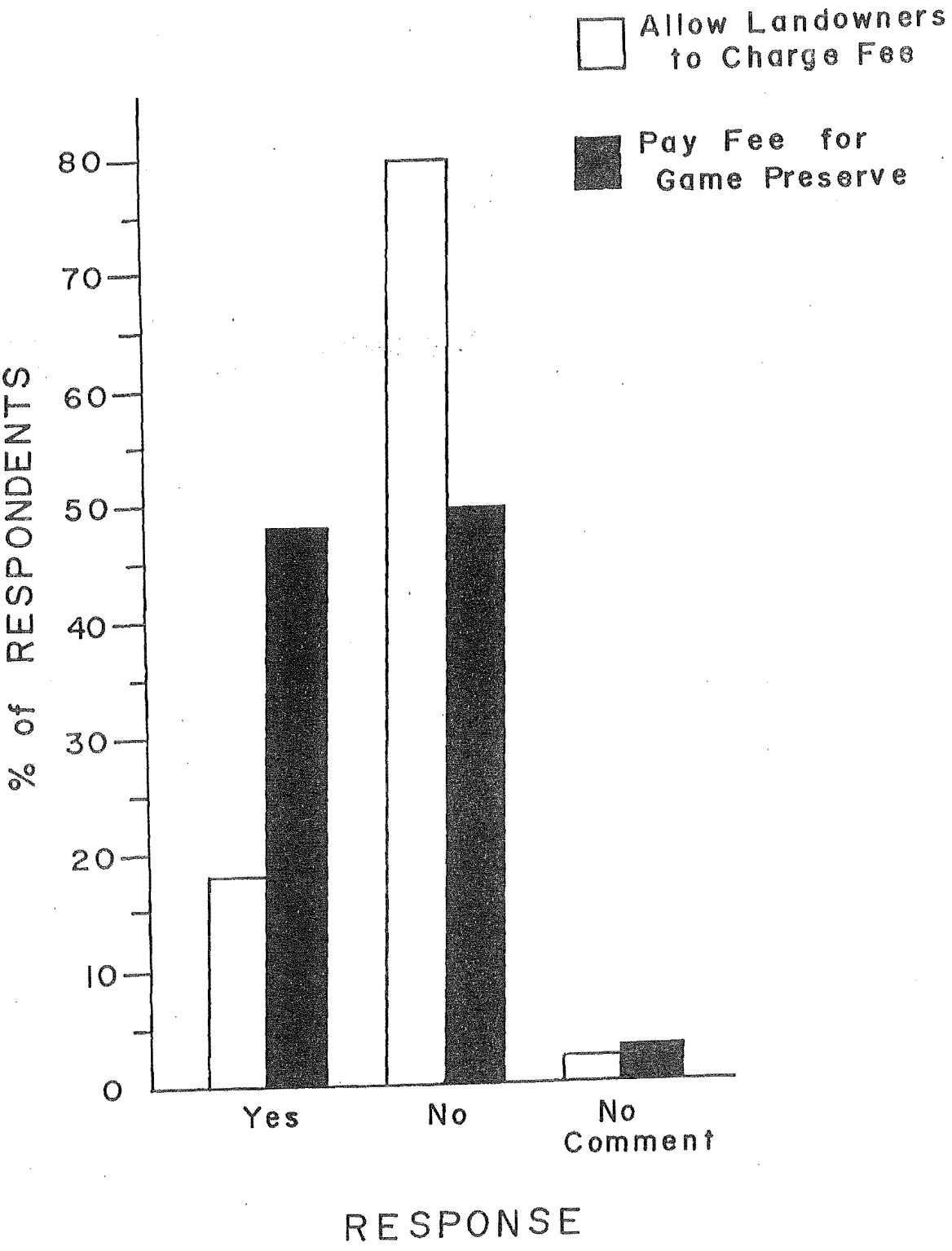

Fig. 1.19 Hunters' responses to the policies of landowners charging an access fee and paying a fee to hunt on a managed game preserve.

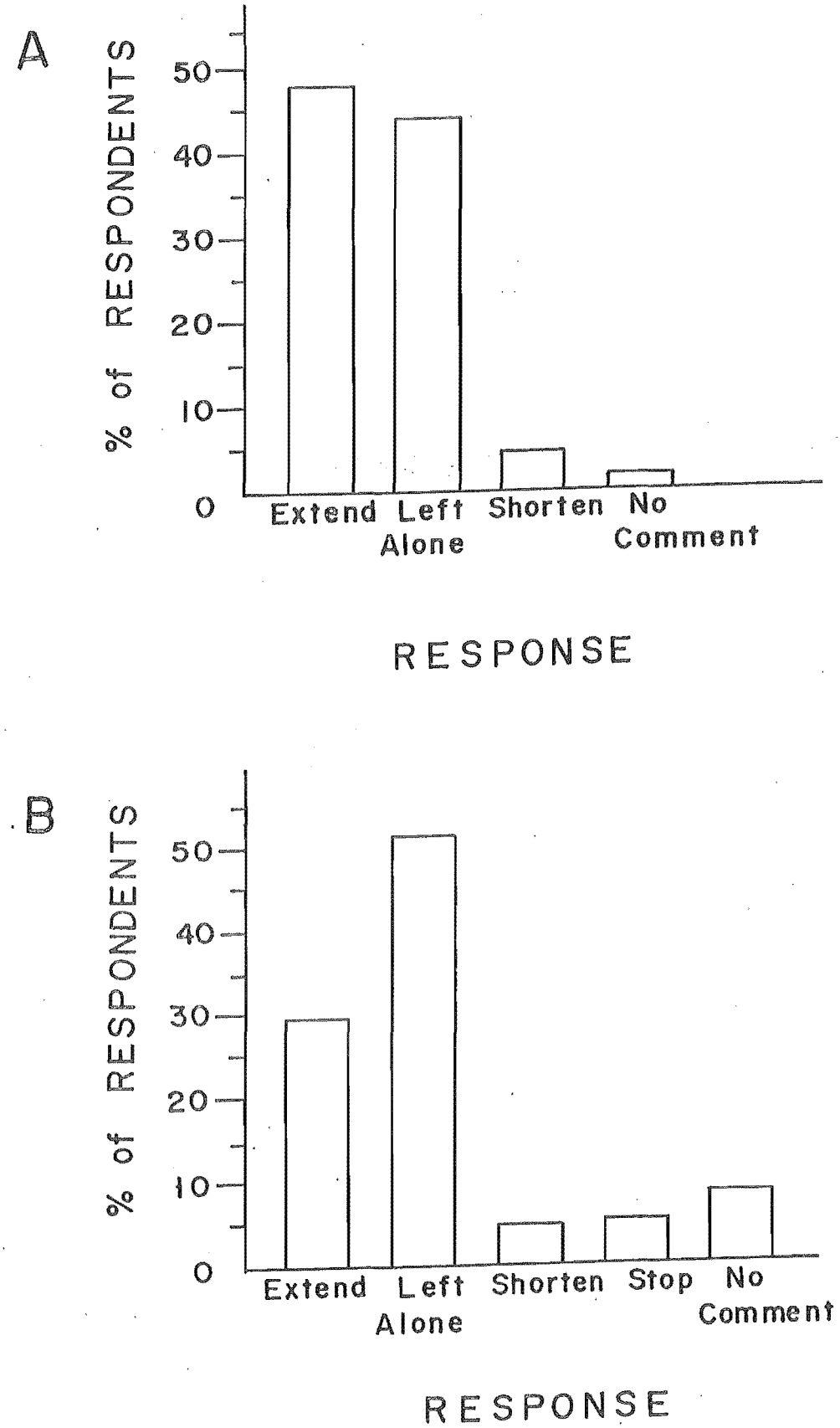

Fig. 120 A & B Hunters' responses on changing the length of the:

A - Duck season

B - Canada Goose season.

Table 1.13. Percentages of respondents who wanted to see the Goose or Duck season extended for each given category.

Extension Wanted	SEASONS Duck	Goose
Beginning of season	35.8%	30.9%
End of season	58.7%	55.3%
Both beginning and end	4%	6.5%
Comment not given	1.5%	7.3%

1) Purchasing of land

2) Protecting and managing existing habitat

3) Rearing and releasing gamebirds

4) Providing educational information

5) Enforcement of regulations

6) Monitoring of populations

7) Organising Canada Goose shoots in High and Low Country

8) Other

In determining preference, the same techniques were used here as were used in Section 1.3.3. In assessing only the #1 (most important) rankings given to each policy, "Protecting and managing existing habitat" was considered most important with "Other" and "Organising goose shoots" being least important (Fig. 1.21). The independent variable analysis again showed a substantial difference from the first method (Tables 1.14 and 1.15) and is again considered to be the most valid assessment.

In order to determine which policy the hunters in each age group felt was most important, the #1 rankings given were split into their respective age groups. Table 1.16 gives the results of this analysis.

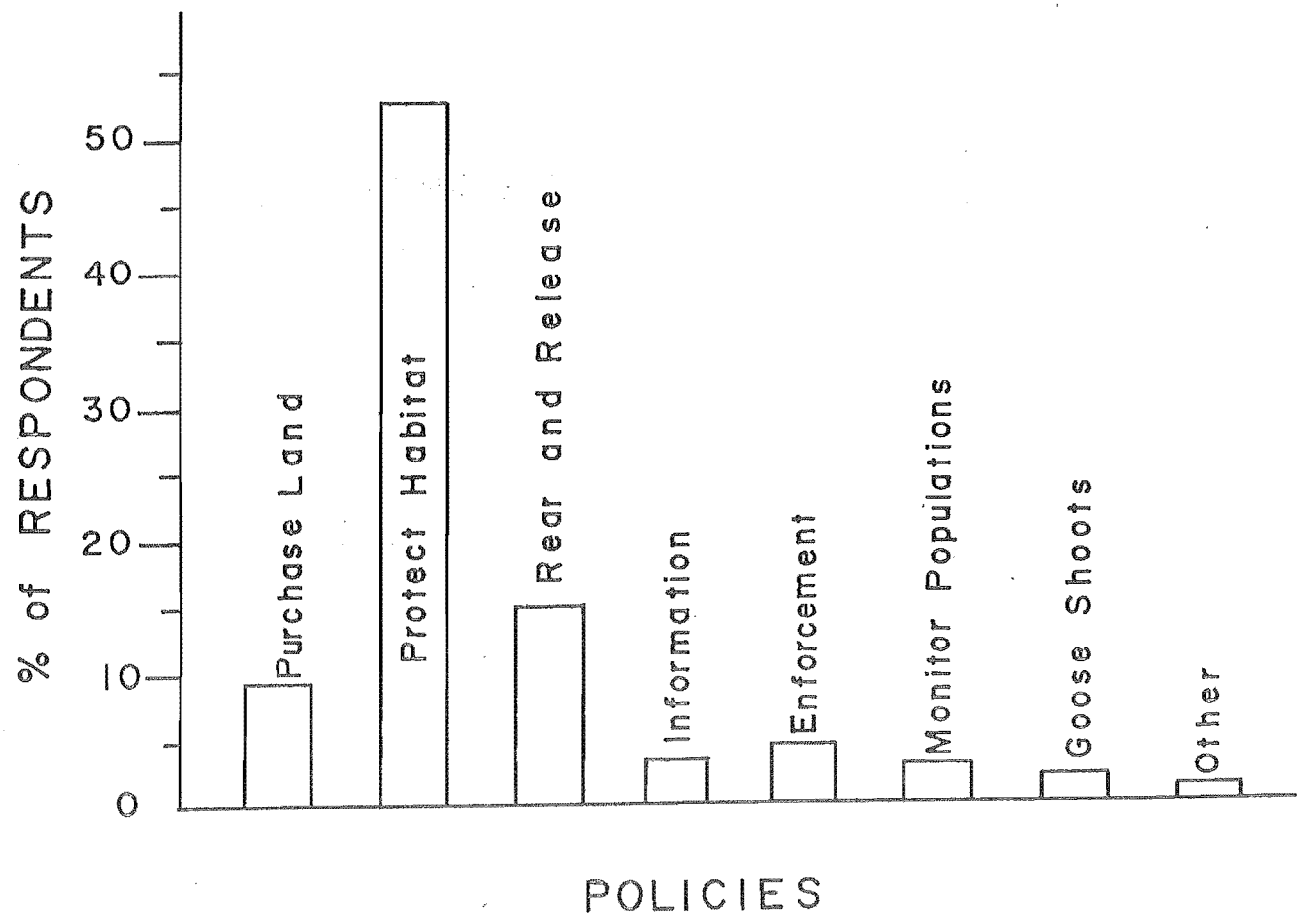

Fig. 1.21 Percentage of respondents who ranked each policy as #1, most important.

Table 1.14 Means ± standard deviations and subsequent preference rankings of management policies using cluster analysis.

Policy	Mean ± Standard Deviation	Rank
Purchase Land	4.60 ± 2.53	4
Protect Habitat	6.36 ± 1.50	1
Rear and Release	5.09 ± 2.15	3
Information	4.05 ± 2.34	7
Enforcement	4.22 ± 2.37	6
Monitor Populations	4.32 ± 2.22	5
Goose Shoots	3.07 ± 2.82	8
Other	5.40 ± 4.24	2

Table 1.15. Comparison of the preference ranking results from independent analysis and #1 ranking methods.

POLICY	PREFERENCE RANKING	
	INDEPENDENT ANALYSIS METHOD	#1 RANKING METHOD
Purchase Land	Fourth	Third
Protect Habitat	First	First
Rear and Release	Third	Second
Information	Seventh	Fifth
Enforcement	Sixth	Fourth
Monitor Populations	Fifth	Fifth
Goose Shoots	Eighth	Seventh
Other	Second	Eighth

Table 1.16. Percentage of hunters in each age group who ranked any policy as most important.

Age Groups	Purchase Land	Protect Habitat	Rear & Release	Information	Enforcement	Monitor Populations	Goose Shoots	Other	Total Number of respondents
≤ 16	7.7%	30.8%	23.1%	7.7%	-	7.7%	-	-	13
17-20	2.8%	41.7%	22.2%	5.6%	2.8%	2.8%	2.8%	-	36
21-30	9.8%	50.4%	13.0%	3.3%	6.5%	5.6%	1.6%	0.8%	123
31-40	7.0%	64.0%	11.6%	4.7%	4.7%	1.2%	-	2.3%	86
41-50	12.0%	54.7%	20.0%	1.3%	2.7%	1.3%	6.7%	-	75
51-60	18.9%	43.2%	16.2%	-	2.7%	2.7%	-	5.4%	37
≥ 61	9.5%	54.8%	9.5%	2.4%	4.8%	2.4%	2.7%	-	42

1.3.10 Additional Comments

The aim of this section was to give the respondents the opportunity to add any of their personal comments, observations, or suggestions pertaining to gamebird hunting.

43% of those hunters who returned a questionnaire included some comments in this section. Due to the wide diversity and large number of comments received, it is impossible to describe each individual comment. Thus, they have been catagorized into 14 major topics and the main points summarized.

1) Seasons:

Most comments in this section were concerned with extending the duck hunting season. Options given for an extension varied from (a) extending the end of the season until August 31st, (b) not starting the season until June and then ending it August 31st, and (c) opening the season for 3 weeks; then closing it for 3 weeks; then opening it again for a month.

Another frequent comment in this section was that the Feb-Mar low country goose season did more harm than good, because the shooting scared off other waterfowl. Several respondents felt that it should be abolished, while none volunteered support for it.

2) Habitat:

Comments in this section were almost exclusively about the loss and destruction of waterfowl habitat. The draining and filling of wetlands by farmers was a major concern and several suggestions were given of ways to minimize this practice: (a) write on game licences ways in which a hunter could preserve habitat in his own area, (b) persuade farmers to work with these habitats, not destroy them, (c) keep irrigation ditches open, (d) purchasing of more land by Wildlife Service and NCAS, (e) removing domestic animals from non-productive, marginal farmland.

3) Access:

The difficulty of obtaining access to public and to private lands was the most frequent comment in this section. Access problems were encountered in two areas: 1. High country Canada goose hunting, 2. Shooting areas around Lake Ellesmere. Comments on the access problem for high country shooting centered around the idea that only hunters "in the know" could get access, which excluded many interested hunters from the areas. The main issue concerning Lake Ellesmere was the right of way on "paper" roads. It was felt that since the land was leasehold Crown land, the farmers should have grazing rights only and not be able to restrict "paper" road access.

4) Canada Geese:

More hunters responded in this category than any other, and the vast majority of the comments were centered around the Canada Goose Organised Shoots. Most of these comments focused on the feeling that only certain, privileged persons were allowed on NCAS Goose Shoots and that the average licence holder was never invited. The suggestion made in order to rectify this situation was to publicly advertise beforehand when a shoot was to be held.

Another frequent comment was that the shooting of geese by helicopter should be stopped in order to avoid over-depletion of geese numbers. Respondents in this section said that the goose was the best gamebird in New Zealand, and under no circumstances wanted it declared a pest and, as such, poisoned.

5) Enforcement:

In this section the comments were mainly concerned with the need for more and stricter enforcement of the game regulations. The suggestion was made for heavy fines and loss of licence and firearm for persons shooting and not retrieving gamebirds.

6) Upland Gamebirds:

Most comments in this section were about the use of 1080 poison on riverbeds killing off large numbers of upland gamebirds. Better cooperation between Pest Destruction Boards and the NCAS was suggested so that poisoning regimes could be coordinated around the hunting season, and bait unappetizing to gamebirds used.

Another concern in this section was the rearing and releasing of gamebirds. Most respondents wished to see the system continued and for it to include new species; however, some felt that the carrying capacity of the habitat should be scrutinized more carefully before any more gamebirds were released.

7) Bag Limits:

The relatively few comments in this section varied from the extreme of allowing mallard drakes and Canada geese to be hunted year around with no limit, to putting limits on all gamebirds, so that the long-sought-after limit bag could be achieved.

8) Teal:

The majority of the respondents felt that the grey teal numbers were increasing; but, no respondents in this section wanted them on the game licence. Suggestions were made that either shooting grey teal not be illegal, or that a limit of one bird be allowed for accidental shootings.

9) Crop Damage:

In this section the comment was made that when ducks are causing crop damage, it should be legal to shoot them. It was suggested that hunters be supplied with a list of properties suffering crop damage before the shooting season, so that the hunters knew in which areas to concentrate shooting.

10) Fees and Feeding:

The comments in this section varied between two extremes. Some replied they would begrudge paying landowners access fees and felt that charging for game preserves would turn gamebird hunting into a rich man's sport; while others felt that the selling of shooting rights would encourage landowners to maintain waterfowl habitat and they would be happy to pay for good shooting.

The raising of crops for waterfowl was considered a good management technique by several respondents. Also, one suggested that financial assistance be given by the Acclimatisation Society to shooters in order to encourage them to build their own waterfowl ponds.

11) Information and Education:

Very few comments were received in this section, but they covered a variety of subjects. Several respondents felt that the NCAS should have some sort of educational shoot to encourage and teach young hunters. Others commented on the need for education regarding protected species, to reduce accidental shootings. It was also felt that there was a need to know how to get permission from landowners in order to hunt on their property.

12) Licence Fees:

The comments here ranged from those who felt that the licence fees were quite cheap, to those who felt they were too dear. Some suggestions made were for a pensioner's licence, and for a cheaper weekly licence, as in fishing.

13) Population Numbers:

In general the respondents who commented in this section felt that duck numbers, in particular the grey duck, shoveler, and mallard, were on the decrease. The swan population; however, was seen to be on the increase. Suggestions on ways to increase the waterfowl numbers varied from purchase and management of areas around Lake Ellesmere; to removal of species (e.g. shoveler) from the licence; to education of the hunters on species whose numbers are declining.

14) Lake Ellesmere:

Comments in this section were mainly concerned with the eutrophication of the Lake. Some felt that the land which has been purchased around the Lake has not been managed properly and has not realized its full potential. Others felt that the influx of herbicides and effluents was the major determining factor in the "death" of the Lake.

1.4 DISCUSSION

In this survey, a response from 10% of the NCAS gamebird hunters was considered as sufficient to meet the questionnaire objectives. The 51.5% overall return more than fulfilled this criterion since it yielded a response of 18.3% from the total North Canterbury hunters.

The low percentage of female hunters (0.7%) was anticipated and reflects similar findings from other studies (Buchanan 1985: Peterle and Scott 1977). As with Buchanan's survey, the majority of the hunters were between the ages of 21 and 30, and the same trend in age classes was observed in both surveys (Fig. 1.22). The only major difference between the two studies was the substantially higher percentage of young hunters (20 and under) in North Canterbury (11.9% as compared to 7.4%).

The range for being a licence holder was from 1 to 62 years with an average of 15.8 years, which is again comparable to the Wellington survey of 1 to 60 years and average of 14.8 years. The average income of the NCAS gamebird hunters was found to be much higher than the national average as 85% of the respondents claimed to have an income in excess of $10,000, while in the national figure, only 32.1% have an income over $10,000 (N.Z. Dept of Statistics 1985).

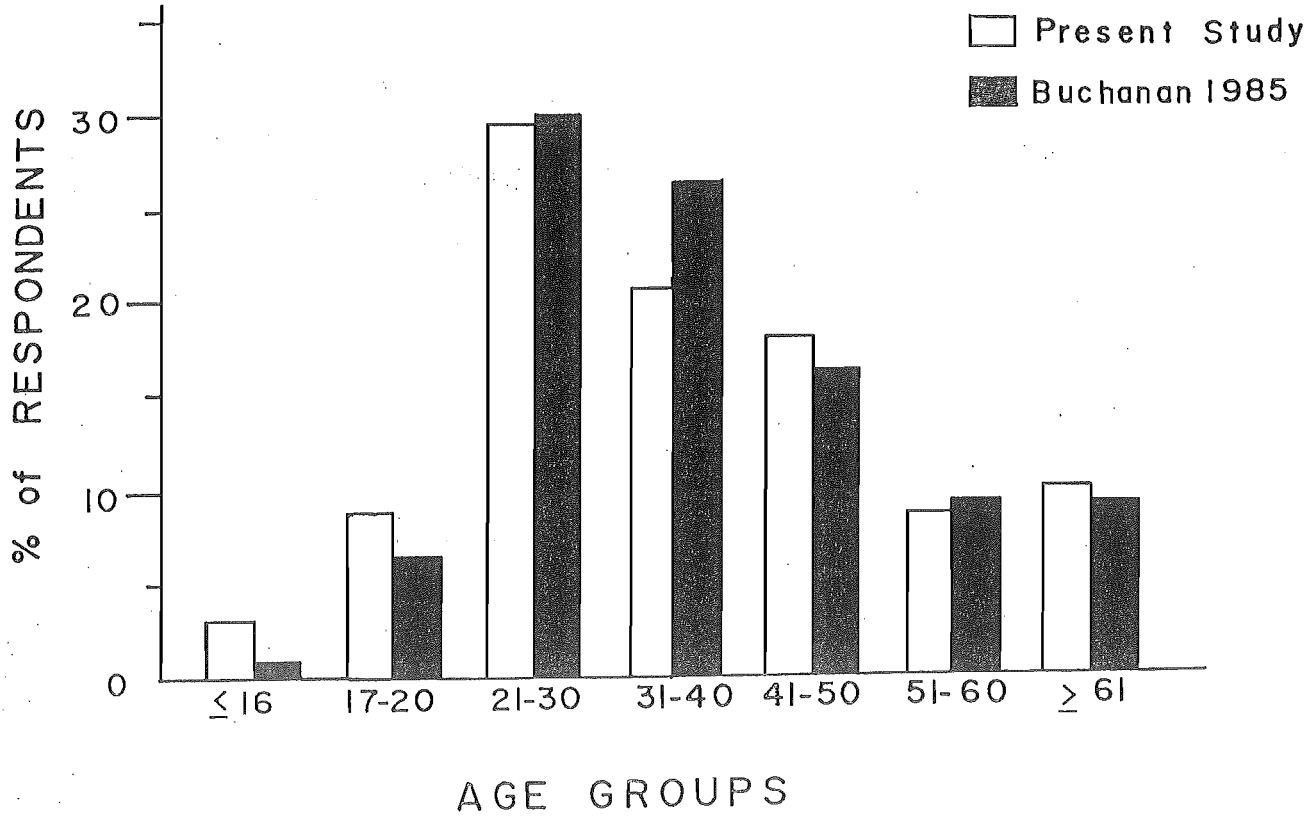

Fig. 1.22 Comparison of age makeup of hunters in Buchanan's Wellington study and this present study.

The next consideration was of species hunted and hunter preference. When discussing these data, the identification problem of grey ducks and female mallards must be considered. greys and mallard ducks are easily confused: a problem which is compounded by hybridization. Responses directed specifically at either species must be treated cautiously, as they could very well be interrelated. Since it is impossible to determine the the extent to which this possible identification problem affects this study, the data have been presented in the manner in which they were collected, with the two species taken separately. However, it should be remembered that these data could very well be inseparable.

The fact that more hunters pursued waterfowl than upland birds was not surprising as there are far more of the former in North Canterbury. While the exact density of upland gamebirds in North Canterbury is not known, they are known to be quite scarce (Caithness 1982) despite on-going releases by the NCAS (NCAS 1986). It is to be expected that if the birds aren't there to hunt in the first place--they will not be highly preferred. This; however, does not mean that the hunters are not interested in upland hunting. Several respondents stated that they would like to hunt the birds if they were more plentiful.

The mallard was the most preferred gamebird, which again was not surprising as it is North Canterbury's most abundant and easily accessible gamebird, and made up 63% of the hunters' bag for the 1985 season (NCAS 1986). Again, taking into account the possible grey duck/mallard identity confusion, either the grey duck or Canada goose could be considered the second most

preferred gamebird, and each made up 11% of the 1985 hunters' bag, respectively (NCAS 1986). The pukeko and black swan were by far the least preferred species, as only the extremely scarce and therefore little hunted chukor ranked lower than they did.

For management purposes, it is as important--if not more important--to know why a species is preferred or not rather than its preference ranking. Six reasons for preferring to hunt any species were presented to the respondents so that they could rank them in terms of personal importance. Of these choices (Appendix 1, question 10), the perceived challenge of hunting the bird was found to be the most important reason in preferring any one species. Palatability and access followed at a distant second and third, while the social aspect of a hunt was of minor importance.

Once there is an overall picture of hunter preference, then individual species can be considered. Since the mallard, grey duck, and Canada goose were the three most preferred species in North Canterbury and contributed to 85% of the 1985 bag (NCAS 1986), they were considered the target species for determining why hunters preferred them. Reasons for preference rankings were assessed only for those hunters who had previously ranked the mallard as #1 (most preferred); the same was done for the grey duck and Canada goose.

The main reason hunters preferred mallards was the hunting challenge of the species. This was closely followed by those who preferred mallards due to their easy accessibility and/or palatability. Thus, the mallard could be looked upon as an all-around gamebird--one that is enjoyed as a challenge, yet easy

to get to, and tasty once got. In comparison, for those purporting to prefer grey ducks palatability was the most important reason with accessibility and challenge coming second. Abundance and the social aspect were more important here than in either of the other two species. The Canada goose is known worldwide as the ultimate sporting bird (Bauer 1965; Williams 1981), and those who preferred the Canada goose in North Canterbury did so because of the challenge associated with this bird. A few hunted it because of its palatability, but the remaining reasons did not play much part in preferring the Canadas.

Once the reasons for preferring a species are known, then the reasons for not preferring a species can be considered. To determine this, six reasons were again presented (Appendix 1, question 11) for hunters to rank in terms of personal importance for not hunting whatever species they considered as least preferred. Overall, scarcity in numbers and unpalatability were the major reasons for not preferring a species, and birds not in area and not a challenge were a close third and fourth.

Again, once the overall reasons for preference are known, then the preference status of individual species can be considered. The three least preferred species, black swan, pukeko, and chukor, were used in this section. Reasons for preference rankings were assessed only for those respondents who had previously ranked the black swan as #10 (least preferred); the same was done for the pukeko and chukor.

The hunters who did not wish to hunt the black swan mainly felt that it was unpalatable. The swan's scarcity, its

unchallenging nature as a sporting bird, and its absence from the area hunted, were all close to other reasons why the swan was not preferred. The swan being unavailable was not a major reason for not preferring to hunt it. The category of "Other" was greater for black swans than for either of the other two species, and mainly related to those who preferred to not hunt swans because of their ornamental value. The non-preference of swans could also be related to the fact that they have just recently been returned to gamebird status after having been fully protected for approximately ten years.

Unpalatability was also the prime reason for not hunting pukekos. It was closely followed by the ukeko being seen as no hunting challenge and their numbers being low. A few responded that the pukeko was not in their area, but the reasons of its unavailability and "other", were of minor importance.

The chukor contrasted to both of the previous wetland species. Whereas both the black swan and pukeko weren't preferred mainly because of their perceived unpalatability, the chukor wasn't preferred mainly because it is scarce, or it is not in the hunting area. The remaining reasons for non-preference were only about half as important. For management purposes it is extremely difficult, if not impossible, to get hunters to hunt an animal which they deem unpalatable or unchallenging (e.g. black swan and pukeko) without first changing their attitude towards the animal. In contrast, if a gamebird such as the chukor would become more highly preferred if the the bird's population will have to increased. No change in hunter attitude is needed.

Hunters have often asked that grey teal be given gamebird

status, because they are frequently shot by mistake (Williams 1981; Caithness 1982). Known for being a highly mobile species, the grey teal population was estimated to be 20 000 in 1976 (Mills 1976) and in part due to the nesting scheme of Ducks Unlimited, their numbers may be increasing. Because Lake Ellesmere supported 25% of the estimated grey teal population (O'Donnell 1985), North Canterbury hunters were asked their opinion on this issue. While quite a few respondents admitted to accidently shooting grey teal, the majority (over 65%) did not want to have the grey teal declared a gamebird in North Canterbury.

Due to their greater abundance, accessibility and close proximity of wetland hunting areas in North Canterbury, it was expected that the wetland gamebirds would have more hunting pressure than the upland gamebirds. This expectation held true for every age group of hunters.

When hunters travelled away from their usual area, the species most of them sought were mallards, Canada geese, grey ducks, and paradise shelducks. As these were the top four preferred species, their being sought after in other areas was not surprising. The quail (Lophortyx californicus), which ranked sixth--behind shoveler (Anas rhynchotis)-- in the preference ratings was the fifth most hunted species when hunters travelled from their usual area. More respondents hunted either quail or pheasant (Phasianus colchicus) than any of the remaining waterfowl, and the chukor was hunted more than black swan, but slightly less than either the shoveler or pukeko. Thus, when travelling away from his usual area, the gamebird hunter was

probably seeking either the four most preferred wetland gamebirds or the two most preferred upland gamebirds.

In North Canterbury, the gamebird hunter has four Canada goose seasons per annum. In Wairewa and Ellesmere Counties, east of State Highway 1, the Canada goose seasons for 1986 were from 3 May to 31 Aug 1986 and 7 Feb to 29 Mar 1987. In the remainder of North Canterbury, the 1986 seasons were from 3 May to 30 Nov 1986 and 7 Feb to 29 Mar 1987. The reason for the creation of these special seasons was to lower the goose numbers which were reaching pest proportions (Williams 1981). For these seasons to be effective, the hunters must use them. Almost half of the questionnaire respondents hunted during both of the Wairewa and Ellesmere Counties' seasons, but only about 30% took advantage of the high country seasons. Many more hunting trips were made to the low country than to the high country.

The higher percentage of hunters and hunting trips in the low country is related to accessibility. Geese are considered as a particular problem in North Canterbury's high country (Williams 1981). The hunters do not kill enough birds during these special seasons for effective control. It is much more difficult to get to, and onto, high country areas to hunt, and until this changes, the trends seen here will probably remain unchanged.

On the average, the North Canterbury hunter has a capital investment (not including boat or dog) of $1,333.00 and spends another $244.00 per annum on expendible items and maintenance. Thus the 2246 shooters in the district had a total investment of almost $3,000,000 and paid approximately $550,000 on shooting related expenditures in 1985. In comparison Buchanan (1985)

found the capital outlay for the Wellington District to be $4,500,000 with an annual expenditure of $1,400,000. As the Wellington District has approximately twice as many hunters as the North Canterbury District, the expenditures per sportsman are similar in both districts.

Like their Wellington counterparts, the North Canterbury hunters were not in favor of landowners being allowed to charge an access fee for hunting, but many were willing to pay to hunt on managed game areas. The majority of the North Canterbury hunters felt that the raising of sacrificial crops for waterfowl was sound management. Most hunters were content with season lengths, although some wanted the duck season extended.

On the average, the hunters felt their licence fees were adequate and wanted to see the funds generated spent on protecting and managing existing gamebird habitat. Other practices such as: (a) finding alternate methods to lower geese numbers, (b) imporving Upland gamebird hunting, (c) persuading landowners to keep and maintain wetlands, and (d) huts for shooters in High Country areas, were considered second in importance with the purchase of land following third, and rearing and releasing of gamebirds fourth. This varied considerably from the Wellington District hunters, who also considered habitat protection and management most important, but felt rearing and releasing of gamebirds the second most important concern (Buchanan 1985).

1.5 CONCLUSION

Gamebird hunting in North Canterbury generates a considerable sum of money in the District, and as a revenue producer, the gamebird hunter cannot be ignored. While most of the hunters are content with gamebird hunting in North Canterbury, they are ready and willing to see some changes.

These changes could include (but are by no means limited to): introduction of managed game preserves and sacrificial feeding areas; lowering of some limit bags; and altering of duck season dates. Among other practices which are in use in other countries, and which could be structured to accommodate the specific conditions found in North Canterbury, are tax incentives and subsidies. Noonan and Zagata (1982) highlighted these and other schemes which would enhance gamebird habitat and, ultimately, hunting.

However, before any changes such as the ones mentioned above can be implemented, their effect on the gamebird population must be thoroughly studied. Also, in order for any change to be successful, it must be accepted by those people involved. The North Canterbury gamebird hunter is ready to see new management policies applied for the enhancement of gamebird hunting. The aim of this questionnaire was to find out information about gamebird hunting in North Canterbury. This aim has been achieved, and it seems the time is ripe for active management to move forward in North Canterbury.

2.1 INTRODUCTION

The primary goal of waterfowl management is to maintain the abundance of selected waterfowl species in order to ensure their continued use as a recreational resource. It does not mean to simply increase waterfowl populations. Management of a population involves achieving a balance, where they are not overly abundant and viewed as a pest by some sectors of society, and yet abundant enough to be physically exploited by the hunter. One way of managing these populations is through the control of the annual harvest.

Part of a manager's job is to determine the annual harvest levels for each hunted species which will achieve the goal of controlling numbers without overly depleting the population. In order to help the manager achieve this percarious balance, a nationwide hunter survey was established in New Zealand. The survey is done with a hunter diary which is sent out annually to selected hunters by the New Zealand Wildlife Service. The results of which are then tabulated and published in an annual report.

In North Canterbury enough returns were received from 1971 onwards for them to be considered of value for management purposes (Caithness pers. comm.) and it is these diary returns which form the basis of this study. The aims were to discover where and on which species most hunting pressure occurred and the effect of varying bag limits and season lengths on birds harvested. For clarity, this chapter is subdivided into two segments:

A) Hunting Pressure

B) Bag Limits and Season Lengths.

A) HUNTING PRESSURE

2A.1 Introduction

Lake Ellesmere is North Canterbury's largest body of water and is situated close to Christchurch, the District's largest population concentration. For these reasons, Lake Ellesmere is considered one of the most important waterfowl hunting areas in North Canterbury, but no quantitative studies of this perceived importance have been done. Because of the Lake's assumed prominence for waterfowl hunting it was separated from the rest of North Canterbury when hunting pressure was examined. The aim of this study was to discover the amount of hunting pressure, both in terms of hunter days and total birds harvested, at Lake Ellesmere in comparison to the remainder of North Canterbury. Only total harvests and total harvest of each species was considered in this section as comparisons of bag limits and season lengths are discussed in the next section.

2A.2 Materials and Methods

For this study the area considered as Lake Ellesmere was defined as that area within the borders from Taumutu North to and including Lakeside, Timberyard, and East to the Lower Selwyn Huts; continuing South along the Lake's shore (approximately one half mile from the High water line) to Kaituna and West from Kaituna Lagoon along Kaitorete Spit, North of Bayley's Road back to Taumutu (Fig. 2a.1). All hunting areas not included herein were considered as "remainder North Canterbury".

The hunter's diaries (example Fig. 2a.2) for the years 1971 to 1984 inclusive were obtained from the New Zealand Wildlife Service. The information concerning areas hunted and numbers of birds harvested was collected from each diary and entered onto the Burroughs Operating System and analysed using the BMDP Statistical Software.

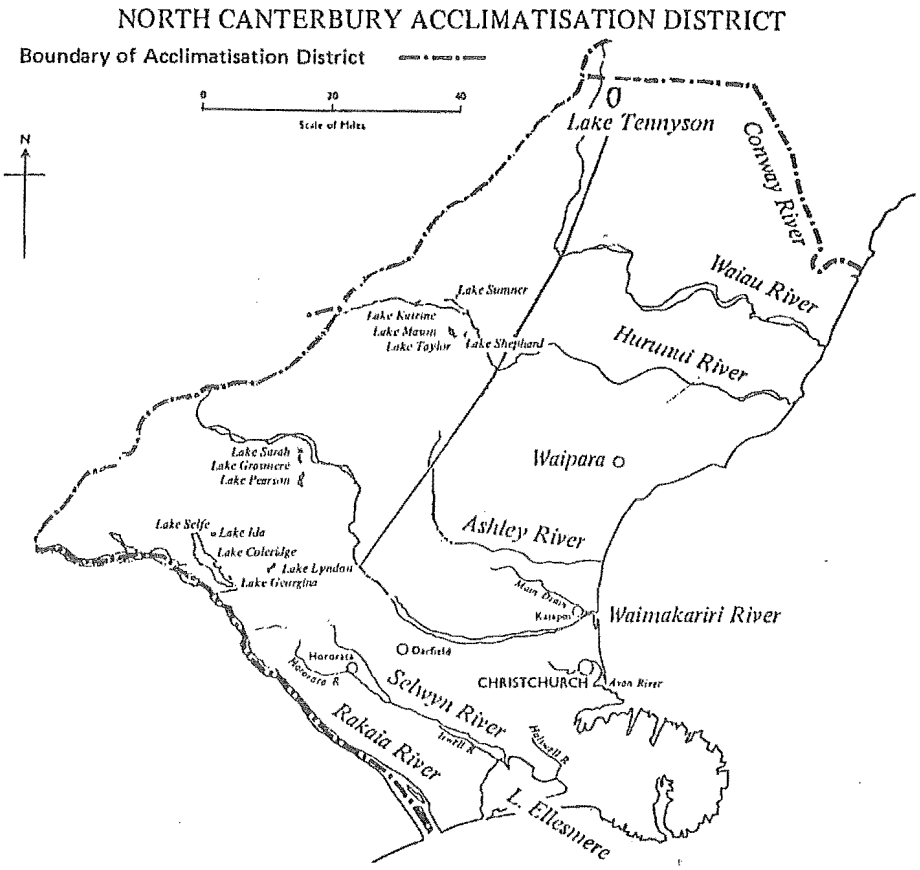

Figure 2a.1 The study area designated as Lake Ellesmere.

YOUR ADDRESS: Please use Block Capitals

Stand Number

Licence Number

CHANGED ADDRESS? PLEASE CORRECT

rect (W.A.458)

(Please tick appropriate Square)

Do you use a dog ? Yes ☐ No ☐

Do you want a copy of this Diary Returned? Yes ☐ No ☐

Please indicate in which Acclimatisation Society districts you shot. 1 ____ 3 ____

2 ____ 4 ____

HOW DID THE NUMBER OF BIRDS SEEN COMPARE WITH LAST SEASON

(Please tick appropriate column).

	MALLARD	GREY	SHOVELER	PARADISE	BLACK SWAN	CANADA GOOSE	PUKEKO
MORE							
SAME							
LESS							
NONE							

GENERAL COMMENTS ON SEASON ....

RECORD BELOW ACTUAL NUMBERS RETRIEVED

DATE	MALLARD	GREY	SHOVELER	PARADISE	BLACK SWAN	CANADA GOOSE	PUKEKO	WHERE SHOT

RECORD BELOW TOTAL NUMBERS OF BIRDS NOT RETRIEVED

Figure 2a.2 Example of the hunter diary used by the New Zealand Wildlife Service.

2A.3 Results

A total of 792 diaries were examined, making an average of 57 diaries per year, with a high of 69 and a low of 44. During this same time period (1971-1984) a yearly average of 2521 waterfowl licences were sold. Therefore, the diaries sampled an average of 2.3% of the hunters each year (Appendix 2).

The total number of hunting days over all the years was 4722: 1962 at Lake Ellesmere (41.5%) and 2760 in the remainder of North Canterbury (58.4%). Table 2a.1 gives the number of shooter days and shooters for each area each year and the overall average of shooter days per hunter for each area. Except for 1971 and 1972 more hunter days were spent outside of Lake Ellesmere than on the Lake, and every year more shooters hunted outside of the Lake than on the Lake. Yet only in 1973, 1974, 1975, 1979 and 1984 were more hunter days/hunter spent in areas outside of Lake Ellesmere.

Hunting pressure on the birds at each area was first examined on an overall scale and then by individual species. First the average number of birds bagged by hunters in each respective area each year was examined (Table 2a.2). Except for the years 1973, 1975 and 1984 more birds were bagged per hunter at Lake Ellesmere than in the remainder of North Canterbury. Also, the total number of birds bagged by shooters at Lake Ellesmere was considerably higher than the rest of North Canterbury (21.8/shooter versus 18.7/shooter). Secondly, the average bag per number of hunting days spent in each area was examined. Here, again, the Ellesmere average for each year was either greater than or within 0.5 birds/hunting days of the average for the remainder of North Canterbury. The

Table 2a.1. Number of shooter days, number of shooters and average hunting days/hunter for each area.

	LAKE ELLESMERE			REMAINDER N.C.		
YEAR	DAYS	SHOOTERS	DAYS SHOOTER	DAYS	SHOOTERS	DAYS SHOOTER
1971	183	34	5.38	146	38	3.84
1972	184	35	5.26	155	36	4.31
1973	116	27	2.66	140	28	2.68
1974	167	31	5.39	210	36	5.38
1975	134	20	6.70	249	34	7.32
1976	138	23	6.00	207	36	5.75
1977	127	19	6.68	225	39	5.77
1978	101	14	7.21	187	27	6.93
1979	95	16	5.94	228	34	6.71
1980	135	19	7.11	161	29	5.56
1981	205	29	7.07	274	45	6.09
1982	128	22	5.82	212	38	5.58
1983	144	22	6.55	183	33	5.55
1984	105	21	5.00	183	32	5.72
TOTAL	1962	332	5.90	2760	485	5.69

Table 2a.2. Average total season bag per shooter each year.

	LAKE ELLESMERE			REMAINDER N.C.		
YEAR	TOTAL SHOT	SHOOTERS	AVG. BAG	TOTAL SHOT	SHOOTERS	AVG. BAG
1971	689	34	20.3	485	38	12.8
1972	635	35	18.1	502	36	13.9
1973	308	27	11.4	375	28	13.4
1974	744	31	24.0	571	36	15.9
*1975	511	20	25.6	917	34	27.0
*1976	493	23	21.4	698	36	19.4
*1977	537	19	28.3	962	39	24.7
*1978	312	14	22.3	583	27	21.6
*1979	336	16	21.0	678	34	19.9
*1980	506	19	26.6	472	29	16.3
*1981	774	29	26.7	1077	45	23.9
*1982	603	22	27.4	677	38	17.8
*1983	515	22	23.4	538	33	16.3
1984	265	21	12.6	540	32	16.9
TOTAL	7228	332	21.8	9075	485	18.7

* = Closed season on black swan

overall total average of birds bagged per days spent hunting was also slightly higher for Lake Ellesmere (Table 2a.3).

The average bag per hunter of each species in the respective areas was examined for each year (Tables 2a.4 to 2a.10). Overall, the average bag/hunter of mallard, grey duck, paradise shelduck and pukeko were slightly higher in other areas of North Canterbury, while average bag/hunter of shoveler, Canada goose and black swan were considerably higher at Lake Ellesmere. An interesting observation from this study was the difference in average bag/hunter during the open as compared to the closed black swan hunting seasons in the two areas (Table 2a.11). At Lake Ellesmere the average seasonal bag/hunter for mallard, Canada goose and shoveler was much higher during the closed black swan season; the remaining species being fairly constant during the two time periods. For the rest of North Canterbury, the results were much different. All species, excepting the mallard and pukeko remained relatively constant. The pukeko average bag/hunter was less during the closed black swan season, while the mallard bag/hunter was greater.

Table 2a.3. Average daily bag of birds (all species).

	LAKE ELLESMERE			REMAINDER N.C.		
YEAR	TOTAL SHOT	DAYS	AVG. BIRDS DAY	TOTAL SHOT	DAYS	AVG. BIRDS DAY
1971	689	183	3.8	485	146	3.3
1972	635	184	3.5	502	155	3.2
1973	308	116	2.7	375	140	2.7
1974	744	167	4.5	571	210	2.7
*1975	511	134	3.8	917	249	3.7
*1976	493	138	3.6	698	207	3.4
*1977	537	127	4.2	962	225	4.3
*1978	312	101	3.1	583	187	3.1
*1979	336	95	3.5	678	228	3.0
*1980	506	135	3.7	472	161	2.9
*1981	774	205	3.8	1077	274	3.9
*1982	603	128	4.7	677	212	3.2
*1983	515	144	3.6	538	183	2.9
1984	265	105	2.5	540	183	3.0
TOTAL	7228	1962	3.7	9075	2760	3.3

* = Closed season on black swan

Table 2a.4. Average seasonal bag of mallards per shooter.

	LAKE ELLESMERE			REMAINDER N.C.		
YEAR	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER
1971	346	34	10.2	227	38	6.0
1972	296	35	8.5	285	36	7.9
1973	113	27	4.2	197	28	7.0
1974	355	31	11.5	279	36	7.8
1975	272	20	13.6	540	34	15.9
1976	258	23	11.2	452	36	12.6
1977	391	19	20.6	674	39	17.3
1978	219	14	15.6	459	27	17.0
1979	185	16	11.6	478	34	14.1
1980	271	19	14.3	400	29	13.8
1981	475	29	16.8	771	45	17.1
1982	359	22	16.3	401	38	10.6
1983	280	22	12.7	334	33	10.1
1984	82	21	3.9	370	32	11.6
TOTAL	3902	332	11.8	5867	485	12.1

Table 2a.5. Average seasonal bag of grey ducks per shooter.

	LAKE ELLESMERE			REMAINDER N.C.		
YEAR	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER
1971	113	34	3.3	167	38	4.4
1972	72	35	2.1	137	36	3.8
1973	39	27	1.4	102	28	3.6
1974	98	31	3.2	161	36	4.5
1975	42	20	2.1	245	34	7.2
1976	53	23	2.3	137	36	3.8
1977	66	19	3.5	165	39	4.2
1978	25	14	1.8	67	27	2.5
1979	36	16	2.3	125	34	3.7
1980	47	19	2.5	37	29	1.3
1981	96	29	3.3	143	45	3.2
1982	51	22	2.3	85	38	2.2
1983	47	22	2.1	68	33	2.1
1984	21	21	1.0	74	32	2.3
TOTAL	806	332	2.4	1713	485	3.5

Table 2a.6. Average seasonal bag of shovelers per shooter.

	LAKE ELLESMERE			REMAINDER N.C.		
YEAR	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER
1971	53	34	1.6	11	38	0.3
1972	58	35	1.7	16	36	0.4
1973	22	27	0.8	19	28	0.7
1974	95	31	3.1	4	36	0.1
1975	56	20	2.8	42	34	1.2
1976	116	23	5.0	29	36	0.8
1977	28	19	1.5	9	39	0.2
1978	35	14	2.5	11	27	0.4
1979	56	16	3.5	10	34	0.3
1980	66	19	3.5	6	29	0.2
1981	130	29	4.5	59	45	1.3
1982	119	22	5.4	64	38	1.7
1983	102	22	4.6	14	33	0.4
1984	53	21	2.5	8	32	0.3
TOTAL	989	332	3.0	302	485	0.6

Table 2a.7. Average seasonal bag of paradise shelducks per shooter.

	LAKE ELLESMERE			REMAINDER N.C.		
YEAR	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER
1971	5	34	0.1	27	38	0.7
1972	6	35	0.2	30	36	0.8
1973	4	27	0.1	17	28	0.6
1974	13	31	0.4	99	36	2.8
1975	2	20	0.1	49	34	1.4
1976	2	23	0.1	65	36	1.8
1977	1	19	0.1	44	39	1.1
1978	1	14	0.1	35	27	1.3
1979	1	16	0.1	47	34	1.4
1980	2	19	0.1	20	29	0.7
1981	8	29	0.3	49	45	1.1
1982	8	22	0.4	78	38	2.1
1983	3	22	0.1	73	33	2.2
1984	1	21	0.05	61	32	1.9
TOTAL	57	332	0.2	694	485	1.4

Table 2a.8. Average seasonal bag of Canada geese per shooter.

	LAKE ELLESMERE			REMAINDER N.C.		
YEAR	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER
1971	60	34	1.8	12	38	0.3
1972	37	35	1.1	9	36	0.3
1973	22	27	0.8	11	28	0.4
1974	124	31	4.0	17	36	0.5
1975	135	20	6.8	28	34	0.8
1976	64	23	2.8	13	36	0.4
1977	48	19	2.5	55	39	1.4
1978	27	14	1.9	7	27	0.3
1979	52	16	3.3	10	34	0.3
1980	111	19	5.8	6	29	0.2
1981	63	29	2.2	23	45	0.5
1982	63	22	2.9	32	38	0.8
1983	82	22	3.7	36	33	1.1
1984	86	21	4.1	8	32	0.3
TOTAL	974	332	2.9	267	485	0.6

Table 2a.9. Average seasonal bag of black swan per shooter.

	LAKE ELLESMERE			REMAINDER N.C.		
YEAR	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER
1971	101	34	3.0	20	38	0.5
1972	157	35	4.5	10	36	0.3
1973	102	27	3.8	15	28	0.5
1974	54	31	1.7	4	36	0.1
*1975	---	---	---	---	---	---
*1976	---	---	---	---	---	---
*1977	---	---	---	---	---	---
*1978	---	---	---	---	---	---
*1979	---	---	---	---	---	---
*1980	---	---	---	---	---	---
*1981	---	---	---	---	---	---
*1982	---	---	---	---	---	---
*1983	---	---	---	---	---	---
1984	21	21	1.0	5	32	0.2
TOTAL	435	148	2.9	54	170	0.3

* = Closed season on black swans

Table 2a.10. Average seasonal bag of pukeko per shooter.

	LAKE ELLESMERE			REMAINDER N.C.		
YEAR	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER	TOTAL SHOT	SHOOTERS	AVG. BAG SHOOTER
1971	11	34	0.3	21	38	0.6
1972	9	35	0.3	15	36	0.4
1973	6	27	0.2	14	28	0.5
1974	5	31	0.2	7	36	0.2
1975	4	20	0.2	13	34	0.4
1976	0	23	0.0	2	36	0.1
1977	3	19	0.2	15	39	0.4
1978	5	14	0.4	4	27	0.1
1979	6	16	0.4	8	34	0.2
1980	9	19	0.5	3	29	0.1
1981	2	29	0.1	32	45	0.7
1982	3	22	0.1	17	28	0.4
1983	1	22	0.04	13	33	0.4
1984	1	21	0.05	14	32	0.4
TOTAL	65	332	0.2	178	485	0.4

Table 2a.11. Average season bag/hunter during the open and closed black swan seasons at Lake Ellesmere and the remainder of North Canterbury.

LAKE ELLESMERE

SEASON	MALLARD	GREY DUCK	SHOVELER	PARADISE SHELDUCK	CANADA GOOSE	PUKEKO
Open	7.66	2.20	1.94	0.17	2.36	0.21
Closed	14.74	2.47	3.70	0.16	3.54	0.19

REMAINDER NORTH CANTERBURY

SEASON	MALLARD	GREY DUCK	SHOVELER	PARADISE SHELDUCK	CANADA GOOSE	PUKEKO
Open	8.06	3.72	0.36	1.36	0.36	2.10
Closed	14.28	3.36	0.72	1.46	0.64	0.31

B) BAG LIMITS AND SEASON LENGTHS

2B.1 Introduction

One of the primary tools of waterfowl management is the use and manipulation of bag limits and season lengths. Theoretically, the setting of large bag limits and/or long season lengths should help in controlling or decreasing the population of a species, while small bag limits and/or short season lengths should help to protect a species from being over-depleted.

Even the most sound management theories do not necessarily always hold true in real life situations. For example, no matter how high a limit or long a season is placed on a species, if the hunters are not taking advantage of the opportunities, population control through harvest will not occur. The hunted waterfowl species in North Canterbury have undergone several bag limit and/or season length changes through the years from 1971-1984, yet a quantitative study of the hunter response to these changes has not been done. The aim of this study was to determine the effectiveness of varying bag limits and season lengths on the harvest of birds in North Canterbury.

2B.2 Materials and Methods

The season lengths and bag limits for each species were obtained from the New Zealand Gazette for the years 1971 to 1984 inclusive. Season lengths for each species were calculated to the nearest day and were compiled for each year along with the corresponding bag limit. The number of birds of each species harvested each year was taken from the New Zealand Wildlife Service's annual hunter diary scheme for North Canterbury as these diaries were considered to be representative of the hunters throughout North Canterbury.

To determine the effect of a daily bag limit on number of birds harvested, the total number of each species harvested was divided by the total number of hunter days and this was compared to the respective year's daily limit. Season length for each species was compared with the species total seasonal harvest/hunter to determine if there were any noticeable changes as season length increased.

2B.3 Results

The mallard, grey duck, shoveler, paradise shelduck and pukeko all had the same season lengths each year varying from one to three months. The black swan and Canada goose season lengths were quite different, both from each other and the other species. Of all the species, only the shoveler had a constant daily bag limit throughout the entire 14 year time period.

For mallards the bag limit from 1971 to 1976 was 15 birds/day; in 1977 to 1980 the limit was 25 birds/day and from 1981 to 1984 there was no daily limit on mallards. Hunters bagged a high of 3.03 mallards/hunter day and a low of 1.21 mallards/hunter day with an average of 2.04 mallards/hunter day over the entire 14 year period. The seasonal bag/hunter varied from 5.64 mallards/hunter to 18.36 mallards/hunter with an average of 12.12 mallards/hunter (Table 2b.1). When the legal limit of mallards was 15 per day, the harvest/hunter day averaged 1.75; when the daily limit was 25 the harvest/hunter day averaged 2.43; when there was no daily limit on mallards the harvest averaged 2.07 mallards/hunter day. The season length for mallards varied from 30 days to 90 days and the average seasonal bag/hunter for each seaaon length is listed below.

Season Length	Seasonal Bag Hunter
30 days	9.58
37 days	12.78
60 days	14.59
74 days	16.84
81 days	12.67
90 days	9.85

Table 2b.1. Yearly season lengths, bag limits, daily bag/hunter, and seasonal bag/hunter for the mallard.

YEAR	SEASON LENGTH	BAG LIMIT	DAILY BAG HUNTER	SEASONAL BAG HUNTER
1971	37 days	15	1.74	7.96
1972	30 days	15	1.71	8.18
1973	30 days	15	1.21	5.64
1974	30 days	15	1.68	9.46
1975	30 days	15	2.12	15.04
1976	37 days	15	2.06	12.03
1977	37 days	25	3.03	18.36
1978	60 days	25	2.35	16.54
1979	60 days	25	2.05	13.26
1980	60 days	25	2.27	13.98
1981	74 days	None	2.60	16.84
1982	81 days	None	2.24	12.67
1983	90 days	None	1.88	11.16
1984	90 days	None	1.57	8.53
		Average Bag	2.04	12.12

The bag limits for grey duck were similar to the mallard's, the only difference being in 1977 when the grey duck daily limit was 15, as compared to the mallard limit of 25. The hunters bagged between 0.28 and 0.85 grey ducks/hunter day with an average of 0.53 grey ducks/hunter day. The seasonal bag/hunter varied from 1.75 to 5.31 grey ducks/hunter with an average of 3.03 (Table 2b.2). When the daily limit of grey ducks was 15 the harvest/hunter day averaged 3.68; when the limit was raised to 25 per day the harvest/hunter day averaged 2.40; when ther was no daily limit on grey ducks the harvest/hunter day averaged 2.34. The season length for grey ducks were the same as those for the mallard and the average seasonal bag/hunter is given below.

Season Length	Seasonal Bag Hunter
30 days	3.67
37 days	3.70
60 days	2.40
74 days	3.23
81 days	2.27
90 days	1.94

Shoveler was the only species to have a constant daily bag limit during the 1971 to 1984 time period. The daily limit for this entire time was five, and the hunters bagged between 0.11 and 0.54 shovelers/hunter day with an average of 0.26 shovelers/hunter day. The seasonal bag/hunter varied from 0.64 to 3.05 with an average of 1.56 shovelers/hunter (Table 2b.3). The season lengths were again

Table 2b.2. Yearly season lengths, bag limits, daily bag/hunter, and seasonal bag/hunter for the grey duck.

YEAR	SEASON LENGTH	BAG LIMIT	DAILY BAG HUNTER	SEASONAL BAG HUNTER
1971	37 days	15	0.85	3.89
1972	30 days	15	0.62	2.94
1973	30 days	15	0.55	2.56
1974	30 days	15	0.69	3.87
1975	30 days	15	0.75	5.31
1976	37 days	15	0.55	3.22
1977	37 days	15	0.66	3.98
1978	60 days	25	0.32	2.24
1979	60 days	25	0.50	3.22
1980	60 days	25	0.28	1.75
1981	74 days	None	0.50	3.23
1982	81 days	None	0.40	2.27
1983	90 days	None	0.35	2.09
1984	90 days	None	0.33	1.79
		Average Bag	0.53	3.03

Table 2b.3. Yearly season lengths, bag limits, daily bag/hunter, and seasonal bag/hunter for the shoveler.

YEAR	SEASON LENGTH	BAG LIMIT	DAILY BAG HUNTER	SEASONAL BAG HUNTER
1971	37 days	5	0.19	0.89
1972	30 days	5	0.22	1.04
1973	30 days	5	0.16	0.75
1974	30 days	5	0.26	1.48
1975	30 days	5	0.26	1.81
1976	37 days	5	0.42	2.46
1977	37 days	5	0.11	0.64
1978	60 days	5	0.16	1.12
1979	60 days	5	0.14	1.32
1980	60 days	5	0.24	1.50
1981	74 days	5	0.39	2.55
1982	81 days	5	0.54	3.05
1983	90 days	5	0.35	2.11
1984	90 days	5	0.21	1.15
		Average Bag	0.26	1.56

identical to the mallard's. The average seasonal bag/hunter for each season length is given below.

Season Length	Seasonal Bag Hunter
30 days	1.27
37 days	1.33
60 days	1.31
74 days	2.55
81 days	3.05
90 days	1.63

For paradise shelducks the bag limit from 1971 to 1975 was three birds/day; in 1976 the daily limit was four per day, and from 1977 to 1984 the daily limit differed between low and high country. In 1977 the daily limit was four in the low country and six in the high country; from 1978 to 1980 the daily limit was two in the low country and six in the high country; in 1981 and 1982 the daily limit was two for the low country and eight for the high country, and in 1983 and 1984 the daily limit was two in the low country and 10 in the high country.

When the daily limit of paradise shelduck was three, the harvest/hunter day averaged 0.14 and when the daily limit was four, the harvest/hunter day averaged 0.19 paradise shelducks/hunter day (Table 2b.4). During 1977 when the limit was four per day in the low country, the harvest/hunter day averaged 0.0079, and from 1978 to 1984 when the low country daily limit was two, the harvest/hunter day averaged 0.024. In the high country the daily limit from 1977

Table 2b.4. Yearly season lengths, bag limits, daily bag/hunter, and seasonal bag/hunter for the paradise shelduck.

YEAR	SEASON LENGTH	BAG LIMIT	DAILY BAG HUNTER	SEASONAL BAG HUNTER
1971	37 days	3	0.097	0.44
1972	30 days	3	0.11	0.51
1973	30 days	3	0.082	0.38
1974	30 days	3	0.30	1.67
1975	30 days	3	0.13	0.94
1976	37 days	4	0.19	1.14
1977	37 days	4L 6H	0.0079L 0.20H	0.053L 1.13H
1978	60 days	2L 6H	0.0099L 0.19H	0.071L 1.30H
1979	60 days	2L 6H	0.011L 0.21H	0.063L 1.38H
1980	60 days	2L 6H	0.015L 0.12H	0.11L 0.69H
1981	74 days	2L 8H	0.039L 0.19H	0.28L 1.09H
1982	81 days	2L 8H	0.063L 0.37H	0.36L 2.05H
1983	90 days	2L 10H	0.021L 0.40H	0.14L 2.21H
1984	90 days	2L 10H	0.0095L 0.33H	0.048L 1.91H
		Total Average Bag	0.14	0.82
		L Average Bag	0.022	0.14
		H Average Bag	0.25	1.47

L = Low Country
H = High Country

to 1980 was six and the harvest/hunter day averaged 0.18; in 1981 and 1982 the high country daily limit was raised to eight and the harvest/hunter day averaged 0.28, and in 1983 and 1984 the daily bag limit was raised to 10 with the harvest/hunter day averaging 0.37. The season lengths for paradise shelduck were the same as the previous species, and the average seasonal bag/hunter for each season length is given below.

Season Length	Seasonal Bag Hunter
30 days	0.88
37 days	0.79
60 days	0.77
74 days	0.77
81 days	1.43
90 days	1.28

Pukeko also had a daily limit split between two areas of North Canterbury. From 1971 to 1977 the daily bag limit was one pukeko north of the Ashley River and three pukekos south of the Ashley River. From 1978 to 1984 the daily limit was two pukekos north of the Ashley River and four pukekos south of the Ashley River. Because so few pukeko were harvested between 1971 and 1984 (a total of only 263 birds) and the difficulty in determining whether they were shot north or south of the Ashley River, daily bag/hunter day and seasonal bag/hunter were calculated using the total number of pukeko shot rather than being split into north or south regions.

The hunters bagged between 0.0058 and 0.097 pukeko/hunter day

and averaged 0.055 pukeko/hunter day. The seasonal bag varied from 0.034 to 0.46 pukeko/hunter with an average of 0.29 pukeko/hunter (Table 2b.5). From 1971 to 1977 the daily bag limit for the entire North Canterbury Acclimatisation District was four birds; during this time the average harvest/hunter day was 0.043, and from 1978 to 1984 the total bag limit was six per day with the average harvest/hunter day 0.049. The season lengths for pukeko were the same as the previous species, and the average seasonal bag/hunter for each season length is given below.

Season Length	Seasonal Bag Hunter
30 days	0.30
37 days	0.26
60 days	0.24
74 days	0.46
81 days	0.33
90 days	0.27

The Canada goose was the only species in North Canterbury which did not have a limit placed on it during the 1971 to 1984 time period. It also had the most varied season lengths. In 1971 and 1972 the season length was 81 days throughout the entire Acclimatisation District. From 1973 to 1976 the season was extended to 194 days and from 1977 to 1984 the season was split between Ellesmere and the remainder of North Canterbury. The Ellesmere season lengths varied from 141 to 171 days and the season lengths for the remainder of North Canterbury varied from 224 to 261 days.

Table 2b.5. Yearly season lengths, bag limits, daily bag/hunter, and seasonal bag/hunter for the pukeko.

YEAR	SEASON LENGTH	BAG LIMIT	DAILY BAG HUNTER	SEASONAL BAG HUNTER
1971	37 days	4*	0.097	0.44
1972	30 days	4*	0.071	0.34
1973	30 days	4*	0.078	0.36
1974	30 days	4*	0.032	0.18
1975	30 days	4*	0.044	0.31
1976	37 days	4*	0.0058	0.034
1977	37 days	4*	0.051	0.31
1978	60 days	6*	0.031	0.20
1979	60 days	6*	0.043	0.28
1980	60 days	6*	0.041	0.25
1981	74 days	6*	0.071	0.46
1982	81 days	6*	0.059	0.33
1983	90 days	6*	0.043	0.25
1984	90 days	6*	0.052	0.28
		Average Bag	0.055	0.29

* = Limit for the entire North Canterbury Acclimatisation District

The daily harvest/hunter day varied from 0.12 to 0.43 with an average of 0.26 geese/hunter day. The seasonal harvest/hunter varied from 0.60 to 3.02 geese/hunter with an average of 1.55 geese/hunter (Table 2b.6). The seasonal bag/hunter has been separated into three areas: All of North Canterbury; Ellesmere, and North Canterbury excluding Ellesmere. These results are given below.

NORTH CANTERBURY:

Season Length	Seasonal Bag Hunter
81 days	0.83
194 days	1.76

ELLESMERE:

Season Length	Seasonal Bag Hunter
141 days	2.70
150 days	3.25
157 days	3.89
164 days	2.95
171 days	4.10

NORTH CANTERBURY EXCLUDING ELLESMERE:

Season Length	Seasonal Bag Hunter
224 days	0.84
231 days	0.81
240 days	0.40
247 days	0.26
254 days	1.09
261 days	0.25

Table 2b.6. Yearly season lengths, bag limits, daily bag/hunter, and seasonal bag/hunter for the Canada goose.

YEAR	SEASON LENGTH	BAG LIMIT	DAILY BAG HUNTER	SEASONAL BAG HUNTER
1971	81 days	None	0.22	1.00
1972	81 days	None	0.14	0.65
1973	194 days	None	0.13	0.60
1974	194 days	None	0.37	2.10
1975	194 days	None	0.43	3.02
1976	194 days	None	0.22	1.31
1977	141 daysE 231 daysR	None	0.29	2.53E 1.41R
1978	157 daysE 247 daysR	None	0.12	1.93E 0.26R
1979	150 daysE 240 daysR	None	0.19	3.25E 0.29R
1980	157 daysE 231 daysR	None	0.40	5.84E 0.21R
1981	164 daysE 240 daysR	None	0.18	2.17E 0.51R
1982	141 daysE 224 daysR	None	0.28	2.86E 0.84R
1983	164 daysE 254 daysR	None	0.36	3.73E 1.09R
1984	171 daysE 261 daysR	None	0.33	4.10E 0.25R
		Average Bag	0.26	1.45 Total 3.30 E 0.61 R

E = Ellesmere area

R = Remainder of North Canterbury

The black swan was the only waterfowl species to be taken off the licence and protected in North Canterbury during the 1971 to 1984 time period. It was hunted during the years 1971 to 1974 and again in 1984. During this time the daily limits varied from one per day to five per day. In 1984 the season length and bag limit were different for open water and 400m from the shore line; however, the majority of respondents from this year did not indicate how far from shore they were when they shot a black swan and, for the purpose of this study, these two areas were combined.

The daily bag of black swan/hunter day varied from 0.15 to 0.49 with an average of 0.34 black swan/hunter day. The seasonal bag per hunter varied from 0.49 to 2.35 with an average of 1.50 black swan per hunter (Table 2b.7). When the daily limit was one, the daily harvest/hunter day averaged 0.15; when the daily limit was two, the daily harvest/hunter day averaged 0.43, and when the daily limit was five the average daily harvest/hunter day was 0.46. In 1984 the combined area bag limit was seven and the average daily harvest per hunter day was 0.25. The season lengths varied from 37 days to 81 days and their respective seasonal harvests/hunter are listed below.

	Season Length	Seasonal Bag Hunter
1984 Season	37 days 51 days	0.49
	81 days	1.76

Table 2b.7. Yearly season lengths, bag limits, daily bag/hunter, and seasonal bag/hunter for the black swan.

YEAR	SEASON LENGTH	BAG LIMIT	DAILY BAG HUNTER	SEASONAL BAG HUNTER
1971	81 days	2	0.37	1.68
1972	81 days	2	0.49	2.35
1973	81 days	5	0.46	2.13
1974	81 days	1	0.15	0.87
1975	-------	-	----	----
1976	-------	-	----	----
1978	-------	-	----	----
1979	-------	-	----	----
1980	-------	-	----	----
1981	-------	-	----	----
1982	-------	-	----	----
1983	-------	-	----	----
1984	37 daysO 51 daysS	2 5	0.25	0.49
		Average Bag	0.34	1.50

O = open water

S = 400m from shore line

2.2 DISCUSSION

When examining hunter pressure in an area, the total number of hunters, hunting days and the number of hunting days per hunter must be taken into account. Every year more hunters went to areas outside of Lake Ellesmere and more total hunting days were spent in areas other than Ellesmere. Since the Lake is a comparatively small component (in terms of acreage) of the North Canterbury Acclimatisation District, fewer hunters and total hunting days at Lake Ellesmere was not surprising. What is important to note is that hunters at Lake Ellesmere spent more hunting days at the Lake than hunters in the remainder of North Canterbury spent at their respective hunting areas.

The reason for more hunter time being spent at Lake Ellesmere is twofold. First, the Lake is very accessible and close to the majority of North Canterbury's population and second, the success rate for Lake Ellesmere is higher than that of the remainder of North Canterbury. From personal observation it has been noted that the majority of waterfowl hunters equate an enjoyable hunt with a successful hunt; therefore, they are going to spend more time where they feel their chance of success is greatest. The average bag per shooter was over three birds greater for hunters at Lake Ellesmere as compared to hunters from all of the remaining areas of North Canterbury combined (Table 2a.2).

When the average bags for each hunter were separated into different species, it is interesting to note the species which were most prevalant in each area. The average bags per shooter

of mallard, grey duck, paradise shelduck and pukeko were all slightly higher for the hunter in areas other than Lake Ellesmere, but none of these averages was greater by more than 1.2 birds per hunter. In comparison, the average bags of shoveler, Canada goose and black swan were all higher for the Lake Ellesmere hunter, and these averages were all greater by more than 2.2 birds per hunter (Tables 2a.4 to 2a.10).

Comparison of the bag/hunter of the different species at the two areas indicates that a hunter would be able to bag approximately the same number of mallards; slightly fewer grey ducks, paradise shelducks and pukekos, and substantially more shovelers, Canada geese and black swans at Lake Ellesmere in comparison with the rest of North Canterbury. Lake Ellesmere is considered one of the most important waterfowl hunting areas in North Canterbury. The greater amount of hunter time and higher bag/hunter at Lake Ellesmere in comparison to the rest of North Canterbury supports the conception of the Lake's prominence to waterfowl hunters.

Season lengths and bag limits play a crucial role in the annual harvest of waterfowl. Theoretically longer seasons and higher bag limits should increase the waterfowl harvest; however this study showed that this is not always the case. An example of the effect of changing bag limits and season lengths on the harvest can be made with the mallard.

In the first section mallards were shown to be the most preferred species to hunt from the shooters point of view. Since it is the most preferred species, it is safe to assume that whenever a shooter has the chance he will bag a mallard. What then

was the effect on the total average daily bag/hunter when the daily limit on the mallard went from 15 to 25 to no limit? When the daily limit went from 15 to 25 mallards/day, the average daily bag/hunter jumped from 1.75 to 2.43 mallards/day, holding true to the theory that as limits increased bags increased. However, when the daily limit went from 25 mallards/day to no limit at all, the average daily bag/hunter dropped from 2.43 to 2.07. The most likely reason for this variance from the above theory can be found in the comments portion of Section 1. Hunters place a great deal of value on the achievement of a "limit bag" and most are willing to continue hunting if they think that they will be able to obtain a limit. When there is no hope of them being able to obtain a limit (e.g. no limit placed on the bird), they are more likely to "call it a day" and be satisfied with however many birds they have. This phenomena of average daily bag/hunter decreasing as daily bag limits increase is also observed for the grey duck, and black swan.

In theory the setting of season lengths should have the same effect on waterfowl harvest as the setting of bag limits. Using mallards as an example again, it can be seen that the seasonal bag/hunter did in fact increase with the increase in season length up to a point. Seasonal bag/hunter increased from the time the season length was increased from 30 days to 74 days, but when the season was increased to 81 days and again to 90 days the average seasonal bag/hunter decreased. While poor weather played a role in this harvest decrease (diaries for these years indicated that the weather was dry and still for the most part) a major factor

could also be that the hunters are not taking advantage of the extra hunting opportunities available in a longer season. As seen in Table 2a.1, during the years when the season length was 81 days or longer, the number of days spent hunting/shooter decreased, for both Lake Ellesmere and elsewhere in North Canterbury. This phenomena was also observed in other species (grey duck, pukeko and shoveler), while the harvest of some species did in fact increase as season lengths increased (Canada geese and black swan).

An interesting sideline discovered while doing this study was the difference in the average seasonal bag/hunter, particularly at Lake Ellesmere, during the open and closed black swan season. The average seasonal bag/hunter of mallards almost doubled during the closed season, while the average bags of grey duck, shoveler and Canada goose all increased as well. Theories for this occurence include: a) black swans act as a decoy, pulling other ducks into an area; b) hunters spend effort normally directed at black swans on other species, and c) since the black swans are not being harrassed, they will stay in the area, enticing other species to stay as well thus keeping them available to the hunter. It is not within the scope of this study to probe this issue in depth, but it is certainly worthy of investigation in the future.

2.3 CONCLUSION

In terms of hunter effort (hunting days/hunter) and total seasonal harvest per hunter, Lake Ellesmere is the single most important waterfowl hunting area in North Canterbury. Hunters spend more of their time and harvest more birds at the Lake than all the other waterfowl hunting areas of North Canterbury combined. Any waterfowl management which is to be done in North Canterbury, must address itself to the Lake, particularly for the black swan and shoveler, in order for it to be successful.

To control and/or decrease the population of some species (e.g. Canada goose in North Canterbury), bag limits have been raised until they are non-existent and season lengths extended. In this study it was discovered that these methods do not necessarily achieve their goal, and can even decrease, rather than increase, the hunter's daily bag. In order for the manipulation of season lengths and/or bag limits to have the desired effect, the waterfowl manager must take into careful consideration not only biological aspects of the target species, but also the sociological aspects of the waterfowl hunter.

While this study exhibited the importance of Lake Ellesmere in North Canterbury and exposed some of the flaws in waterfowl management theory, it is limited to being simply a baseline type study. From the findings here, it would seem prudent for some type of experimental waterfowl management practices to be initiated. These practices could include (but are not limited to) the implementation of split seasons and the lowering of bag limits and/or

season lengths on certain species in order to increase the harvest. These programs would have to be carefully monitored and followed through in order to compare their success with previous methods. Careful experimentation with bag limits and/or season lengths, including feedback from the waterfowl hunter, is now needed in North Canterbury in order to achieve the management goals for the waterfowl population.

3.1 INTRODUCTION

The black swan, Cygnus atratus, was first introduced into New Zealand from Australia around 1864 by the Nelson Acclimatisation Society (Thompson 1922). In 1864 the Canterbury Acclimatisation Society (now the North Canterbury Acclimatisation Society or NCAS) released four birds on the Avon River, and in 1865 the Christchurch City Council imported and released another 13 pairs (Lamb 1964). The generally accepted reason behind these introductions was the control of cress in the Avon River (Williams, G.R. 1969); however, another reason given for the introduction of black swans into Canterbury is that loggers needed them to control weed growth in Lake Ellesmere to make the moving of logs easier (G. Thompson, pers. comm.).

The introduced swans filled the ecological niche left empty by the extinct native swan, Cygnus summerensis, and their numbers increased rapidly. This rapid increase may have been augumented by spontaneous immigration occurring at the same time (Kirk 1895, Williams, M. 1973a), although there is no proof. On Lake Ellesmere swan numbers increased dramatically, and they were shot as game from 1875.

Lake Ellesmere was the swans' main feeding and breeding area in the South Island. By the late 1950's early 1960's, their numbers had peaked to the conservative estimate of 80,000 (estimates from New Zealand Wildlife Service and NCAS files), and several management controls were practiced. These controls included: Organised swan drives (usually two or more a year); allowing nesting only at the Birdlings Flat Colony; and

restricting the yearly breeding attempt to 25,000 eggs--through collection and sale of excess eggs, approximately 3000 dozen annually in the early 1960's. These controls were in addition to the swans being hunted, with no limit, for three months of the year.

In April 1968 disaster struck the Lake Ellesmere swan colony. A tropical cyclone hit the East Coast of the South Island in what locals called the "Wahine" storm (after the inter-island ferry, T.E.V. Wahine which foundered in the storm). The effect of the gale force winds on Lake Ellesmere was cataclysmic. An estimated 5000 swans were killed outright, and the lake's luxurious weed beds of Ruppia and Potamogeton (the swans' main food source) were ripped up and blown into huge windrows four or five feet beyond the lake's normal level (Bucknell 1969).

The loss of their major food supply, coupled with several years of poor breeding, caused a dramatic crash in the swans' population. The hunting seasons and organised shoots continued until 1974, with no limit placed on the birds during the hunting season until 1971 (limit decreased to 2). In 1972 the hunting bag limit for black swans was 2 again; then in 1973 it was increased to 5; and in 1974 it was decreased to 1. From 1975 to 1983 (inclusive) the black swan in North Canterbury was totally protected; then in 1984, due to pressure from local farmers (complaining of paddock depredation by swans) and gamebird hunters (NCAS), black swans were once again put on the hunting licence in North Canterbury with a daily limit of 2. Thus, the black swan has gone from gamebird status to protected species and back to gamebird status.

In the pre-Wahine times, the Ellesmere black swan productivity was researched by Cutten (1966) and Miers and Williams (1969). Since that time only one in-depth study, Williams (1979), and one cursory study, Adams (1971), have been done. Several studies have been done on the swans' demographic characteristics and management problems (Williams, M. 1973a, 1973b, 1975, 1977a, 1977b, 1980a, and 1980b). The aims of this research were to explore the 1986 black swan productivity in order to compare it to previous studies, both in New Zealand and Australia, and to discover the present status of the black swan at Lake Ellesmere for management purposes.

3.2 STUDY AREA

The study took place between August 1986 and Feburary 1987 at the Birdlings Flat Swan Colony of Lake Ellesmere (Fig. 3.1). Lake Ellesmere is situated on the central east coast on the South Island of New Zealand, 43o 47' S and 172o 30' E, south of Banks Peninsula. The lake is 22 kilometers long, 12 kilometers wide at its widest point, and has a margin of approximately 93 kilometers. It has a maximum depth of approximately 3.6 meters and is about 96 square kilometers in area.

The lake level is regulated by the North Canterbury Catchment Board. When lake level reaches 1.13 m above m.s.l. in April-July and 1.05 m above m.s.l. in August- March, the lake is opened to the Pacific Ocean by a cut through the shingle spit on the lake's south-eastern most shore at Taumutu (Fig. 3.2). This opening closes naturally during strong southerly winds or storms. It may remain open for long periods during the summer when storms are few and of lesser magnitude.

Because of its proximity to the ocean and the periodic interchanges of water, Ellesmere is more or less saline. The flora and fauna reflects this. O'Donnell (1985) summarized this concisely.

The Birdlings Flat Colony is on the eastern shore of the lake (Fig. 3.2). Its vegetation consists primarily of the three-square sedge, Scirpus americanus; shore ribbonwood, Plagianthus divaricatus; purple mimulus, Mimulus repens; Southern glasswort, Salicornia australis; and salt-tolerant grasses, Hordeum marinum and Agrostis stolonifera. The study area in the

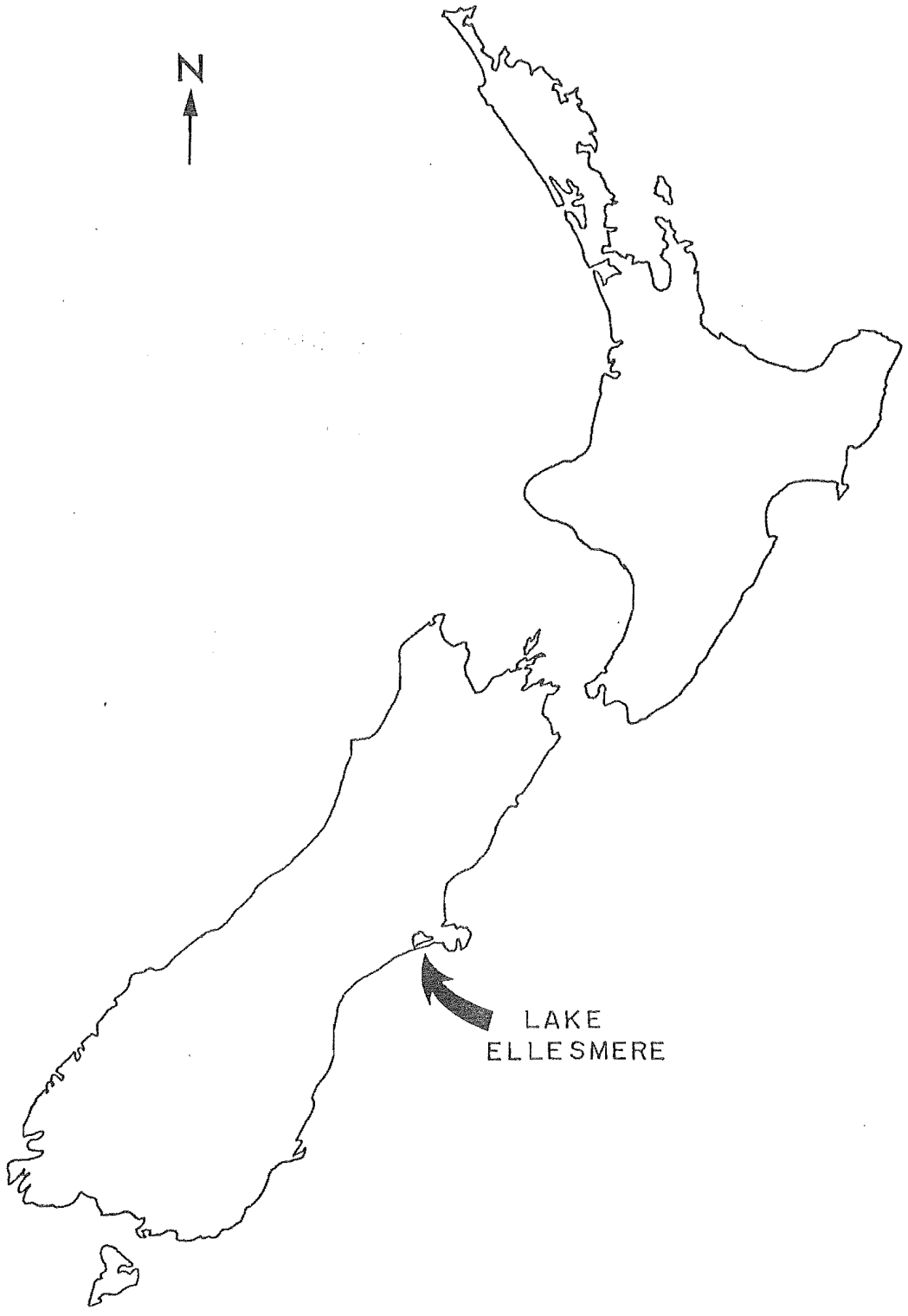

Figure 3.1 Lake Ellesmere, New Zealand

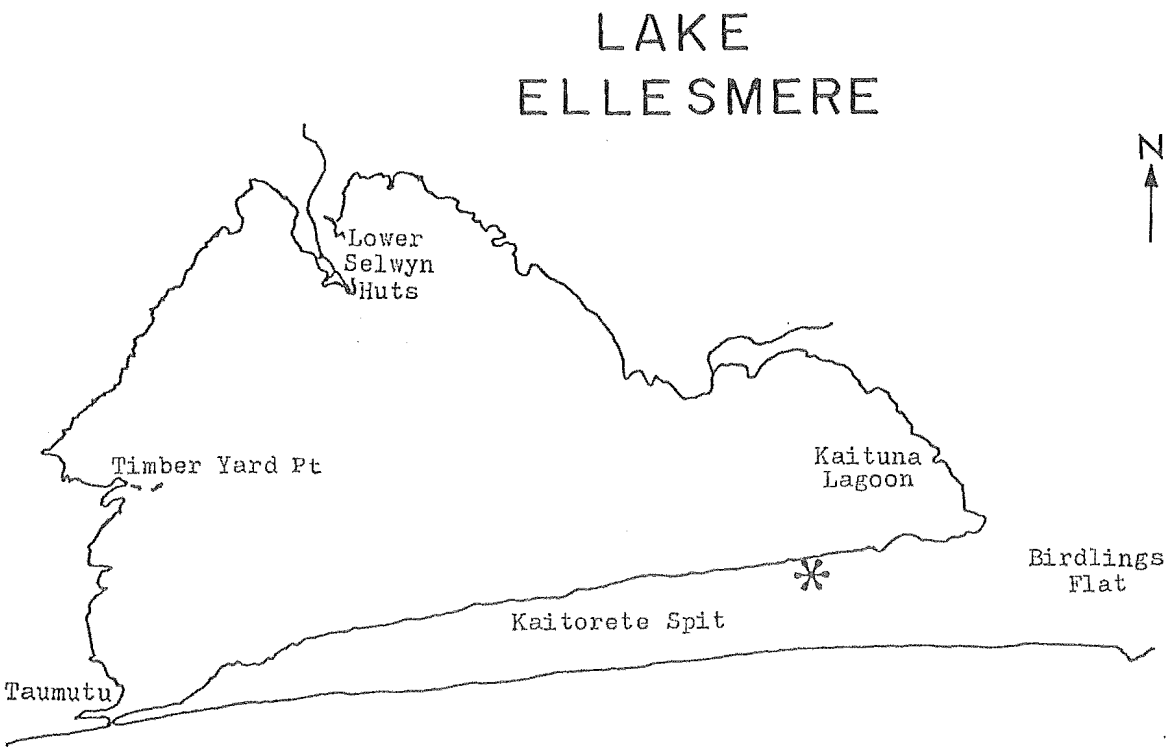

Figure 3.2 Birdlings Flat black swan colony location (*).

Colony extended for approximately 2.5 kilometers north to south and 200 meters east from the shoreline.

Local farmers lease this land from the Crown for grazing purposes, and the stock allowed on the Colony have shaped it into two very different habitats. South of the Coop/Birdling fenceline (Fig. 3.3) cattle have been grazed, and as a result, there are no Plagianthus taller than 0.5m and the Scirpus is only found in isolated clumps. North of the boundary fenceline, only sheep have been grazed, and the Plagianthus and Scirpus are much more lush and abundant. Because of this conspicuous difference, the Colony was divided into North and South sections for comparative purposes in this study.

The 1986 season was an extremely wet one in comparison to the 1984 and 1985 seasons. During the four month period of August through November, 365.4mm of rain fell in 1986 as compared to 213.5mm in 1985 and 152.0mm in 1984. Because of the saturation of the ground and the abundance of feed in other paddocks, no stock were released into the Colony during the course of the study. Thus, the effect of stock upon the nesting birds can only be assessed in terms of the effect that cattle grazing has had on the vegetation in the Colony, and the shelter it affords the nesting birds.

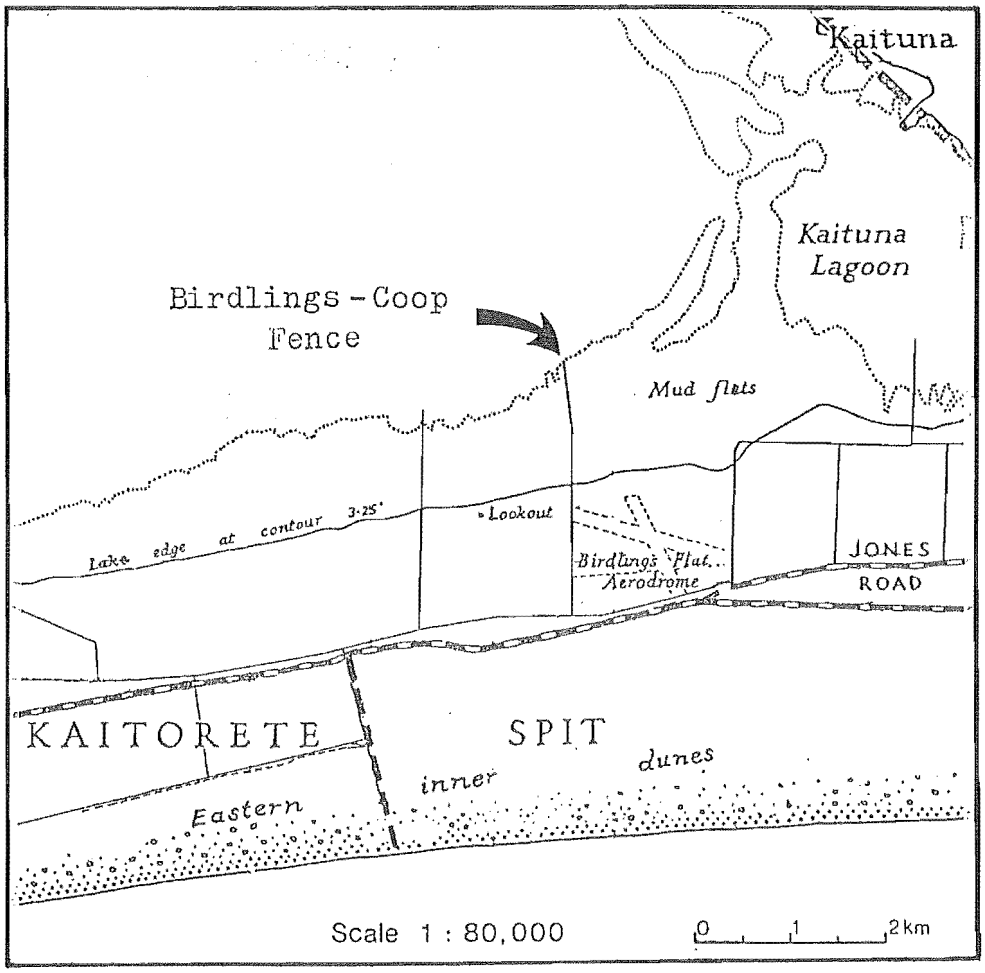

Figure 3.3 Division of the black swan colony along the Birdlings-Coop fenceline.

3.3 MATERIALS AND METHODS

3.3.1 Nest Sites

The first week of the study was spent in allowing the swans to become accustomed to my presence in the Colony. I walked through the Colony every day observing the behaviour of swans, when they were put off their nests, and determining how long until they would return to their nests. It took approximately 5 minutes for swans to return to their nests after I had left an area. The impact of my moving quitely through the Colony along a constant path was considered to be minimal.

Because black swans may start laying eggs before any nest structure is constructed, a nesting attempt was defined as the laying of one or more eggs in a specific spot with later initiation of construction and maintenance of nest structure Each nest was pegged with a numbered stake (2.54cm X 2.54cm X 51cm). The stake was placed near the nest and close to standing cover, so as not to alarm the birds. Any nest where one or more eggs hatched was deemed successful, and if no eggs hatched, the nest was unsuccessful.

During the egg-laying period, the Colony was visited every second day, except twice when heavy rains and flooding prohibited visits. Once hatching started the Colony was visited daily in order to catch and tag as many cygnets as possible.

3.3.2 Egg Marking and Measuring

The eggs in each nest were marked with a permanent black felt tip marker when they were freshly laid. The nest number and the

egg's sequence number in the laying order were written on each egg. This method of marking has been found to have no effect on the eggs' hatchability (M.J. Bell, New Zealand Wildlife Service, Wellington; pers. comm.). Marking the eggs had no determinable effect on hatching success.

The fresh weight of each egg was recorded using a 500 gram spring balance calibrated at 5g intervals and a specialized egg sling made of PVC material and Velcro (Fig. 3.4). The scale's accuracy was tested using known weights. The weight loss during incubation was recorded for the clutches in 20 nests. Each egg was weighed every second day.

After fresh weight was recorded, each egg was measured using a vernier caliper. Maximum length and diameter were recorded to the nearest 0.1mm. Repeat trials were used to determine the amount of error between the recordings for weight and size. The usual difference in recording weight was within a range of 5g and for size within a range of 0.2mm.

3.3.3 Incubation

Following Braithwaite's (1977) method onset of incubation was determined for clutches, rather than individual eggs. In this study incubation was considered to begin with the laying of the penultimate egg, and ending when the first egg hatched. The date when the clutch was completed was determined retrospectively when 7 days had elapsed without any further eggs being laid. Since the study nests were checked on a constant, frequent basis, any eggs which were eaten or removed from a nest, or added to a nest were discovered and noted. Thus, the clutch size given for each study

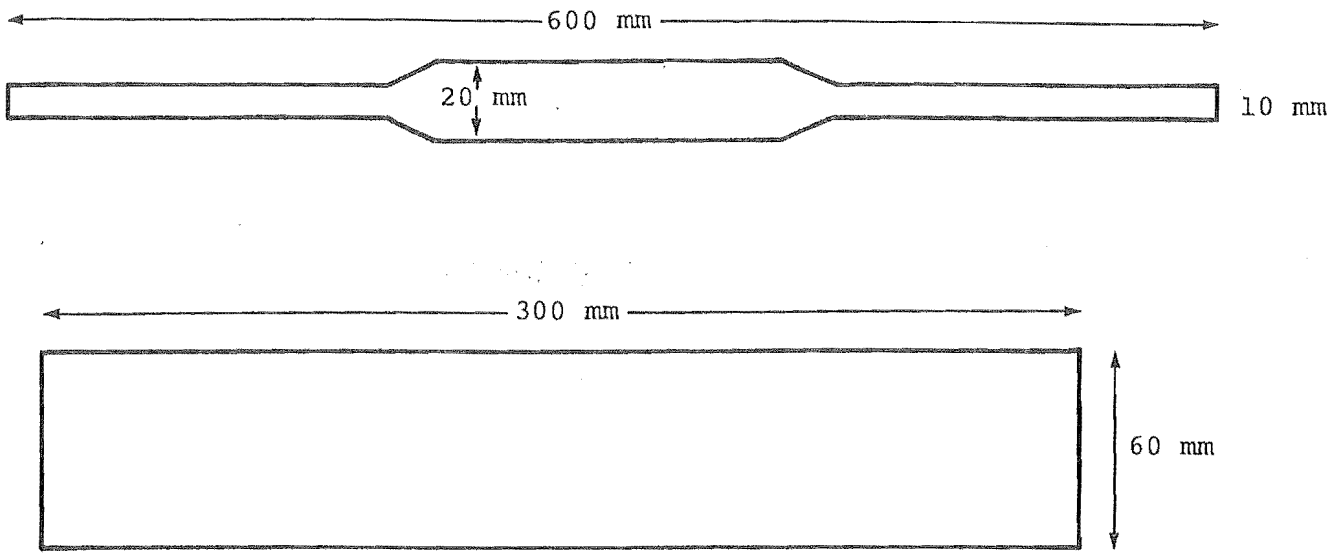

Figure 3.4 Sling used to weigh eggs.

nest is accurate and includes all eggs laid in each nest.

3.3.4 Cygnets

Every dry cygnet found in a study nest was weighed using the 500g scale and a special sling constructed from an old sock (Fig. 3.5) and web tagged. Weights, weg tag numbers, and, if possible, egg numbers and hatching order were recorded for each nest. Wet cygnets in study nests and all cygnets from non-study nests were web tagged only. All web tags were placed on the outer web of the left foot.

Since swans at Lake Ellesmere may breed all year round, the 1986 nesting season was determined to have ended for this study when two weeks had passed without attempts at nesting. After this date (21 November 1986) , only those nests alreaady pegged were followed through. All new attempts were ignored. The last cygnets were tagged on 12 December 1986.

The first recapture of the cygnets was on the 4th and 5th of January 1987. During this recapture all cygnets, regardless of size, were taken. Six boats with either 15 or 25 hp outboard motors were used to capture cygnets while either kayaks or motor-cycles pushed the swans from the shallow water out to the boats. Cygnets were captured using a swan hook (Fig. 3.6) and all cygnets captured were banded before being released. Cygnets with and without web tags were counted and, where possible, web tag numbers recorded with the corresponding band number. All web tagged cygnets caught in one boat were weighed using a 10kg scale, calibrated at 0.2kg intervals, and these weights were recorded.

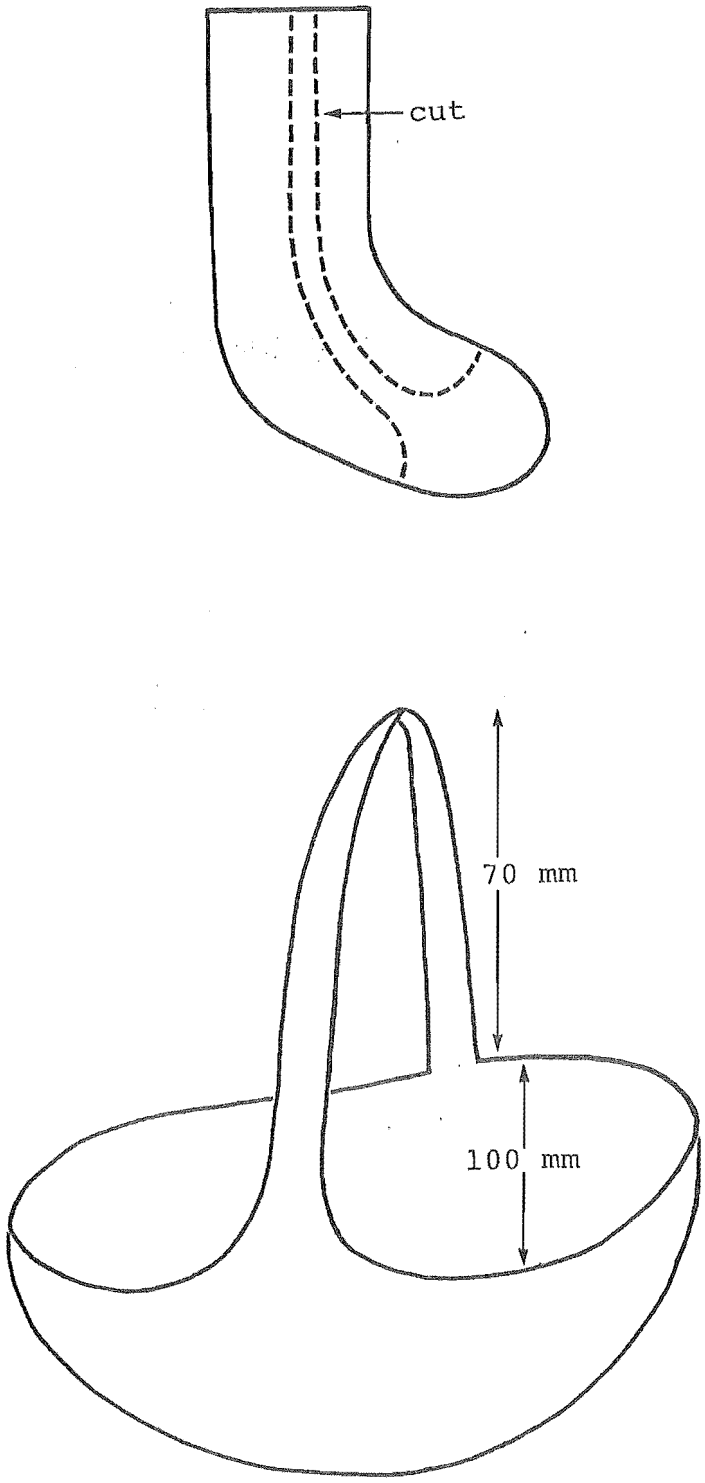

Figure 3.5 Sling used to weigh cygnets.

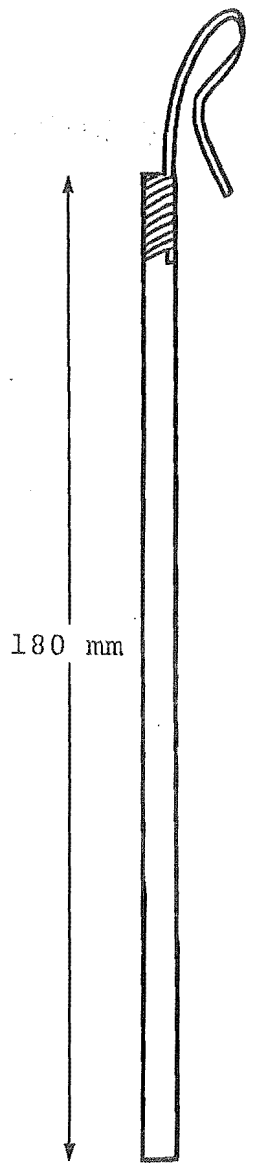

Figure 3.6 Swan hook used for capturing swans when banding.

On 11 Feburary 1987 cygnets were again recaptured. On this occasion only three boats and one kayak were used. The number of cygnets from each of the following categories was recorded along with band and web tag numbers (where suitable):

-No Marking

-Web Tag Only

-Web Tag and Band

-Band Only.

As in the first recapture, all web tagged cygnets caught in one of the boats were weighed using a 10kg scale. To protect the sample from the bias of recruitment to the cygnet population data, only cygnets judged to be older than 2 months by their size and plummage were taken on this recapture.

3.4 RESULTS

3.4.1 Nest Sites

A total of 222 study nests were marked and followed. 149 of these were in the North Colony and 73 in the South Colony. 263 nesting attempts took place at the study sites, of which 160 were successful and 103 were unsuccessful. In the North Colony 113 nests (76%) were successful and in the South Colony 47 nests (64%) were successful.

Of the 263 nesting attempts, 197 were incubated and 66 were not incubated. None of the non-incubated nests was successful, while 81% (160) of the incubated nests were successful and 19% (37) were unsuccessful. The nests that were not incubated were lost due to:

Flooding-24

Predation-20

Abandonment-21

Infertile Eggs-1.

The 37 nests which were incubated and were unsuccessful were lost due to:

Flooding-2

Predation-19

Abandonment-8

Infertile Eggs-8.

If the nest was abandoned after egg predation, the nest was included in "predation" and not "abandonment". Table 3.1 gives the data on unsuccessful nests for incubated and unincubated.

Egg predation was the main factor leading to nesting

Table 3.1. Percentage of nests (incubated and not incubated) lost due to flooding, predation, abandonment, and infertile eggs.

	Incubated	Non-Incubated	Total Nests
Flooding	7.7%	92.3%	26
Predation	48.7%	51.3%	39
Abandoned	27.6%	72.4%	29
Infertile Eggs	88.9%	11.1%	9
% of Total Attempts	14.1%	25.1%	263

failure. The important egg predators at Birdlings are stoats, Mustela erminea, and Southern Black-Backed Gulls, Larus dominicanus. Other minor predators are ferrets, Mustela furo, and rats, Rattus norvegicus and R. rattus. When enough of the remains of a partially eaten egg were found, the predator could be determined. Gulls peck at an egg in the nest, until they have made a hole large enough for them to reach in and eat the contents. Frequently, eggs eaten by gulls spilled yolk into the nest and over the remaining eggs. Sometimes this caused the swans to abandon the nest. At other times, the swan simply removed the broken eggshell from the nest and continue to sit. Stoats removed the entire egg from the nest before eating it. Usually they took the egg under cover (e.g. overhanging grasses) and ate it by breaking large bits off one side of the egg. Eggs eaten by stoats typically have large openings, with the inside completely cleaned out. Several stoat nests were found within the Colony and about three-quarters of all egg predation was attributed to them.

For a nest to be considered successful, one or more eggs from that nest had to hatch. Table 3.2 shows the number of incubated nests and successful nests for each clutch size.

Table 32. Comparison of incubated with successful nests for each clutch size.

Clutch Size	No. of Incubated Nests	No. of Successful Nests
1	5	1
2	6	4
3	21	11
4	43	32
5	65	61
6	46	42
7	8	7
8	3	2
TOTAL NESTS	197	160

Of the 160 successful nesting attempts:

61-all egs hatched
51-all but one egg hatched
18-all but two eggs hatched
20-all but three eggs hatched
7-all but four eggs hatched
1-all but five eggs hatched
2-all but six eggs hatched

In total there were 854 eggs in successful nests and 186 of these were lost. 148 eggs were infertile/addled, 36 eggs were eaten, and 2 eggs were thrown out of the nest. If data from successful nests only were used to determine a "successful clutch size", it would be 4.96 ± 1.15 (S.D.) eggs per nest, with an average hatching of 3.77 ± 1.50 (S.D.).

The average duration for incubation for the 160 successful nests was 39.18 ± 2.55 (S.D.) days with a median of 40 days. The longest any successful nest was incubated was 50 days, and the shortest time any successful nest was incubated was 31 days.

3.4.2 Clutch Size and Egg Measurements

Only those nests which were incubated were used in determining the average clutch size. The data for clutch size were distributed among the 197 incubated clutches with a mean of 4.74 ± 0.096 (S.E.); the minimum 1.0; maximum 8.0; and median 5.0. There were a total of 934 eggs in the incubated clutches. These eggs were all weighed and measured within two days of being laid. The data from three eggs were destroyed in a severe reainstorm; however, since the data came from three different nests with eggs

at different sequence order, and because the data base is so large, the missing data from these three eggs were not felt to skew any of the results. Table 3.3 shows the means ± twice the standard error (95% confidence interval), minimum, and maximum for all the eggs in their respective sequence for length, diameter and weight.

In all the comparative data for lengths, diameters, and weights only the means are used. Some overlap may therfore occur between measurements. The results are given in this way for better comparisons with other studies in the discussion segment of this section. All statements in the upcoming segment are generalizations and should be taken as such.

A comparison of lengths for all eggs is given in table 3.4. The third egg in the clutch was overall the longest, while the sixth was the shortest. The egg lengths for eggs in the five main clutch sizes were then compared to determine if clutch size had any effect on the egg length (Table 3.5). From these data, it can be seen that the last egg in a clutch of six or fewer was the shortest; while the second egg in a clutch of seven or eight was the shortest. The first egg laid in a clutch of three or less was the longest; while the third egg was the longest in clutches of four and six, and of equal length with the second egg in clutches of five. Finally, these data were compared in terms of the egg's length in laying order for each clutch size (Table 3.5). These data show that the first egg laid is the longest in a clutch of three or fewer and shortest in a clutch of six; while the second egg laid is the longest in a clutch of four and shortest in a

Table 33. Means ± standard errors and ranges (in parentheses) for all eggs in their respective sequence order.

Sequence Order	N	Length (mm)	Diameter (mm)	Weight (g)
1	196	102.8±0.69 (83.6-114.9)	66.26±0.33 (60.0-72.0)	260.6±3.60 (175-330)
2	192	103.3±0.58 (91.6-113.9)	66.99±0.28 (61.0-71.7)	266.6±3.18 (215-330)
3	185	103.7±0.59 (93.1-114.3)	66.97±0.32 (62.1-79.9)	268.1±3.33 (225-335)
4	166	102.8±0.68 (85.8-115.0)	66.54±0.34 (60.1-72.8)	263.6±3.85 (200-320)
5	121	102.7±0.76 (92.8-113.8)	66.15±0.39 (60.9-71.8)	260.4±4.06 (200-320)
6	57	101.2±1.25 (90.9-111.6)	64.40±0.58 (61.2-71.9)	252.6±6.45 (210-320)
7	11	103.0±2.29 (96.9-108.3)	66.17±1.27 (64.0-70.1)	264.5±12.96 (240-305)
8	3	103.3±4.49 (98.8-105.9)	65.50±1.53 (64.5-67.0)	260.0±20.00 (240-270)

Table 3.4. Comparison of mean lengths for all eggs in their respective sequence order.

Sequence Number	Mean Length (mm)
1	102.8
2	103.3
3	103.7
4	102.8
5	102.7
6	101.2
7	103.0
8	103.3
Total Mean	103.0

Table 3.5. Mean lengths (mm) of eggs in each clutch size for each sequence order.

Clutch Size	Sequence Order 1	2	3	4	5	6	7 & 8
1 to 3	104.1	103.4	103.4				
4	103.4	103.8	104.2	102.4			
5	102.7	103.7	103.7	103.1	102.0		
6	101.6	102.3	103.1	102.3	103.0	100.8	
7 to 8	102.3	101.8	103.8	103.9	104.0	104.6	102.9

clutch of seven or eight.

The data for egg diameters were then treated in the same manner as egg lengths (Tables 3.6 and 3.7). Overall, egg diameter was greatest for the second and third eggs laid and least for the sixth egg laid (Table 3.6). When examining the diameter of eggs in clutches, the diameter of first and last eggs was found to be less than eggs laid in the middle of the sequence order (Table 3.7).

The data for egg fresh weights were treated in the same manner as lengths and diameters (Tables 3.8 and 3.9). Again, the third egg was the largest of all eggs, being the heaviest, and the sixth was the lightest overall (Table 3.8). For clutches of three or fewer, the first egg laid was the heaviest and the second and third eggs were equal in weight. The first egg laid in a clutch of three or fewer was heavier than first eggs in any other clutches, and the third, fourth, and fifth eggs laid in a clutch of seven or eight were heavier than third, fourth, of fifth eggs in any other clutches (Table 3.9).

When comparing the tables for overall length, diameter, and weight (Tables 3.4; 3.6, and 3.8), the same general trends are seen: high peaks at the third and seventh eggs, and lows at the first, sixth, and eighth eggs. The only variations from these trends are in table 3.4 where the length of the eighth egg is greater than that of the seventh egg, and in table 3.8 where the second egg is equal to the third egg in diameter. These overall trends show that the third egg is the largest one laid, while the sixth is the smallest, and eggs laid after the sixth

Table 3.6. Comparison of mean diameters for all eggs in their respective sequence order.

Sequence Number	Mean Diameter (mm)
1	66.26
2	66.99
3	66.97
4	66.54
5	66.15
6	64.40
7	66.17
8	65.50
Total Mean	66.53

Table 3.7. Mean diameters (mm) of eaggs in each clutch size for each sequence order.

Clutch Size	Sequence Order 1	2	3	4	5	6	7 & 8
1 to 3	66.7	67.2	66.8				
4	66.2	67.0	66.5	65.4			
5	66.6	67.2	67.4	66.9	65.8		
6	65.4	66.6	66.9	66.8	66.3	64.8	
7 to 8	66.7	67.2	68.0	68.3	67.6	67.2	66.0

Table 3.8. Comparison of mean fresh weights for all eggs in their respective sequence order.

Sequence Number	Mean Fresh Weight (g)
1	260.0
2	266.6
3	268.1
4	263.6
5	260.4
6	252.6
7	264.5
8	260.0
Total Mean	263.4

Table 3.9. Mean fresh weights (g) of eggs in each clutch size for each sequence order.

Clutch Size	Sequence Order 1	2	3	4	5	6	7 & 8
1 to 3	268.4	267.0	267.0				
4	262.5	269.5	265.5	252.0			
5	263.0	270.0	270.5	268.0	256.0		
6	249.5	259.5	267.0	264.0	262.0	250.0	
7 to 8	261.5	265.5	272.5	277.5	275.5	264.0	263.0

become larger again. Clutch size and sequence order in the clutch are also important factors relating to egg size and cannot be ignored. Other possible factors related to egg size are the age of the laying swan and whether the swan is nesting for the first time, or renesting. These parameters could not be determined in this study and are not considered further here.

Eggs from 20 nests were weighed every second day until hatching to determine the weight loss during incubation. Of the original 20 nests, 5 were lost to flooding and predators during incubation. Sixty-two eggs hatched from the remaining 15 nests.

The average weight loss from laying to hatching was 34.68g ± 1.78g (S.E.) or 13.9%, and the average weekly loss was 5.78g ± 0.30g (S.E.) or 2.3%. During the first week after laying, there was very little weight loss (0.807g ± 1.95 S.E.), this is probably due to the extremely wet conditions at the time. Freshly laid eggs are able to absorb water (M.J. Bell, pers. comm.), and at this time, rain was falling constantly in the Colony. Many nests became permanently damp as a result. As the weather cleared and the nests dried, weight loss increased dramatically.

3.4.3 Cygnets

2842 cygnets were web tagged, of these, 275 came from study nests. The average weight of the cygnets was 175.9g ± 16.47g, (S.D.) and their weights ranged from 130g to 220g.

On the first recapture during the 4th and 5th of January 1987, 2242 cygnets were captured. 602 of these cygnets carried web tags and 56 of them were from study nests. 2228 cygnets were banded and released (14 cygnets died during the recaptures). The recaptures were done on the northern shores of Lake Ellesmere from Selwyn River to the Birdlings Flat Colony. This area is where most black swans nest and enabled the maximum number of swans to be recaptured, as trying to recapture cygnets over the entire lake was impossible. The average weight of the cygnets at this recapture was 3.42kg ± 0.15kg (S.E., N = 70).

The second recapture was during 11 Feburary 1987, and 285 cygnets were captured at this time. Cygnets from this recapture were not banded before being released; they were only checked for previous web tags and/or bands and then released. After releasing cygnets, the boats moved forward so that cygnets would not be captured again. Of the 285 cygnets captured: 27 had web tags only; 16 had both a web tag and a band; 55 had bands only; and 187 had no markings. The average weight of cygnets from this recapture was 3.93kg ± 0.18kg (S.E., N = 13); weights were again normally distrubuted, but due to the low value of N, are not graphed.

In order to estimate population size and cygnet survival the

Bailey's triple catch method was used (Begon 1979). The estimated cygnet population size after the first marking (web tagging) was estimated to be 6816.37. The survival rate from first web tagging to the first recapture was 0.51 and birth-rate was 0.85. The survival rate from the first recapture to the second recapture was 0.75, with a birth rate of 0.35. The cygnet population at the end of the recaptures was estimated at 10,197.28 $\pm$ 709.14 (S.E.).

3.5 DISCUSSION

3.5.1 Nest Sites

Swans nesting in the northern half of the Colony were markedly more successful than swans nesting in the southern half of the Colony. The higher success is in part due to the greater amount of vegetation in the northern colony. The swans nesting here have more cover and protection for their nests, from both avian predators and the elements. Nesting started earlier in the northern colony than in the southern colony, and although about equal in area, many more nests were built in the nothern colony by comparison with the southern. Since swan access to both areas is similar, the greater numbers using the nothern colony reflects the swans' prefernce.

During field studies it was observed that the swans in the northern colony were much more aggressive and protective of their nests than were southern colony swans. Swans with black tips to the white primary feathers (chacteristic of juvenile plummage) were seen frequently in the south colony, but never in the north colony. While not clearly established, it could be that the swans nesting in the northern colony are the older, more dominant, members; while, those in the southern colony are the younger (possibly first year breeders), later breeders, or renesters, and are less aggressive swans.

Another common occurence at the Colony was the defaecating over nests by sitting swans when they were disturbed or alarmed. While this could be simply a reflex reaction to being startled and fleeing, it may also be a type of anti-predator device as proposed for some anatidids (Swennen 1968). No faeces-covered eggs were eaten by predators during this study, but more studies on this subject are needed.

The incubation period found in this study (39.18 days $\pm$ 2.55 days, S.D.) was slightly longer than the 36.4 days $\pm$ 1.17 days, S.D. which Miers and Williams (1969) found. The reason for this difference could be the fact that incubation was defined in their study as beginning once the clutch was complete, while in this study incubation was defined as beginning with the penultimate egg. The time difference between the penultimate and last eggs in a clutch being approximately two days.

The incubation period discovered in this study is closer to incubation periods found in Australian studies. Guiler (1966) found incubation to last 42 days $\pm$ 1 day, with a minimum of 36 days, but, unfortunately, he does not define the start or finish of incubation in his paper. Firth (1967) defined incubation as beginning after the third egg in clutches of four and five, after the fourth egg in clutches of six, and after the fifth egg in clutches of seven or more and continuing until the hatching of the last egg. The incubation period for black swans in his study was 39.7 days with a minimum of 35 days and a maximum of 45 days. Braithwaite (1977) defined incubation as beginning with the laying of the first egg and ending when the first cygnet is hatched; he found incubation duration to be 40.45 days with a

usual range of 39 to 43 days.

3.5.2 Clutch Size and Egg Measurements

Clutch size is greatly influenced by the condition of the adult birds at breeding. In 1959 Miers and Williams (1969) found the clutch size at Lake Ellesmere to be 4.3 and attributed this to starvation. During "good" years at Lake Ellesmere, the clutch size was found to be 5.4 ± 1.7 (S.D.) (Miers and Williams 1969) and 5.9 (Cutten 1966). The average clutch size found in overseas studies varies from 5.4 ± 1.5 (S.D.) (Braithwaite 1977) to 5.5 (Firth 1967) and Guiler (1966) found clutch size to vary from 3.9 to 5.12, depending upon the location of the nests.

The average clutch size of 4.74 ± 0.096 (S.E.) found in this study is much less than the 5.4 ± 1.7 (S.D.) found by Miers and Williams (1969) for the 1960 and 1961 seasons; and the 5.9 found by Cutten (1966) for the 1964 season. In Williams (1979), the clutch size was found to be 3.5 for the 1970 season. Both the Cutten (1966) and Miers and Williams (1969) studies were done prior to the "Wahine" storm, and the marked reduction in clutch size from this period in time to the 1970 clutch size in Williams (1979) may be some indicator of how the swans were affected by the storm. The present clutch size of 4.74 could then be viewed as an indication that the swan population at Lake Ellesmere, and their food source in the Lake, are recovering.

The only other data for egg measurements at Lake Ellesmere were discussed by Oliver (1955) and Cutten (1966). Oliver gave overall dimensions of 111.0mm X 68.0mm, and Cutten found the dimensions of 104.1mm X 67.2mm. In this study the overall egg

dimensions were 103.0mm ± 0.14 (S.E.) X 66.53 ± 0.072 (S.E.) with a fresh weight of 263.4g ± .78g (S.E.). In Australia, Firth (1967) found the average egg dimensions to be 104mm X 67mm; while, Guiler (1966) found egg dimensions of 106.9mm X 69.8mm and fresh weight 299.84g. The most comprehensive study done in Australia was by Braithwaite (1977) who found the mean egg dimensions to be 105.0mm ± 0.1mm (S.E.) X 67.3mm ± 0.1mm (S.E.), with a fresh weight of 264.01g ± 1.32g (S.E.).

The dimensions and fresh weight found in this study are comparable to those from other studies. Like the Cutten (1966) and Braithwaite (1977) studies, a distinct size difference was found in eggs as they were laid. However, this difference seems to be directly related to clutch size (Tables 3.5; 7; 9), which was not discussed in either Cutten (1966) or Braithwaite (1977) who looked at overall egg size per clutch only. When discussing egg size as related to sequence order, it is important to also consider the number of eggs in the clutch. While the first egg may usually be the smallest, in some clutches it is actually the largest. It is also interesting to note the tendency for egg size and weight to increase after the sixth egg in clutches of seven or more.

As incubation progressed, the egg weight decreased until, on the average, after a loss of 34.68g ± 1.78g (S.E.) the egg hatched. Fresh weights of successful eggs were compared with fresh weights of unsuccessful eggs to discover if there was any significant difference. This could be of use to the manager when trying to determine or control an annual hatch. However, no statistical difference was found between the two weights.

The hatching success for study nests at the Colony was 78.22%. This is slightly higher than the 74.55% in Firth (1967) and much higher than the 67.3% from the Miers and Williams (1969) study done during the peak swan number years. This could again be an indication of the recovery of the swan population at the Lake.

3.5.3 Cygnets

The cygnet weight after hatching (175.9g ± 16.47g S.D., range 130g-220g) compared favourably with Firth's (1967) estimate of 171g, range 125g-215g, as did their relative growth weights (3.42kg and 3.93kg compared with a range of 3.2kg to 4.0kg). The cygnets' weights are also comparable to Williams (1979), where they were found to be 3.7kg ± 0.4kg.

The high mortality rate in cygnets from hatching to the first recapture is customary in black swans (Scott 1972) and reflects losses due to starvation (once yolk reserves are used up), to adverse weather conditions which can drown or chill a young cygnet, and to predation. The lower mortality rate between the first and second recaptures was to be expected as the cygnets were older and better able to take care of themselves. The corresponding smaller clutch sizes is a reflection of either the ending of the nesting season for the swans or the laying of young, first-time breeders.

Overall, the survival rates found in this study were comparable to those in Firth (1967). However, they were lower than the original rate for Lake Ellesmere before the "Wahine" storm (Miers and Williams 1969) and higher than those in Adams

(1971) and Williams (1979) done after the storm. This seems to be yet another indication of the return of the swan colony to semblance its former status.

3.6 CONCLUSION

The data from this study show a good recruitment to the swan population at Lake Ellesmere during 1986, in terms of nesting and cygnet survival, as compared to data since the "Wahine" storm. This recruitment is probably related to the higher lake levels in the 1986 season as compared to previous seasons (O'Donnell 1985) and the reestablishment of some lake weeds (Gerbeaux and Ward 1986). The 1986 season was also favourable to the swans as farmers did not use the colony area for grazing of stock.

The swan population will probably continue to grow, in a direct relation to food availability (provided other environmental conditions do not limit them), until they reach their carrying capacity. Lake Ellesmere may never again see the vast numbers of black swans it carried in the pre-"Wahine" times, but the swan population is in no danger of collapsing. If this population increase continues at a rate in excess of the growth of the Lake's capacity to carry it, serious management problems will once again arise. However, the age structure of present Ellesmere swans could be of concern to their re-establishment. Williams (1979) shows an age makeup of mainly very old swans (10 years and older) for Ellesmere. More study is needed to discover if this trend is still present. If it is, then the fecundity of the population could be affected by a lower fecundity of older swans.

Swans compete with other waterfowl for the weedbeds, and excessive numbers of swans could have a substantial effect upon the habitat of the area. Smith (1983) has shown that intensive

grazing of saltmarsh communities can alter them profoundly. Also, if the swan population exceeded the lake's ability to carry them, they would go to nearby farmers' paddocks for food. This would result in the necessity for control measures.

Lake Ellesmere and its surrounds are a multi-use habitat, and satisfying all users on the issue of black swans is difficult. They are a gamebird, and, as such, hunters want a viable population for shooting. Yet, farmers do not want the swans depleting and/or degrading pasture they wish to have eaten by their stock. As it stands presently, the swan population is sufficient for hunting and is not overly worrying most farmers. However, it the population continues to grow, some management practices will have to be undertaken in order to control it.

Increasing the hunting pressure on swans would probably be one of the most effective types of control. This control would be very difficult to initiate as it means changing the shooters' attitude on black swan hunting (as discussed in Section 1). Education as to why the swans should be hunted as well as ways of preparing them for eating would have to be incorporated into this management practice. If a campaign of this type was successful, the increasing swan population could be held in balance without the swan drives and egg collections necessary in previous years.

The management practices mentioned above would only be necessary if trends found in this one year study continued. Before any such practices are used, more study must be done on the swan's population structure and dynamics to insure that these trends are not simply the result of a single atypical year at the colony.

GENERAL CONCLUSION

In these days of increasing but diverse pressures from shooters, farmers, and recreational bird watchers, the importance of maintaining viable bird populations in well managed habitats, without allowing them to become agricultural pests or to inflict damage on their own environment, cannot be over-emphasized. This study should be viewed as a stepping stone for future works. The gamebird populations are dynamic ones and no single study can cover all aspects involved in their management, or even a representative sample of kinds of seasons. For example, continuing research on the productivity of swan colony should be done for comparative purposes. Another study could be done on the relative roles of black swans as compared with Canada geese. Because both groups can exploit the same resources, study could, and should, be done on their overlap in feeding and in degradation of farmers paddocks and, perhaps, maximum population limits discovered. Additionally, studies on other gamebird species need to be initiated.

The knowledge gained and presented here will be valuable for future waterfowl managers when deciding what the gamebird shooters would like to see in their overall hunting, and for the future of the black swan. It is a start, but, as with all studies of this type, the true test of its value will be how the information available here is used by those managing and working with the gamebird populations.

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APPENDIX 1

Please Quote

WILDLIFE SERVICE
DEPARTMENT OF INTERNAL AFFAIRS

P.O. Box 1308 Christchurch, N.Z. Telephone 790 290 Telegrams and Cables "Internal" Telex CVDXCH NZ4778

Dear Licence Holder

A study is currently being done on waterfowl hunting in North Canterbury with the help of the Wildlife Service and the North Canterbury Acclimatisation Society. This study will encompass all aspects of waterfowl hunting from 1971 through to the present, and it is hoped that it will be able to assess the changing waterfowl resource and assist in future management decisions for both individual species and waterfowl hunting as a whole in your district. To this end, select game bird licence holders are being asked to complete and return (via self-addressed, stamped envelope) the enclosed questionnaire. The questionnaire is designed to be quick and easy to fill out and will provide crucial information to the study of the waterfowl resource in North Canterbury. All questionnaires will be completely confidential.

Thank you for your time and assistance in this study of the waterfowl resource in North Canterbury. Please return questionnaires to the undersigned.

Yours sincerely

Teri Meis

(Teri Meis)
Zoology Department
University of Canterbury
Private Bag
CHRISTCHURCH 1

Encl

TM:AT

(70)

North Canterbury Acclimatisation Society

GAME BIRD HUNTER QUESTIONNAIRE

CONFIDENTIAL

Selected game bird licence holders throughout the North Canterbury Acclimatisation District are being requested to fill out the following questionnaire. The prompt return of the completed questionnaire is essential to a study being done on waterfowl hunting in North Canterbury. This questionnaire is completely confidential. Thank you for your consideration and assistance.

INSTRUCTIONS:

(a) Place ticks or numbers in the appropriate boxes or fill in the gaps, unless otherwise directed, for all questions.

(b) If a question is not relevant to you, please enter N/A.

****

1. Sex: ☐ Male
☐ Female

2. Age at time of purchasing 1985 game bird licence:

☐ under 16 years
☐ 17 to 20 years
☐ 21 to 30 years
☐ 31 to 40 years
☐ 41 to 50 years
☐ 51 to 60 years
☐ Over 60 years

3. Present yearly gross salary:

☐ Less than $5,000
☐ $5,001 - $10,000
☐ $10,001 - $15,000
☐ $15,001 - $20,000
☐ $20,001 - $25,000
☐ More than $25,000

4. How many years in total have you purchased a licence? _____

5. How many years have you hunted game birds solely on your own property? _____

6. Do you use a dog when you hunt? ☐ Yes ☐ No ☐ Sometimes

7. Do you feel a dog is necessary for a more successful hunt?
☐ Yes ☐ No

8. Which species do you hunt during open season? (tick all appropriate)

- ☐ Mallard
- ☐ Grey
- ☐ Shoveler
- ☐ Paradise Shelduck
- ☐ Canada Goose
- ☐ Black Swan
- ☐ Pukeko
- ☐ Pheasant
- ☐ Quail
- ☐ Chukor

9. What species do you prefer to hunt? (rank from 1 - most preferred to 10 - least preferred)

- ☐ Mallard
- ☐ Grey
- ☐ Shoveler
- ☐ Paradise Shelduck
- ☐ Canada Goose
- ☐ Black Swan
- ☐ Pukeko
- ☐ Pheasant
- ☐ Quail
- ☐ Chukor

10. Reasons for preferring to hunt your MOST preferred species: (rank from 1 - most important reason to 6 - least important reason)

- ☐ Easily accessible
- ☐ Good table bird
- ☐ Abundant in your area
- ☐ Provides hunting challenge
- ☐ Social event
- ☐ Other _____

11. Reasons for not hunting your LEAST preferred species: (rank from 1 - Most important reason to 6 - least important reason)

- ☐ Numbers scarce
- ☐ Not in your area
- ☐ Poor eating
- ☐ Too easy to kill
- ☐ Can't get to where birds are
- ☐ Other _____

12. Do you always hunt opening weekend of waterfowl season?

☐ Yes ☐ No

13. Do you regularly see Grey Teal? ☐ Yes ☐ No

14. Have you ever accidently shot Grey Teal? ☐ Yes ☐ No

15. Do you think there are sufficient numbers of Grey Teal for them to be on licence? ☐ Yes ☐ No

16. How many times did you go game bird hunting during the 1985 year? (include both full and part days)

(a) For ducks and swans:
- ☐ 1 to 5 days
- ☐ 6 to 10 days
- ☐ 11 to 15 days
- ☐ 16 to 20 days
- ☐ More than 20 days

(b) For upland game:
- ☐ 1 to 5 days
- ☐ 6 to 10 days
- ☐ 11 to 15 days
- ☐ 16 to 20 days
- ☐ More than 20 days

17. Have you ever taken advantage of the special Canada Goose seasons?

(a) February-March (high country) ☐ Yes ☐ No

(b) February-March (low country) ☐ Yes ☐ No

(c) May-August (Ellesmere & Waiwera counties) ☐ Yes ☐ No

(d) May-November (high country) ☐ Yes ☐ No

18. If yes above, for how many years have you hunted during the special season(s)?

(a) February-March (high country) _____

(b) February-March (low country) _____

(c) May-August _____

(d) May-November _____

About how many times do you hunt during the special season(s) in the high country?

- ☐ 1 to 5 days
- ☐ 6 to 10 days
- ☐ 11 to 15 days
- ☐ 16 to 20 days
- ☐ More than 20 days

About how many times do you hunt during the special season in the low country?

- ☐ 1 to 5 days
- ☐ 6 to 10 days
- ☐ 11 to 15 days
- ☐ 16 to 20 days
- ☐ More than 20 days

19. Do you feel that the extended Canada Goose season actually increases your chances of bagging more geese?

☐ Yes ☐ No

20. Would you like to see the special Canada Goose seasons:

- ☐ Extended even more
- ☐ Left as is
- ☐ Shortened
- ☐ Ceased

21. Would you like to see the regular duck season:

- ☐ Extended even more
- ☐ Left as is
- ☐ Shortened

22. If you replied "Extended" to either Q20 or Q21, would you like to see the extension:

- ☐ At the beginning of the season
- ☐ At the end of the season

23. (a) Do you hunt away from your usual area on specific hunting trips during the season?

☐ Yes ☐ No

(b) If so, what game species are you hunting for?

☐ Mallard
☐ Grey
☐ Shoveler
☐ Paradise Shelduck
☐ Canada Goose
☐ Black Swan
☐ Pukeko
☐ Pheasant
☐ Quail
☐ Chukor

(c) For these trips, do you travel:

☐ Within North Canterbury District
☐ Outside of North Canterbury District

(d) If you travel within North Canterbury, approximately how far do you travel? _____

(e) If you travel outside North Canterbury, approximately how far do you travel? _____

24. During the 1985 year, what percentage of your hunting time did you spend using any of the following methods?

☐ From a mai mai
☐ Jump shooting streams or ponds
☐ Rough shooting with dog (upland game)
☐ Other _____

25. (a) The majority of your waterfowl hunting is on:

☐ Public land
☐ Private land

(b) The majority of your pheasant/quail/chukor hunting is on:

☐ Public land
☐ Private land

26. (a) What is the distance (one way) to your regular hunting area for:

☐ Water fowl _____kms
☐ Pheasant/Quail/Chukor _____kms

(b) Average number of trips per season to your regular area for:

☐ Water fowl _____

☐ Pheasant/Quail/Chukor _____

27. The value of equipment used in your game bird hunting is: (corrected to 1985 values if possible)

Shotgun: $_____

Shells: $_____

Boat and Motor: $_____

Decoys: $_____

Dog: $_____

Mai Mai: $_____

Other (food, waders, clothing etc): $_____

28. The annual maintenance costs for your equipment (including dog) are:

$_____

29. Should landowners be allowed to charge for access to hunting on their property?

☐ Yes

☐ No

30. Would you be prepared to pay an access fee to hunt game on private land that was managed to provide high quality waterfowl or upland game hunting? (eg game preserve)

☐ Yes

☐ No

31. Do you feel that the raising of crops for the sole purpose of feed for the waterfowl is a sound management technique?

☐ Yes

☐ No

32. Do you feel that licence fees are:

☐ Too high

☐ Adequate

☐ Too low

33. Where do you think the Acclimatisation Society should be placing the most emphasis in the spending of game licence income? (rank from 1 - most important to 8 - least important).

- ☐ Purchasing of land for game bird management
- ☐ Protecting and managing existing habitat
- ☐ Rearing and releasing game birds
- ☐ Providing hunter and public with educational information
- ☐ Enforcement of game regulations
- ☐ Monitoring game bird populations
- ☐ Organising major goose shoots in both low and high country
- ☐ Other _____

Additional Comments:

Thank you for your time and cooperation.

APPENDIX 2

Licences sold and diaries returned in North Canterbury for the years 1971 to 1984.

Year	Number of Licences Sold	Number of Diaries Returned	%
1971	2507	64	2.6
1972	2171	59	2.7
1973	2058	54	2.6
1974	2526	68	2.7
1975	2651	61	2.3
1976	2643	55	2.1
1977	2869	52	1.8
1978	2693	44	1.6
1979	2786	49	1.8
1980	2830	47	1.7
1981	2441	69	2.8
1982	2432	61	2.5
1983	2397	56	2.3
1984	2285	53	2.3
Mean($\bar{x}$)	2521	57	2.3