Preliminary Report

AN ANALYSIS OF AGRICULTURAL DAMAGE BY WATERFOWL IN ALBERTA

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By

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Mr. William J. Thurlow made a major contribution in the analysis and interpretation of results. His assistance is greatly appreciated.

INTRODUCTION

This paper discusses results obtained to date on several aspects of waterfowl damage to commercial grain crops in Alberta based on a study carried out by Renewable Resources Consulting Services Ltd. for the Alberta Fish and Wildlife Division.

By agreement with the Fish and Wildlife Division, the study was conducted on a provincial basis. By this approach it was hoped to put the problem in perspective and to indicate requirements for more detailed studies.

While the study has yielded much information on the scope and magnitude of waterfowl damage in Alberta, it has also revealed the need for further breakdowns on a regional basis, since waterfowl populations, climatic conditions and vulnerability of crops to damage show considerable variation throughout the province. The local effects of these variations and their significance are masked

when viewed on a provincial basis.

Since 1964 Alberta has been engaged in a program of monetary compensation to farmers for crop damage caused by waterfowl. Funds for this program are derived from hunting license fees. Eligibility for compensation does not require the payment of insurance premiums by farmers. Dr. S.B. Smith outlined the legislative and administrative structure of the program in his paper to the 1968 Federal Provincial Wildlife Conference.

Disbursements from the Crop Damage Fund since its inception in 1964 have been steadily increasing and in 1968 exceeded $400,000 (Table I). The cumulative total of disbursements has passed the one million dollar mark. The issuance of shooting permits to farmers sustaining waterfowl damage constitutes the major effort to reduce damage in Alberta.

The effectiveness of both the foregoing programs in reducing damage and farmer unhappiness with damage has never been tested due to the lack of quantitative data on the nature and extent of the problem in the province. Increasing costs of compensation and the need for a quantitative assessment of the effectiveness of shooting permits and compensation, and identification of trends and alternatives available to dealing with waterfowl damage on a provincial basis resulted in the initiation of the present study.

The analyses presented here constitute those data available from the study to date.

T A B L E I

Number of Damage Claims and Cost of Payments

(1961 - 1968)

YEAR	Number of Claims	Amount Paid
1961	2	$ 140.00
1962	10	1,485.00
1963	22	5,448.00
1964	743	321,841.00
1965	531	207,752.00
1966	477	158,130.00
1967	99	28,222.00
1968	821	400,000.00*
Total	2,705	$1,123,018.00

*Approximate total

METHODS

A considerable volume of data pertaining to individual damage sites (identifiable to exact location by quarter sections)* by year since 1964 are available for claims records (Fig. 1) of the Alberta Hail Insurance Board, the agency responsible for administering the waterfowl damage compensation program. In addition to those data provided by claims records (Fig. 1), auditing of adjusters field reports provided information on yields at each location prior to damage.

All claims locations for each year were plotted on a large scale (1:250,000 - 4 miles = 1 inch) composite map of Alberta. These plotted locations formed the basis for tabulation of additional data with ecological implications to the distribution and occurrence of damage sites.

These tabulations were as follows:

Precipitation Data: 150 stations within the 100,000 sq. mile study area were plotted and annual and weekly precipitation totals recorded. Weekly totals were recorded for week of claim and for each of 4 weeks prior to the claim.

Water body Data: In order to relate possible relationships between water bodies and damage, the following data were tabulated from 1:50,000 (1 mile = $1\frac{1}{4}$ miles) maps.

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*a quarter section is 160 acres in size

October 24, 1966 - Floyd Johnston -

FIG. 1 -

VOUCHER NUMBER
420-737-66

Description of Land	AWARD Acres Damaged	Kind of Grain	Net Allowance	Ins. per Acre	Int.	Amount
27-43-26-4	15	B	100	15.00		225.00
	8	B	50	15.00		60.00
	7	B	25	15.00		26.25
W 27	15	B	100	15.00		225.00
	5	B	50	15.00		37.50
	8	B	25	15.00		30.00
E 22	40	B	100	15.00		600.00
	10	B	33	15.00		49.50
W 22-43-26-4	12	B	100	15.00		180.00
	8	B	33	15.00		39.60
E 26-43	35	W	50	15.00		262.50
	5	W	33	15.00		24.75
	10	W	20	15.00		30.00
TOTALS	178	/	/	/	/	$1,790.10

THE ALBERTA HAIL INSURANCE BOARD
CALGARY - ALBERTA

AWARD	$1,790.10 -
PREMIUM UNPAID	$
PREMIUM NO.	
PREMIUM DUE	$
FOR DISTRIBUTION	$1,790.10 -

Negotiable Without Charge At Any Chartered Bank In The Province Of Alberta

The Alberta Hail Insurance Board

NUMBER W 420-737-66 -

CANADIAN IMPERIAL BANK OF COMMERCE
628 - 8th AVE. S.W. - CALGARY, ALBERTA

19/10

CALGARY, ALBERTA December 1, 1966

Pay $1,790.10 -

to. Glen Crandall
Box 476
PONOKA, Alberta

VOID - ADVICE ONLY

APPROVED FOR PAYMENT RW

CLAIMS REGISTER COPY

WILDLIFE DAMAGE PAID

FIGURE 1: Sample Damage Claim Voucher

a) Number of potholes on each damaged quarter section (all potholes 1/3 acre and larger are mapped at the scale used)

b) Distance of each damage location to the nearest waterbody in each of the following size categories:

i) 30-50 acres
ii) 51-160 "
iii) 161-320 "
iv) 320+ "

Other Tabulations: Other data recorded included distance to nearest town and Canada Land Inventory Waterfowl Capability ratings at each damage site. All the above data were coded and key punched on to computer cards. Appendix A summarizes the data categories, sources and measurement parameters which were recorded for each damage site and punched on computer cards.

Shooting Permits: A separate deck of computer cards listing the exact location of quarter sections covered by shooting permits and date of issuance of permits was prepared. In addition, the locations of quarter sections covered by shooting permits was plotted on overlays on a 12 miles = 1 inch base map for each year for the years 1964-1968. Analysis of shooting permit and claims data by location was carried out by merging the decks of cards during the computer run.

Questionnaire Survey: A mail questionnaire survey was designed in order to obtain information on questions unavailable from existing data and also to elicit opinions on the damage problems from farmers themselves. Figure 2 is a sample of the questionnaire sent to 7,500 Alberta farmers.

FIG. 2 Sample Crop Damage Questionnaire

Dear Sir:

We are conducting a survey on behalf of the Fish & Wildlife Division of the Alberta Government, to obtain information on crop damage caused by ducks, geese and cranes.

It would be very helpful if you would answer the questions below, refold the form, seal it with the gummed edge and return it to us.

Your assistance will be greatly appreciated.

R.D. Jakimchuk, President
Renewable Resources Consulting Services Ltd.

1. *Location of farm: buildings.* — Sec. ☐ Twp. ☐ Rge. ☐ Mer. ☐
2. *Number of acres farmed:* ☐
3. *Have you ever had damage to crops caused by ducks, geese or cranes?* ☐ Yes ☐ No
4. *If yes, which years did damage occur?* — 1968 ☐ 1967 ☐ 1966 ☐ Other Yrs. (specify) ☐
5. *Have you ever claimed compensation for damage?* ☐ Yes ☐ No
6. *If you have claimed compensation, which years were claims made?* — 1968 ☐ 1967 ☐ 1966 ☐ Other Yrs. ☐
7. *If you did not claim compensation what do you estimate the value of damage caused?* — 1968 $ ☐ 1967 $ ☐ 1966 $ ☐ Other Yrs. (specify) $ ☐
8. *What method did you use to control or prevent damage during....* — 1968 / 1967 / 1966 / Other Yrs.
   - *Shooting* ☐ ☐ ☐ ☐
   - *Machinery left standing in field* ☐ ☐ ☐ ☐
   - *Scaring with acetylene exploders* ☐ ☐ ☐ ☐
   - *Scarecrows* ☐ ☐ ☐ ☐
   - *Chasing with truck* ☐ ☐ ☐ ☐
   - *None* ☐ ☐ ☐ ☐
   - *Other (write in)* ☐
9. *If no control method was used, what reason?* — 1968 / 1967 / 1966 / Other Yrs.
   - *Illness* ☐ ☐ ☐ ☐
   - *Too wet* ☐ ☐ ☐ ☐
   - *None effective* ☐ ☐ ☐ ☐
   - *Not worth it* ☐ ☐ ☐ ☐
   - *Damage already done* ☐ ☐ ☐ ☐
   - *Other (write in)* ☐
10. *What do you think should be done about duck, goose and crane damage? (check one)*
    - *No opinion* ☐
    - *Government to acquire special feeding areas (lure crops)* ☐
    - *Increase compensation for damage* ☐
    - *Nothing* ☐
    - *Reduce duck populations* ☐
    - *Other (write in)* ☐
11. *Would you be willing to pay insurance premiums for improved coverage against crop damage by ducks, geese and cranes?* Yes ☐ No ☐
12. *Do you allow the general public to hunt on your land?* Yes ☐ No ☐
13. *Do you personally hunt ducks and geese?* Yes ☐ No ☐

Any further remarks should be sent separately with the code number on the reverse side of this sheet included on your letter.

INSTRUCTIONS FOR RETURNING QUESTIONNAIRE: Refold this sheet so that the Renewable Resources address is on outer fold. Moisten this edge to seal and mail. No postage required. Thank you for your co-operation.

The primary objectives of the questionnaire may be summarized as follows:

1. To determine the number of farmers sustaining damage vs. the number claiming, in order to establish:
   a) the potential number of claimants in Alberta.
   b) the threshold of tolerance (in dollars) to damage by farmers who have not claimed compensation.
2. Methods of damage prevention and control considered to be most effective by farmers.
3. The attitude of farmers to damage prevention and whether or not they actively try to prevent or control waterfowl damage.
4. Farmers opinions on the best manner of dealing with crop damage.
5. Whether or not farmers would consider paying premiums for additional coverage (i.e. compensation).

Statistical basis of the Questionnaire: The sampling universe for the questionnaire was all farmers in Alberta. A random sample of 7,500 of the total of 69,000* farmers in Alberta was selected from a 1968 voters list for Alberta.

The sample was of farmers chosen from a table of random numbers. A measure of the representativeness of the survey was determined by a Chi^2 comparison of the average farm size of respondents to the average farm size of all Alberta farmers**

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*Dominion Bureau of Statistics

**Data from Alberta Dept. of Agriculture Statistics

The frequency of respondent's farm size classes was not significantly different (Chi^2 = 3.66 with 11 d.f.) from those reported in the Alberta Department of Agriculture Statistics, and suggests that the survey sample was representative of Alberta farmers.

DISCUSSION AND RESULTS

The following results do not represent a complete analysis of the data inasmuch as several aspects of the study analyses have not been completed at this writing.

The Provincial Perspective: Table I shows the amount of compensation paid to farmers in Alberta annually since 1964. These sums however do not represent the actual loss incurred since compensation is limited to one half of the crop value or a maximum of $15 per acre, whichever is the lesser amount. Moreover, this sum is based upon fixed values per bushel while commercial values fluctuate annually.

An analysis incorporating pre-damage yield and commercial crop values has been carried out and shows that the average loss sustained by claimants is approximately three times greater than actual compensation paid. (Table II) Conversely, the farmer is reimbursed for only 33% of the value of his actual dollar loss.

During 1968, while compensation payments totalled some $400,000, actual losses to claimants totalled some 1.2 million dollars. However, this sum does not include losses sustained by farmers who did not claim compensation.

T A B L E II

Commercial Value and Compensation paid for all crops on damaged ¼ sections

(1965-1968)

YEAR	# of ¼ Section Damage Sites	Damaged Acres	Commercial Value	Average Commercial Value	Compensation Paid	Average Compensation Paid	Av. Comm Loss/ Average Comp. Paid
1965	24	412	14,251	594	5,571	232	2.6
1966	1,107	16,160	500,830	452	149,539	135	3.4
1967	208	3,275	75,663	364	27,672	133	2.7
1968	2,267	37,118	1,011,939	446	363,935	161	2.8
TOTAL	3,606*	56,965	1,589,857	441	546,717	152	2.9

*This represents approximately half of all ¼ sections on which damage was claimed, since the computer rejected unit records with missing data, necessary to calculate the commercial value of the crop.

Farmers may not claim compensation for two primary reasons a) they are unaware that a compensation program exists or b) they are willing to sustain some damage loss because they consider it a national hazard which they accept as part of their occupation.

From the questionnaire we have determined that during 1968 those who did not claim compensation reported damage totalling $94,483. This sum may be extrapolated by means of expanding this sum by a factor of 53 to represent all Alberta farmers. The total value of damage not claimed derived by this method is $5,007,599 which added to actual claimed losses represents some 6.2 million dollars.

An alternative method used to extrapolate total provincial damage based on questionnaire ratios of claimants to non-claimants sustaining damage resulted in a provincial total loss of $3,060,000. While the possibility exists that the estimated losses reported by respondents to the questionnaire are inaccurate, the mean value of loss reported for that year (Table III) is below the mean compensation paid to claimants. Therefore, it is considered that the 3 to 6 million dollar range is a reasonable estimate of total provincial losses during 1968. Actual value of all crops for this year were approximately $425 million, therefore waterfowl damage losses represent from 1 to 1.5 percent of this total. Nevertheless, in total dollars, waterfowl damage assumes the proportions of a problem of considerable magnitude and importance to the farm economy.

T A B L E III

Average dollar loss and compensation paid per farmer

(1966-1968)

	1968	1967	1966	1966-1968
Average loss by claims	$1,232.57	$764.27	$1049.96	$1137.03
Average Gov't payment	$ 443.28	$278.51	$ 313.50	$ 387.36
Average loss reported by questionnaire	$ 346.09	$308.36	$ 356.86	$ 339.43

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Average loss reported by questionnaire	$ 346.09	$308.36	$ 356.86	$ 339.43

In 1968, some 87% of farmers reporting damage stated that they have never claimed damage compensation. Thus the potential demand on the existing crop damage fund, if realized could quickly eliminate available reserves. Therefore, it is apparent that either funds available for compensation would have to be increased or measures to prevent or control damage in the province be instituted.

Factors influencing crop damage: The following discussion and analysis of data were undertaken in an effort to identify those characteristics of waterfowl damage which may provide meaningful information for evaluating the compensation program and alternatives to monetary compensation such as prevention or control as a means of reducing "farmer unhappiness" with waterfowl damage.

From the plotting of actual damage locations and the analyses conducted to date, we have obtained considerable information on the characteristics of damage locations and factors influencing the distribution and intensity of damage.

Table IV shows the number of acres and bushels lost of each crop type damaged by year. In any given year, total bushels lost of wheat and barley are approximately equal, whereas the oats total is considerably smaller. Significantly, while barley losses are approximately equivalent to wheat in acres and bushels, approximately one half the acreage of barley has been sown annually over the past 5 years in the province, suggesting that ducks damage barley in a ratio of 2 : 1 over wheat. Pending further investigation, this may be

T A B L E IV

YEAR	# of ¼ Sections*	WHEAT Acres Lost	WHEAT Bushels Lost	BARLEY Acres Lost	BARLEY Bushels Lost	OATS Acres Lost	OATS Bushels Lost
1965	24	73	2561	267	10,584	44	2,184
		(18)	(640)	(24)	(962)	(5)	(243)
1966	1107	5,995	198170	4,269	159,418	381	15,805
		(10)	(338)	(9)	(338)	(9)	(376)
1967	208	1,256	28238	888	22,446	118	3,939
		(10)	(230)	(13)	(316)	(11)	(358)
1968	2267	14,636	377841	11,458	462,625	896	43,498
		(12)	(313)	(12)	(470)	(12)	(572)
TOTAL	3606	21,960	608810	16,882	655,073	1,439	65,426

*This represents approximately half of all ¼ sections on which damage was claimed, since the computer rejected unit records with missing data, necessary to calculate the number of bushels lost.

() Averages for each category

interpreted either that ducks prefer barley or that barley crops are more vulnerable to damage in comparison with wheat, due to differences in harvest chronology.

Time of Damage: The time of damage occurrence is directly related to that period of the harvest when the crops are vulnerable. In general, standing grain is not susceptible to damage and the critical or vulnerable period occurs between the time interval when the crop is swathed (in order to hasten ripening and drying and to ensure even ripening) and the time the swaths are combined. Feeding on swaths constitutes the only significant damage interval since once harvest is completed ducks feeding on waste grain on stubble field do not create an enconomic loss to the farmer.

Therefore, time of damage occurrence is a function of the length of harvest, (duration of the swathed condition) rather than start of harvest. It is, of course, also related to waterfowl populations and chronology of the north-south migration in Alberta.

Table V shows time of damage for the various years studied. There is a noticeable difference in amount of damage, number of claims, and time of damage occurrence between 1967 - a dry year with favourable harvest conditions, and 1968 - a wet year when swaths remained on the ground for an extended period of time.

The importance of time of harvest, local waterfowl population and chronology of migration is revealed in a comparison of harvest chronology for two areas of Alberta and inferred information regarding duck populations. Figure 3 shows harvest chronology in

T A B L E V

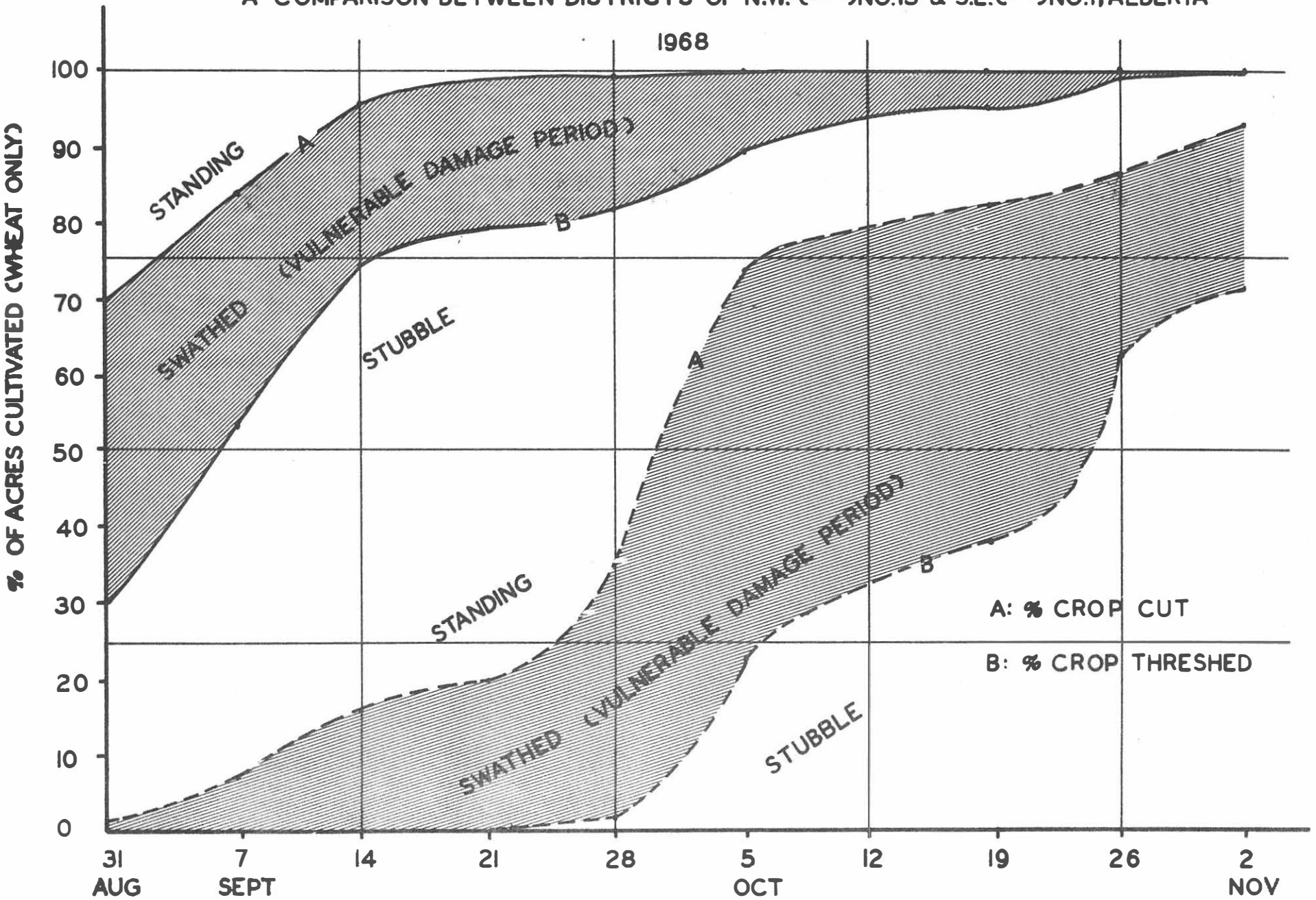
Number of ¼ sections damaged related to week of occurrence

YEAR	# of ¼ Sections	Month of August 1		Sept. (weeks) 2	3	4	Oct. (weeks) 1	2	3	4	Month of November
1965	1393	12	38	55	128	314	516	187	84	47	12
1966	1205	19	49	146	172	164	125	173	223	118	16
1967	214	41	36	71	29	17	2	14	3	0	1
1968	2349	90	30	158	89	281	281	61	275	724	360
TOTAL	5161	162	153	430	418	776	924	435	585	889	389

HARVEST CHRONOLOGY

FIG. 3

A COMPARISON BETWEEN DISTRICTS OF N.W. (---)NO.15 & S.E.(——)NO.1, ALBERTA



1968 in a low damage area in the extreme south eastern part of Alberta contrasted to a high damage frequency area in the Peace River Area of Northern Alberta. Both areas have extensive areas sown to grain crops. Damage frequency and intensity is sporadic and low in the southern area. Figure 3 shows however, that a comparable state of harvest was completed from five to seven weeks earlier in the southern area than in the north. The Northern area is located geographically where migrating populations reach their peak at the time the crops are in the vulnerable swathed condition. A knowledge of these factors provides a basis for predicting damage for distinct geographic areas. Moreover, measures to mitigate depredation whether by compensation or control measures must be tailored to variations in harvest data and other variables for specific geographic locations within the 100,000 square mile damage susceptibility area of the province.

In an effort to facilitate such considerations on the location, frequency, intensity and economic value of damage for specific areas. Some thirteen zones are presently delineated on this basis.

In general, Northern Alberta is characterized by the highest damage frequency per unit area, followed by the parklands of central Alberta with medium frequency, and Southern Alberta with sporadic damage occurrence. Actual dollar loss values vary however, due to the number of square miles encompassed by these three areas.

Damage in relation to Measured variables: Information of ecological relationships influencing damage is pre-requisite to the formulation of a management approach to prevention or control. While behavioural characteristics of waterfowl provide insight into some aspects of their depredations, data on populations for specific locations are unfortunately not available in sufficient detail to enable analyses on this basis.

Therefore, our analyses were designed to obtain such information on a provincial basis of those factors influencing damage occurrence and frequency/intensity in relation to several measured variables.

A regression analysis was conducted on twelve independent variables for all crops and for all years, for which data was available. This step-wise regression analysis determined a best least squares fit of damage intensity against a linear combination of the other parameters and gives an indication of their relative order of significance. It was hoped that such a study would indicate the more important factors operative in waterfowl damage to crops. These computations were performed separately for wheat, barley, oats and other crops, as well as for all crops combined.

A second regression analysis was done to rank the variables relative to the number of damaged acres per quarter section. The results of both these analyses, as well as the correlation coefficients of each variable are listed in Table VI.

T A B L E VI

Statistical order of significance of twelve variables related to Damage Intensity and number of Damaged Acres

Ranked Order	Damage Intensity (%) per ¼ section		Number of damage acres per ¼ section	
	Independent Variable	Correlation Coefficient	Independent Variable	Correlation Coefficient
1	D_2	6.166%	P_A	-6.733%
2	P_4	-4.628%	POT	-5.592%
3	P_A	4.369%	P_1	-5.390%
4	Dist	-3.943%	D_3	+3.903%
5	P_3	-2.736%	D_4	-1.612%
6	P_1	-2.686%	Dist	+3.698%
7	POT	1.309%	P_3	-3.382%
8	P_2	-2.319%	D_1	-3.029%
9	P_0	0.277%	P_0	+1.635%
10	D_1	4.327%	P_2	-1.084%
11	D_3	3.620%	D_2	+0.646%
12	D_4	2.465%	P_4	+0.943%

Dist: Distance to nearest town
POT : Number of potholes on quarter section
D_1 : Distance to nearest body of water of 30-50 acre size
D_2 : " " " " " " " 51-160 " "
D_3 : " " " " " " " 161-320 " "
D_4 : " " " " " " " 320+ " "
P_A : Annual Precipitation
P_0 : Precipitation during week of claim
P_1 : Week's precipitation 1 week prior to claim
P_2 : " " 2 " " " "
P_3 : " " 3 " " " "
P_4 : " " 4 " " " "

As may be seen from Table VI, the correlation coefficients between all variables tested and each of our two dependent variables are relatively small and of the same order of magnitude from which we conclude that all the independent parameters measured, either singularly or in combination with each and all other parameters have only a weak controlling influence on either damage intensity or number of damaged acres.

It should be emphasized that in the analyses conducted, low statistical significance of the correlation coefficients are attributable in large part to the fact that input data have been derived provincially over varying conditions. It is interesting to note from this that no one variable is a major contributing factor in the consideration of crop damage, when applied over the entire province. If regressions are conducted for smaller geographic areas a clearer definition of significance and higher correlations are expected. Our approach to the problem was deliberately carried out in the manner described since information valid provincially was a primary consideration. Further analyses are providing refinement of results on a regional basis.

Since the damage-water body relationships provided by the regression analysis were not clearly defined, a separate Chi^2 analysis was conducted to test the association, if any, between damage sites and distance to water bodies of any size. (Table VII) The result was statistically significant (Chi^2=269.71 with 18 d.f.) and we may reject the hypothesis that there is no association between damaged sites and proximity to water. In fact, the association is so strong

T A B L E VII

Distance of damage sites from potholes of various sizes

Distance in miles	30-50 acres	51-60 acres	161-320 acres	320+ acres	TOTAL
0-1.0	1640	979	590	1271	4480
1.1-2.0	706	413	164	320	1603
2.1-3.0	353	140	44	123	660
3.1-4.0	187	65	31	35	318
4.1-5.0	114	36	27	27	204
5.1-6.0	106	20	23	5	154
6.1-7.0*	13	3	1	5	22
7.1-8.0	14	0	3	3	20
8.1-9.0	2	0	0	0	2
9.1-10.0	0	4	0	0	4
10.0+	0	0	1	1	2
TOTAL	3135	1660	884	1790	7469

$Chi^2 = 269.71$ with 18 d.f.

Highly Significant at P=.001

*In the calculation of Chi^2 - distance categories greater than 6.1 miles were disregarded since the matrix contains classes with frequencies of less than 5.

that the Chi^2 for the first two elements of the first water size category is sufficient in itself to reject the hypothesis of independence. The similar strong association occurs for the category 320+ acres within two miles.

Therefore we can conclude that not only is there a strong association between various sizes of water categories, and distance to damage sites, but that water bodies of 30-50 acres and 320+ acres are statistically the most important categories relating to damage occurrence. This may well be a reflection of the relative numbers of water bodies in each size category and this is presently being assessed. The management implications of these data are extremely important for the design of damage prevention or control programs and the ranking of priority areas throughout the province.

The Influence of Shooting on Damage: Approximately 50% of the respondents to our mail questionnaire favoured shooting as a method of damage control followed by scarecrows (30%) and chasing (21%), suggesting that shooting is the most popular control method (Table VIII). The issuance of pre hunting season shooting permits is based on the premise that individual farmers have a right to protect their crops, and that this is an effective means of doing so.

To test the effectiveness of shooting permits as a means of reducing damage intensity, we conducted an analysis in which the intensity of damage suffered by those who had shooting permits was compared with the intensity of damage suffered by those without

T A B L E VIII

Number of farmers using various methods of damage control

	1968		1967		1966		OTHER	
	No.	%	No.	%	No.	%	No.	%
SHOOTING	304	50.2	235	46.8	297	52.2	309	54.6
SCARECROWS	189	31.2	157	31.3	190	33.4	180	31.8
CHASING	140	23.1	107	21.3	122	21.4	111	19.6
MACHINES IN FIELD	94	15.5	67	13.3	82	14.4	73	12.9
ACETYLENE EXPLODER	12	2.0	8	1.6	16	2.8	13	2.3
NONE	217	35.8	195	38.8	192	33.7	189	33.4
OTHER CONTROL MEANS	42 (did not specify year)							
TOTAL	606		502		569		566	

shooting permits. The results are tabulated in Table IX.

A Chi^2 analysis of these results (Chi^2= 9.2 with 9 d.f.) indicates that the damage intensity suffered was independent of whether the farmers sustaining damage held a shooting permit or not.

This Chi^2 test indicating independence may be due to the lack of constant surveillance and continual shooting to prevent damage. However, in practical terms such measures are not feasible over large areas and the data support the thesis that displacement of ducks by shooting increases actual damage loss on a regional basis.

Upon plotting quarter sections covered by shooting permits for the past five years in Alberta an immediate and unmistakable trend was evident which showed concentrated densities of permits in close proximity to major cities (Calgary, Edmonton, Lethbridge and others) independent of the density of damage claim locations, at shooting permit concentrations.

This suggested that permits were being used as a means for urban hunters to engage in pre-season waterfowl hunting and in fact an indication of widespread abuse of the intent of permits. It is known that on some occassions urban hunters solicit farmers to apply for permits for the purpose of a pre-season hunt.

The plotted distribution of permits did not lead us to the conclusion that they were ineffective in preventing damage since for those areas where permit saturation occurred in conjunction with infrequent damage sites could be interpreted as evidence of their effectiveness.

T A B L E IX

Damage Intensity related to Issuance of Shooting Permits

Damage Intensity Suffered (%)	Farmers claiming compensation		TOTAL
	With Shooting Permit	Without Shooting Permit	
10	2	17	19
20	42	388	430
30	53	609	662
40	52	577	629
50	76	933	1009
60	33	663	696
70	36	569	605
80	49	617	666
90	13	275	288
100	144	2133	2277
TOTAL	500	6783	7283

(Chi^2 = 9.2 with 9 d.f.)

It is well documented that shooting is effective in preventing damage on an individual crop site if the site is under continual surveillance. However, we were most interested in the impact of shooting on a regional basis since displacement of waterfowl from site to site may result in greater total damage to the region than if waterfowl were unmolested by shooting. This thesis is commonly held since ducks have been thought to trample more grain than they consume. Field evidence tabulated by Benson (1952) in Saskatchewan showed that damage per duck day for a 100 acre barley field with known duck populations was 3.8 lbs. of which approximately 8 ounces can be attributed to actual consumption.

Therefore, we may form a hypothesis that on a regional basis less total dollar loss would be incurred by allowing ducks to feed undisturbed once they have established a feeding pattern, since displacement increases the number of damage sites and intensity of damage due to trampling decreases exponentially with time, resulting in greatest losses soon after the flock lands on the field.

Management Implications of the Findings: From the analyses conducted to date, several inferences can be drawn regarding damage prevention, control and compensation. First, stratification of the province into damage susceptibility zones allows the consideration of damage amerlioration programs as an alternative to compensation. In high damage concentration areas, lure crops may provide a more economic long term solution than compensation. Findings on water body

relationships and data obtained from actual plotting of damage sites (particularly those that have sustained damage for several years) provide a basis for the location of permanent lure crops designed to prevent damage in many instances.

Factors influencing damage intensity suggests that a category of lure crops to contain damage (once a feeding pattern has been established) based on purchase of crops on these sites is feasible and would reduce overall damage losses in a region.

Analysis of variables influencing damage will provide some basis for predicting the location and magnitude of damage expected in future years.

Questionnaire and computer data reveal the magnitude of damage in a provincial context. This allows consideration of potential demands on wildlife agencies for compensation or mitigation programs required to reduce losses to farmers.

SUMMARY AND CONCLUSION

1) Waterfowl damage to grain crops in Alberta constitutes a major economic program. Calculated provincial actual losses for 1968 range between three and six million dollars.

2) The existing compensation program reimburses farmers for approximately 35% of actual losses incurred.

3) Questionnaire data suggest that, on average, about 35% of Alberta farmers suffer damage in any one year, of which approximately 1 in 6 claim compensation.

4) Damage susceptibility zones in Alberta have been geographically identified.

5) Waterfowl depredations are a function of length of harvest rather than start of harvest.

6) Damage sites are closely correlated with water bodies in the size categories 30-50 acres and 320+ acres.

7) Shooting does not decrease damage intensity (% damage).

8) Shooting is likely to increase total regional damage losses.

9) The most important variables which we were able to subject to a step-wise regression analysis, influencing damage intensity (either positively or negatively) were found to be: distance to water bodies 51-160 acres and precipitation in the 4th week prior to damage.

10) The most important variables which we were able to subject to a step-wise regression analysis influencing number of acres damaged (either positively or negatively) were found to be: Annual precipitation and number of potholes on a damaged ¼ section.

11) Additional data and study on a regional basis is required if design of programs for damage amelioration are considered.

APPENDIX A

Explanation of Punched Card Data Form

Column	Information	Source	Remarks
1	Quarter	Adjusters Report	SE=1, SW=2, NW=3, NE=4
2-3	Section	" "	
4-5	Township	" "	
6-7	Range	" "	
8	Meridian	" "	Use last digit of Meridian. eg. 104th=4
9-12	Municipality	Map of Municipal Boundaries	Type & Number Improvement District=1 Municipality=2 County District=3 Special Area=4 etc. e.g. 1123(Improvement District No. 123)
13	C.L.I.#	Canadian Wildlife Service-Waterfowl Inventory Maps	0 if not present
14-19	Date of Damage	Adjusters Report	MMDDYY eg. Oct. 3 1967 = 100367
20-22	Damaged Acres	Adjusters Report	To nearest acre
23-25	Damage Intensity	" "	To nearest 1%, 100% has special symbol.
26	Type of Crop	" "	Wheat=1, Barley=2 Oats=3, Mixed=4 etc.
27-28	Yield prior to Damage (Bu/acre)	" "	To nearest Bushel
29-32	Compensation paid/ Quarter	" "	To nearest $1
33-35	Distance to nearest town	1:250,000 scale map	To nearest $\frac{1}{2}$ mile, e.g. $16\frac{1}{2}$ = 165
36-37	No. of Potholes on Quarter Section	1:50,000 " "	

38-40	Distance to 30-50 Acre Waterbody	1:50,000 scale map	To nearest 1/10 mile, e.g. 9.5=95
41-43	Distance to 51-160 acre Waterbody	1:50,000 scale map	To nearest 1/10 mile
44-46	Distance to 161-320 acre Waterbody	1:50,000 " " " " " "	
47-49	Distance to 320+ acre waterbody	1:50,000 " " " " " "	
50-51	Precipitation for week of damage claim	Weekly summaries of precipitation	To nearest 1/10 inch e.g. 4.3=43
52-53	Precipitation for one week prior to damage	Weekly summaries of precipitation	To nearest 1/10 inch
54-55	Precipitation for two weeks prior to damage	Weekly summaries of precipitation	" " " "
56-57	Precipitation for three weeks prior to damage	Weekly summaries of precipitation	" " " "
58-59	Precipitation for four weeks prior to damage	Weekly summaries of precipitation	" " " "
60-62	Annual Precipitation	Dept. of Transport, Meteoroligical Branch	" " " " e.g 19.3 = 193
63-65	Commercial value/Bu (Current year)	Dominion Burea of Statistics	$1.85=185
66-67	Blank		
78-80	Claim Voucher Number		