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Cereal Crop Depredation By Ducks And Its Control In The Canadian Prairies

Alan Lyle Vaudry

PESTOLOGY CENTRE
DEPARTMENT OF BIOLOGICAL SCIENCES
SIMON FRASER UNIVERSITY
BURNABY, B.C., CANADA V5A 1S6

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ABSTRACT

The problem of cereal crop depredation by ducks and methods of damage prevention in Canada was studied through a review of the literature. Intense crop damage did not occur until the mid-1940's with widespread use of the windrow-combine method of harvesting. High economic loss presently occurs when ducks, principally Mallard and Pintail, feed on the swathed grain in the autumn. Barley and wheat, and then oats, are preferred grains; other cereals are seldom damaged.

Damage is related to: the time of migration and the time of harvesting; the length of time swaths are exposed; concentrations of waterfowl; the distribution and size of waterbodies; and areas near waterbodies of certain sizes.

Ducks follow a specific flight path to grain fields, usually twice a day. They actively search for an acceptable feeding site and will return to favoured locations.

The average amount of grain consumed per duck per day was calculated to be 135 grams. Size and energy requirements affect food consumption. Landing on swaths and feeding activities will damage more grain than is consumed, however.

Crop damage is prevented or reduced through scaring ducks by using: scarecrows; light-emitting and light-reflecting apparatus such as revolving beacons, flashing lights, and reflectors; loud, intense sound produced by shotguns, rifles, acetylene exploders, and rockets; and aircraft. Other damage prevention methods also rely on scaring ducks through visual or auditory stimulus. Patrols are used to locate and prevent feeding. Permits are required to use firearms to protect

crops from ducks before the hunting season begins. Presently, there is no known effective chemical repellent for ducks.

Some farming practices can reduce or prevent crop damage. These consist of straight-combining, proper timing of harvest, proper choice of crop, utilizing grain dryers, and leaving stubble fields as feeding sites.

Diversionary feeding areas provide food for ducks, should permit undisturbed feeding, and are economically viable propositions to reduce crop depredation by ducks in some localities. Lure crops are crops set aside specifically for ducks, and may be either dry or flooded. At bait stations, grain is spread for ducks either on shorelines or on fields. These stations reduce duck damage more effectively than lure crops. Presently, there are many diversionary feeding programs in active operation in the Prairie Provinces.

Wildlife crop damage insurance is available in all 3 Prairie Provinces. A damage alleviation program is in effect in the prairies between the federal and provincial governments, and is funded on a 50:50 cost share basis. Crop damage will be a continuing problem as ducks breed in the prairies and pass through during migration.

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INTRODUCTION

The prairies are an important grain producing region of Canada (Table I) as well as being an important duck production area. Canadian wheat and other cereals are in constant demand throughout the world by countries such as China, Japan, India, and the USSR. The price these commodities demand on the market provides for a profitable return for those involved in its production, shipment, and associated activities. Consequently, any grain loss because of pests is undesirable and must be reduced.

Cereal crop depredation by ducks in the fall during grain harvest represents a high economic loss but is being controlled with some success. Damage prevention methods will always be required, however. Ducks from more northerly regions migrating along the Pacific, Central, Mississippi, or Atlantic flyway pass through at least a portion of the prairies. Also, duck breeding grounds (Fig. 1) encompass southern portions of the three Canadian prairie provinces, and portions of the mid-northern United States, which correspond to grain producing regions. It is in this region, which contains 10% of the total duck breeding area, that 50% of all the continental duck population breeds (Munro 1963). Seventy to 80% of Mallard and Pintail are produced here. These two duck species are most favoured by hunters but they are also responsible for the greater portion of duck depredation of cereal crops.

Waterfowl generate business with consequent financial income for those involved in, or affected by, the duck harvest. S. M. Carney (personal communication)[1] summarized from the

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[1] letter dated 29 May 1974, U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Laurel, Maryland.

Table I Acreage of principal field crops in the Canadian Prairies compared to the total acreage of principal field crops in Canada, 1970 (thousand acres)[a].

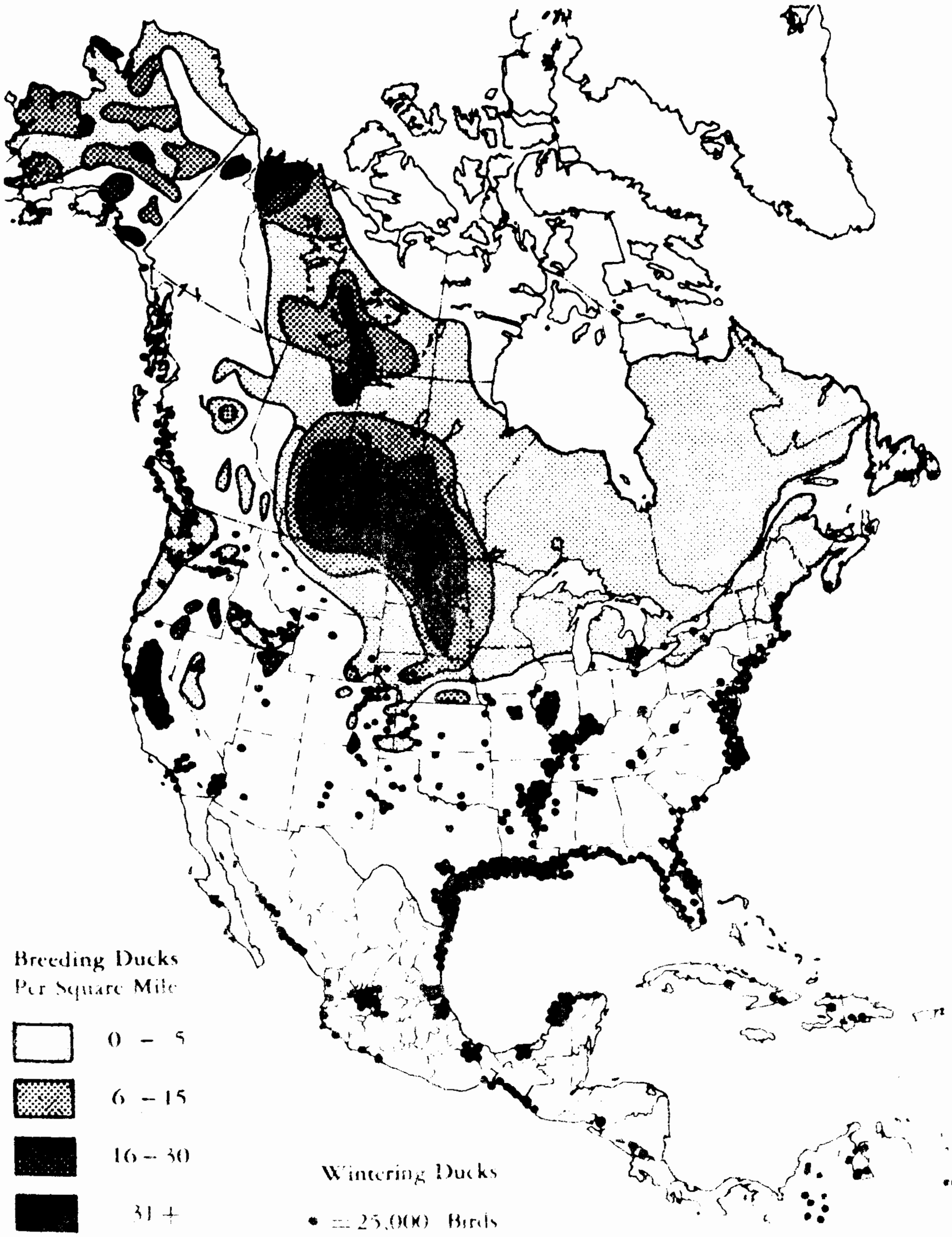
Crop	Canada	Prairie Provinces	Saskatchewan	Alberta	Manitoba
all wheat	12,484	12,000	8,000	2,600	1,400
barley	10,042	9,500	3,300	4,700	1,500
oats for grain	7,149	5,260	1,950	2,050	1,260
all rye	1,015	944	535	215	194
flaxseed	3,368	3,350	1,500	700	1,150
rapeseed	3,950	3,950	2,000	1,600	350
mixed grains	1,940	875	175	450	250
summer fallow[b]	28,800	28,800	18,200	7,400	3,200
total	68,748	64,679	35,660	19,715	9,304

[a] from Daviault 1971.

[b] 1969.

Fig. 1 Mean distribution of breeding and wintering areas of North American ducks. (from Evans 1964, page 720)

AVERAGE DISTRIBUTION OF NORTH AMERICAN BREEDING AND WINTERING DUCKS



National Survey of Hunters and Fishermen-1970, Resource Publication 95-Fish and Wildlife Service, that waterfowl hunters spent an estimated 244,451,000 dollars pursuing their sport. Firearms, ammunition, clothing, other equipment, transportation, meals, and accomodation would likely be considered as expenditures. There is probably a significant amount of money spent on optical equipment, books, art, and other objects, for the purpose of appreciating waterfowl.

Life History

Mallard (Anas platyrhynchos Linnaeus) and Pintail (Anas acuta Linnaeus) are waterfowl and belong to the Family Anatidae, Subfamily Anatinae, the puddle ducks, and feed either on water or land. They prefer shallow water not more than 2 or 3 feet deep since they often tip for their plant food. Mallard are the largest of the puddle ducks with adult males averaging 2 pounds 11 ounces and females 2 pounds 6 ounces, while adult male Pintail average 2 pounds 2.5 ounces and females 1 pound 13 ounces (Kortright 1943).

Pair formation has generally been completed on the wintering grounds before spring migration. With the advent of spring in March, and until May, paired and courting Mallard and Pintail return to their breeding areas. These consist of the potholes, marshes, sloughs, and lakes of the prairies, as well as of waters further north. The nesting season begins in April and ends in July. An average clutch of less than 10 eggs is laid (Kortright 1943) and is incubated for approximately 22 days (Trippensee 1953). Mallard require a fledging period of 49 to 60 days after hatching while Pintail only require 38 to 52 days (Johnsgard 1968). Ducklings initially consume mainly invertebrates. However, as ducklings mature they eat greater quantities of plant material until their diet consists mainly of plants.

The male moults to his eclipse plumage while the hen is incubating the eggs. The male is then flightless for about 3 to 4 weeks in the period from June to August (Johnsgard 1968). The adult female moults after the young have hatched. She is also flightless for about 3 to 4 weeks, but in the period from July to September. Yearlings and adults begin congregating in July, and fall migration commences in August and continues until November. Practically all the ducks are found south of the Canada-United States boundary after freeze-up.

The Prairies

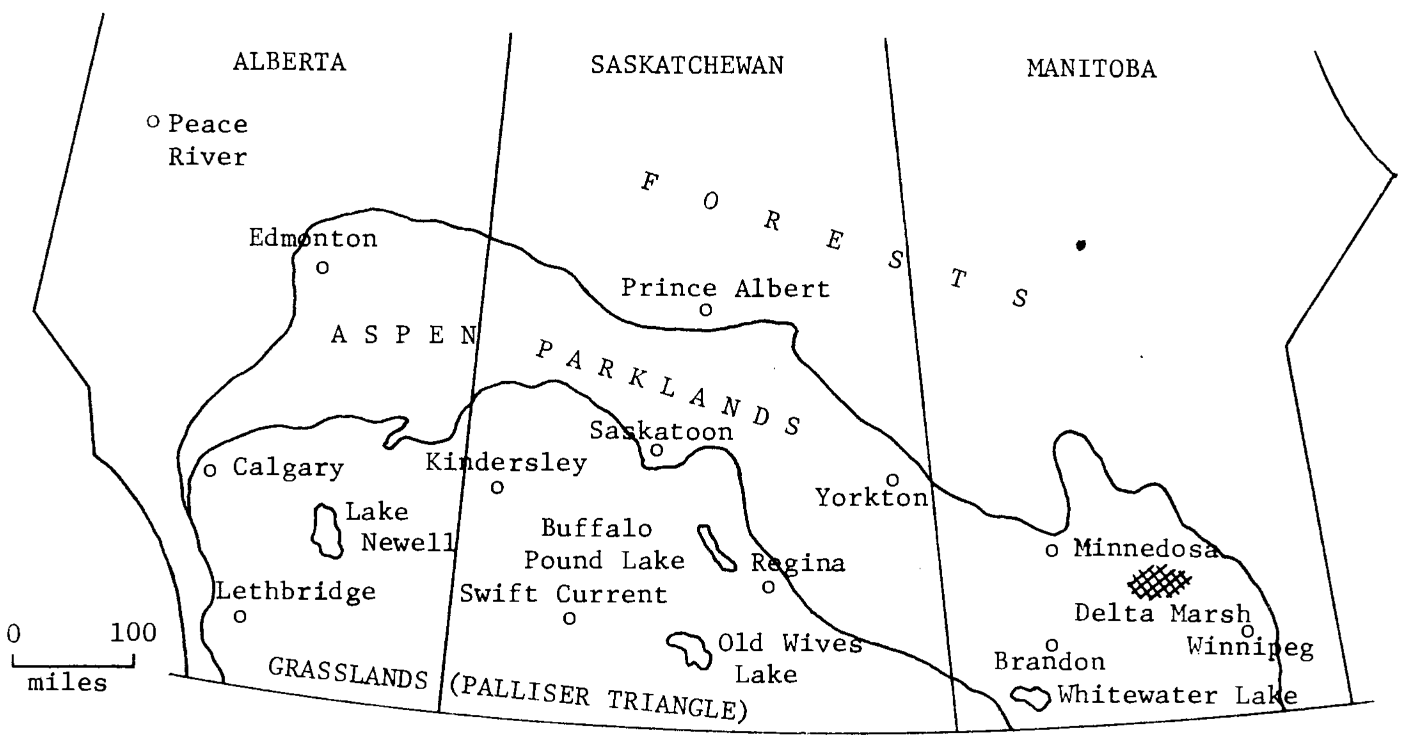
The ploughing action of the glaciers of the Pleistocene age helped shape the topography of the prairies. The characteristic level, rolling, or hilly ground is extensively dotted with potholes in some regions (Fig. 2). Numerous sloughs, marshes, and lakes are also present.

The climate is cold in the winter with freezing temperatures and snow, while hot temperatures prevail in the summer. Precipitation is about 10 to 20 inches in the grain-growing region (Paynter and Stephen 1964) and is extremely variable (Munro 1963). The number of potholes change from year to year according to the amount of water available, and some waterbodies may dry out as the summers progress. The potential number of water areas available in the southern Prairie Provinces could be over 8 million (Munro 1963).

Grasslands are prevalent in southern Canada. Aspen parklands border the grasslands on the north and eventually extend into forests (Fig. 3). It is the grasslands and aspen parklands region, plus an area surrounding Peace River, where the

Fig. 2 Pothole habitat near Minnedosa, Manitoba, in the aspen parklands. (from Kiel *et al*. 1972, page 9)

Fig. 3 Grasslands, aspen parklands, and forests of the Canadian Prairies. (adapted from Munro 1963, page 108)


ALBERTA
SASKATCHEWAN
MANITOBA
Peace River
Edmonton
Calgary
Lake Newell
Lethbridge
Kindersley
Saskatoon
Prince Albert
Buffalo Pound Lake
Swift Current
Regina
Old Wives Lake
Yorkton
Minnedosa
Delta Marsh
Brandon
Winnipeg
Whitewater Lake
F O R E S T S
A S P E N P A R K L A N D S
GRASSLANDS (PALLISER TRIANGLE)
0 100
miles

majority of Canadian cereals are produced. Fires on grasslands are credited with having prevented the aspen parklands from extending into the grass regions prior to farming (Kiel et al. 1972). Later, the prevention of fires on the grasslands by farmers encouraged invasion by trees in some areas.

Agriculture and Ducks

Increased ease of transportation, due to roads and the joining of both coasts by the Canadian Pacific Railway in 1885, allowed easy access to the prairies. Farming on the prairies increased rapidly thereafter. Kiel et al. (1972) found that 4 million acres were under cultivation by 1900, 57 million acres by 1936, and 67 million acres by about 1950. Daviault (1971) reported that over 85 million acres were under cultivation by the mid-1960's (Table II).

Farming on the prairies has had detrimental effects on the breeding areas of waterfowl. Waterbodies have been drained or filled to increase cultivated acreage, to allow easier cutlivation, and to enable road construction. These important breeding areas, with their abundant fauna and flora providing an important food source, were then no longer available for ducks. Consequently, duck populations would have decreased dramatically without intervention and land management. Ducks Unlimited and various other private organizations, the federal government through the Canadian Wildlife Service, and the provincial governments have provided areas suitable for waterfowl and have protected waterbodies from damage.

The continental waterfowl population was approximately 125 million at the turn of the Century (Trippensee 1953). However, the number of waterfowl decreased and was quite low

Table II Total acreage of occupied farms in the Canadian Prairies, 1966 (thousand acres)[a].

Location	Total Area	Improved Land	Unimproved Land
Prairie Provinces	133,476	85,191	48,285
Manitoba	19,084	12,446	6,638
Saskatchewan	65,409	45,469	19,940
Alberta	48,983	27,276	21,717

[a] from Daviault 1971.

from 1925 to 1936. The population was estimated at 27 million in 1934 (Day 1944). This occured because of a reduction in numbers of breeding sites due to drainage and filling of water-bodies, and due to drought. There was also a high mortality rate because of overshooting. With a return to expected precipitation levels, and action by farmers, private organizations, and government agencies, the numbers of waterfowl have increased. S. M. Carney (personal communication)[1] provided rough estimates of population levels for the period 1956 to 1962. The estimated population of total game ducks (not including: eiders, *Somateria* spp., *Polysticta stelleri* (Pallas), *Lampronetta fischeri* (Brandt); scoters, *Melanitta* spp., *Oidemia nigra* (Linnaeus); Oldsquaw, *Clangula hyemalis* (Linnaeus); Harlequin, *Histrionicus histrionicus* (Linnaeus); and mergansers, *Mergus* spp., *Lophodytes cucullatus* (Linnaeus)) averaged 98 million. The peak during this period was 120 million and the low was 77 million. The fall flights of Mallard were assessed at an average of 21 million, with a peak of 30 million and a low of 13 million.

While numbers of ducks were low, farmers were willing to help preserve nests on land being cultivated and to help ducks survive (Mair 1953). However, the attitude of farmers changed as ducks became noted for their depredations on crops. The problem today is to reduce crop damage to an acceptable level while still providing for a large enough duck population to allow an acceptable harvest by hunters and to provide aesthetic value.

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[1] letter dated 29 May 1974, U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Laurel, Maryland.

CROP DEPREDATION

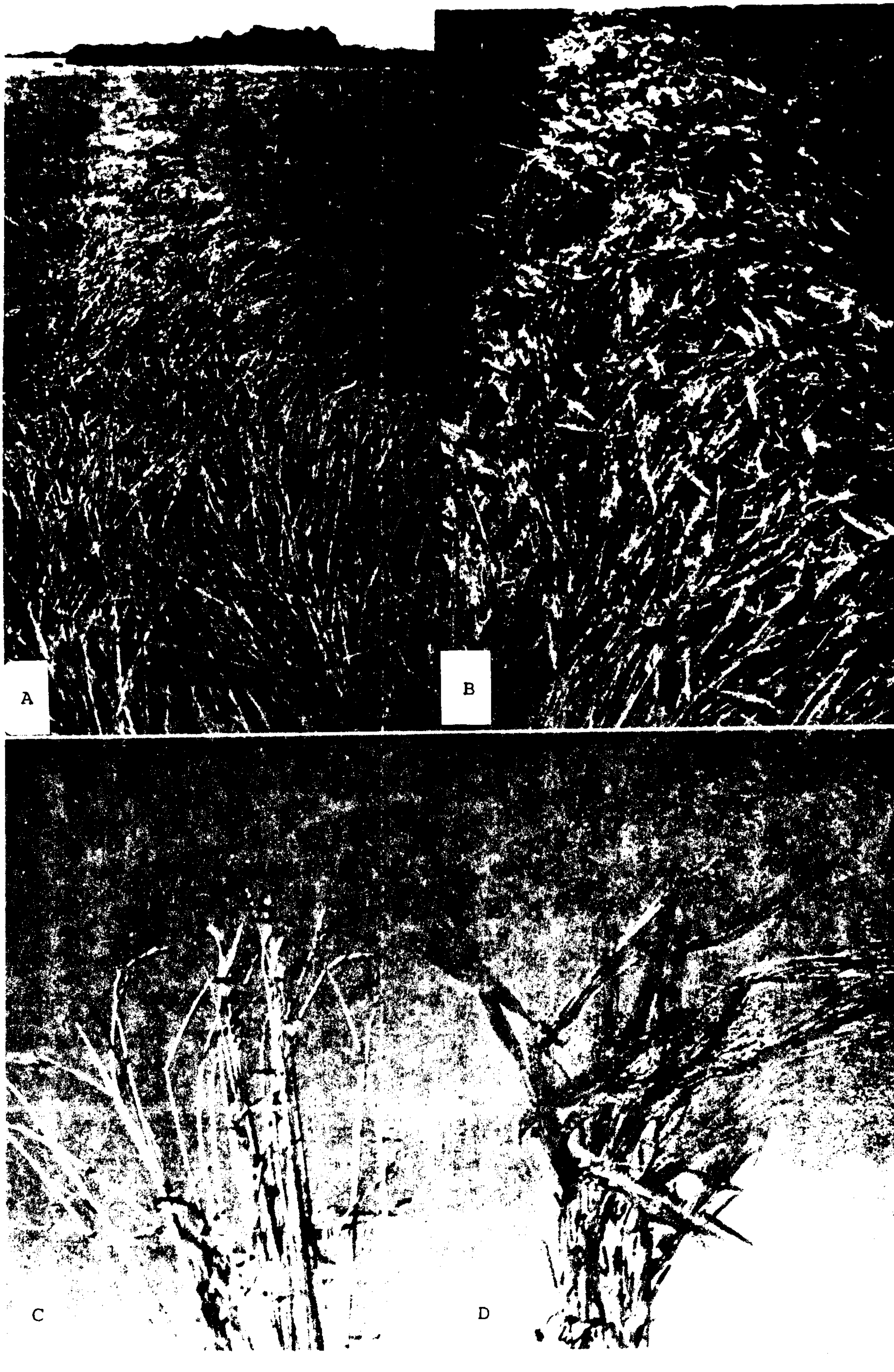
Introduction

Field-feeding occurs during fall migration, spring migration, and during the summer. Feeding on swaths in the autumn during grain harvest is the time of greatest damage. A swath consists of cut grain concentrated into a row (Fig. 9) which lies on 6 to 10 inch stubble (Paynter and Stephen 1964). This permits even drying and maturation. The crop can then be threshed after 4 to 14 days of warm weather (Paynter and Stephen 1964). However, more time is required for drying during unfavourable weather conditions. Dry or flooded stubble fields and cultivated fields, where the grain crop has been removed, are also fed upon. Feeding during the spring on unharvested swaths, waste grain, or spring growth of crops stops because of nesting activities and drying fields. Summer feeding occurs after breeding when ducks congregate on waterbodies, but only if grain is present in the fields.

The greatest crop depredation occurs to dry or flooded swathed grain (Fig. 4). Barley, wheat, and oats are most affected, while flax, rye, and rape are also damaged. Swathed fields are fed upon because of the abundance and easy accessibility of grain. There are more kernels per unit area on swathed fields compared to the amount of waste grain on stubble fields and ploughed fields. However, stubble fields provide some easily accessible waste grain whereas waste grain is not as available in cultivated fields. Consequently, cultivated fields are not fed upon as intensely as other fields.

Damage begins to swathed grain when ducks land on the easily accessible swaths. Landing and trampling causes kernels

Fig 4. Barley swath: A, damaged; B, undamaged. Seed heads: C, damaged; D, undamaged. (from Canadian Wildlife Service [1972?], page 2)


A
B
C
D

to be knocked off and fall to the ground, entire heads of grain to be broken off the straw, and swaths to become compacted. Grain is fouled and becomes dirty when trampled into the ground. The act of landing and the trampling and fouling can cause more damage than feeding. In wet weather, the amount of eaten, damaged, or wasted grain was 140% of the amount actually eaten (Hammond 1951), compared to 560% in dry weather (Imler 1943, cited by Hammond 1950). Burgess (1973) found that up to 22% of all available grain was lost or destroyed because of associated feeding activities. MacLennan (1973) calculated that one duck would destroy a minimum of 870 grams of barley or 660 grams of wheat per day. Benson (1952) found that 1,724 grams of barley were damaged by one duck each day. Studies in Manitoba showed a damage rate of 2,041 grams of barley per field-feeding duck (as mentioned by Burgess 1973). Actual consumption rates are discussed on pages 23-25.

Trampled swaths are more susceptible to freezing to the ground, more difficult to pick up with a combine, and may require longer drying time. If the fields are wet or flooded, trampled swaths can be forced into the ground and become irretrievable. The ground can become very hard because of ducks walking about, especially if the field is wet or flooded during their presence. This may make subsequent cultivation difficult. Grain grades may be reduced because of associated feeding activities thereby resulting in a lower price on the market. The only "benefits" depredating ducks provide are consumption of weed seeds and soil fertilization through their droppings. However, these "benefits" are far outweighed by the damage caused.

Ducks have been reported seen feeding in standing grain in flooded fields (Bossenmaier and Marshall 1958, Lostetter

1956) and in standing grain after a snowfall (Girard 1941, Hammond 1957). However, ducks generally leave standing crops untouched as the grain is out of reach. Ducks also tend to avoid high vegetation when feeding because predators cannot be readily seen.

Mallard and Pintail cause most of the damage to cereal crops, with Mallard being the worst offender. This is often a result of Pintail leaving for the south sooner than Mallard. Mallard are more cold-hardy than Pintail and many will not migrate until freezing temperatures or snowfall occur. Other duck species reported feeding in fields, also belonging to the Family Anatidae, Subfamily Anatinae, are the American Widgeon (*Mareca americana* (Gmelin)), Black Duck (*Anas rubripes* Brewester), and Green-Winged Teal (*Anas carolinensis* Gmelin) (Bossenmaier and Marshall 1958, Hochbaum *et al*. 1954, Stephen 1961a). However, these ducks eat mostly aquatic vegetation and are not a major problem as crop depredators.

Not all the ducks present in an area will feed in the fields. MacLennan (1973) reported that 50 to 70% of ducks observed on a lake fed in surrounding fields. Bossenmaier and Marshall (1958) reported that approximately 5% or less of the Mallard fed in the marsh while the others fed in the fields, and that a large proportion of the Pintail remained on the lake.

History

Damage to cereal grain crops by ducks in the Canadian Prairies has been reported since the turn of the Century but did not reach levels where complaints by farmers received attention by the provincial and federal governments until the mid-1940's. At this time, stook-threshing was mostly replaced by the windrow-combine method (Bossenmaier and Marshall 1958, Colls 1951, MacKay

1961, Paynter and Stephen 1964). This allowed ducks easy access to cut grain whereas the previous methods of stook-threshing and stack-threshing did not. Depredation of stacks and stooks has been reported but it was not as extensive or damaging as feeding on swaths. The federal government through the Canadian Wildlife Service began trying to control crop damage by ducks in the late 1940's by using scaring techniques (MacKay 1961).

Bossenmaier and Marshall (1958) found that most stook depredation in their study area began about 1920 after introduction of new crop varieties preferred by ducks. Durum wheat and barley increased in use while Red Fife and Marquis hard wheat almost disappeared. Crop depredation increased with the introduction of windrow-combining but was not a new phenomenon initiated by the new harvesting technique.

Ducks feed on the relatively new food source of cereals and do not restrict feeding to only waterbodies possibly because of instinctive behaviour. It is believed that they previously fed on upland sites which are now used to grow cereals. This can be surmised from the fact that once grain is swathed, some ducks will feed in the fields and will not eat grain spread out on shores of waterbodies at feeding stations. Wild standing plants cut down by fire, hail, rain, wind, or animals would initiate this behaviour prior to farming on the prairies. Therefore, farmers are presently providing suitable feeding habitats by cutting down tall crops.

Field-Feeding Behaviour

Flights

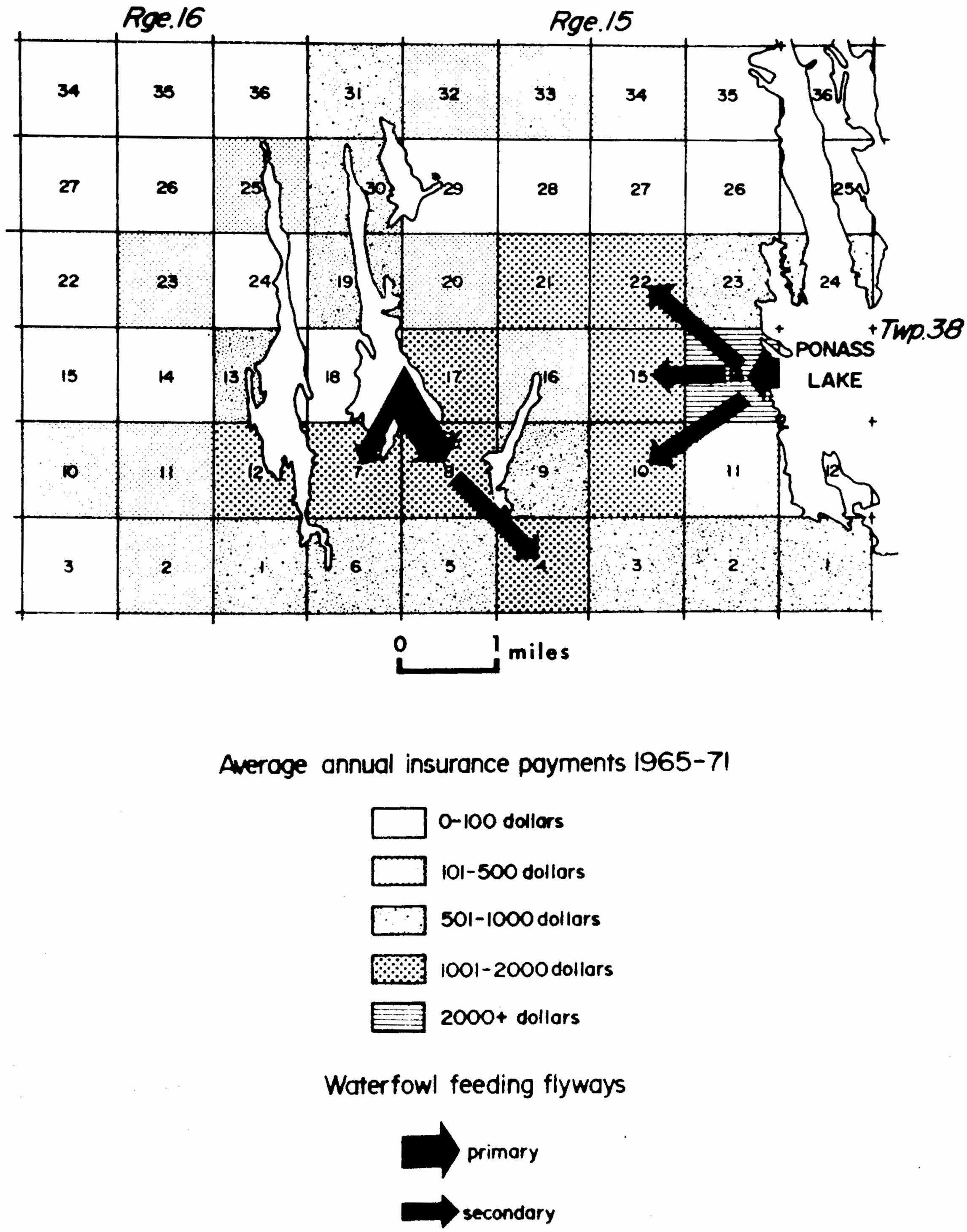
Waterfowl congregate at favoured areas on waterbodies for feeding and loafing. They will follow a specific flight path from these areas to feeding sites in the fields (Bossenmaier and Marshall 1958, Hochbaum et al. 1954, MacLennan 1973) (Fig. 5). The flight paths may remain predictable over many years and particular fields may be visited every year. Some ducks land in fields other than the popular one, however, and some fly in other directions from the flight path. MacLennan (1973) found that large fields with few trees or shrubs which would obstruct vision are preferred. Elevated portions of fields as well as areas with a gradual slope from the feeding site to a nearby slough or lake are also favoured.

Flights occur over the fields before and during harvest. Bossenmaier and Marshall (1958) observed that fields with swathed grain or in stubble are distinguished by flying ducks. A small searching flock then separates from the main flock and lands to determine the acceptability of the chosen field. The searching flock will rejoin the main flock if the location is unfavourable and they will continue the search for a preferred feeding area. Once a field has been chosen it will be revisited for further feedings. As a result, an adjacent field with a more highly-preferred food may not be used for feeding because it was not "discovered" first. The activities of ducks flying to the field and landing, their presence, and feeding activities such as noise-making, will attract other ducks. This habit of feeding in flocks can readily cause significant damage to the crop.

Feeding generally occurs twice a day with flights to the fields in the early morning and evening. Light intensity determines when the birds leave for the fields in the morning and when they return to the overnight roosting area. As soon

Fig. 5 Waterfowl feeding flyways and damage intensity in the Ponass Lake area, Saskatchewan, 1965 to 1971. (from MacLennan 1973, page 15)

Map 4. Area 1 Ponass Lake



as it is light enough to see, ducks will depart for the feeding area. Just prior to darkness they will return to their overnight roosting area. However, feeding may occur in dry or flooded fields during the night (Bossenmaier and Marshall 1958, Girard 1941, Hammond 1950, Hochbaum et al. 1954, Imler 1944, Uhler and Creech 1939, Wagar 1946). The ducks may remain on the water after feeding or return after darkness to stay overnight.

Normal feeding schedules may be changed because of extenuating circumstances (Bossenmaier and Marshall 1958, Girard 1941, Hammond 1950, Kalmbach 1935). During poor weather (rain, strong winds, low temperatures), ducks may leave for the fields in the afternoon and feed. Flights to the fields and feeding throughout the day may occur during very bad weather. Feeding schedules may also be changed to allow undisturbed feeding if hunting pressure is heavy. For instance, ducks may return to resting areas in the morning before hunting begins, and not leave for the fields in the evening until hunting stops (Girard 1941).

Food Consumption

Food consumption varies with many factors but body weight is of primary importance. The average amount of food consumed per bird (waterfowl) per day can be estimated, in dry weight, as 10% of the wet body weight (Sincock 1962). This estimate is for active wild waterfowl eating natural foods. Table III shows the results of determination of grain consumption by ducks: an average of 135 grams of grain were eaten per duck per day. By using the 10% estimate, larger duck species such as Mallard and the larger males of a duck species can be expected to consume more food than smaller species of ducks and

Table III Grain consumption by ducks.

Grams/Duck/Day (Average)	Grain	Duck(s)	Author
199	not specified	mixed wild population	Hammond 1961
198	wheat	wild Mallard	Bossenmaier and Marshall 1958
68	small grain[a]	captive male Mallard	Jordan 1953
170	rice	wild, not specified	Horn 1949
41	small grain[b]	captive male and female Mallard	Sugden 1971
135 average			

[a] wheat, oats, sorghums, flax, and rice.

[b] wheat, barley, and rye.

the smaller females of a duck species. In fact, Jordan (1953) found that male Mallard ate 15% more than female Mallard.

Jordan (1953) reported that energy requirements will affect food consumption. Food intake for Mallard was found to vary inversely with the seasonal air temperature. Adult male Mallard ate an average maximum of 149 grams of corn during abnormally cold weather (15° F or lower) as compared to an average of 73 grams during normal cold winter weather in Illinois. Normal monthly average temperatures range from 26° F in January to 76° F in July at Chicago in Illinois (Delury 1974). Rapidly growing ducks have a high metabolic rate therefore they should eat more food than adults. Immature ducks 8 to 9 weeks old were found to eat 44% more food than mature ducks.

Ducks that eat twice a day may spend an average of 35 minutes per day feeding, with a minimum of 20 minutes per day, when grain is provided (Hammond 1950). However, Paynter and Stephen (1964) said that ducks which feed in fields twice a day normally spend about 8 hours feeding. This represents the period of time damage may occur to swaths, and indicates that persistant control measures are required to keep ducks from fields.

Food Preference

Mallard and Pintail prefer cereal grains to natural foods. Field-feeding may be caused by instinctive behaviour as well as by the ease of obtaining food. Cultivated crops generally produce more food per acre than naturally-occuring plants.

The grains preferred by ducks are described as being barley and wheat, and then oats, with the other grains seldom heavily damaged. Jakimchuk (1969) reported that total bushels of barley and wheat lost were about equal in Alberta from 1965 to 1968, and that bushels of oats lost were only 10% of the average losses of either barley or wheat.

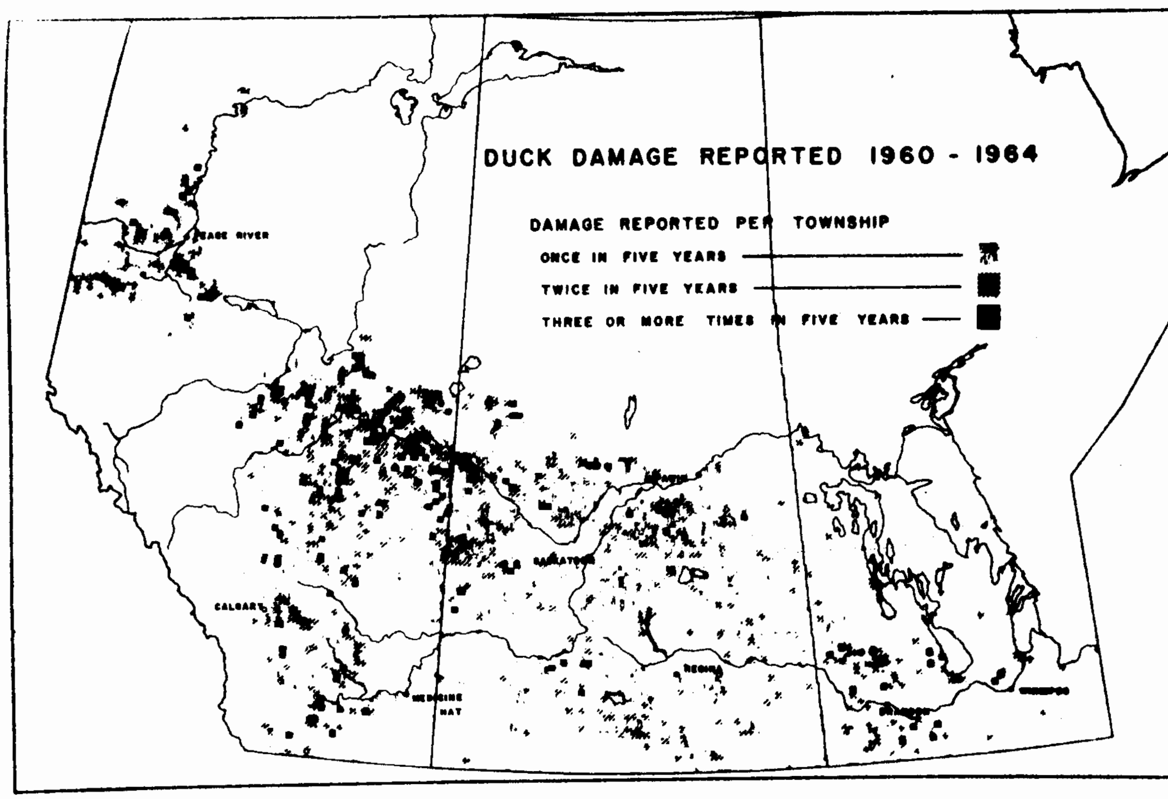
Factors that influence preferences for particular grains likely include size, shape, hardness, texture, ease of shelling, length of awns, and palatability. Hammond (1950) reported that of the threshed grains, wheat was eaten more rapidly than barley during shore feeding, and that either of these grains were preferred over oats. This was thought to be due to either the wheat being preferred or because the lack of awns on the wheat permitted faster feeding. Other observations have shown that swathed hard wheat was not preferred over swathed barley or Durum wheat, which may have been due to the difficulty of loosening kernels which offset palatability (Bossenmaier and Marshall 1958, Hammond 1950, MacLennan 1973).

Factors affecting grain preference by ducks and its determination by observers are: the types of crops available; the time of their availability; the amount available; the location of the crop (eg. close to buildings, far from water-bodies); and the physiological state of the duck.

Factors Influencing Crop Damage Intensity

Surveys of cereal crop damage by ducks have shown that there are certain areas more likely to be subject to depredation than others (Fig. 6). These regions coincide with areas of waterfowl concentrations and may range in size from a few hundred to several thousand square miles. Because of the many variables involved in crop depredation by ducks, damage to crops will vary from year to year. Losses have been as high

Fig. 6 Prairie regions in Canada reporting crop damage, 1960 to 1964. (from Stephen 1965a, page 91)


DUCK DAMAGE REPORTED 1960 - 1964
DAMAGE REPORTED PER TOWNSHIP
ONCE IN FIVE YEARS
TWICE IN FIVE YEARS
THREE OR MORE TIMES IN FIVE YEARS
REGINA

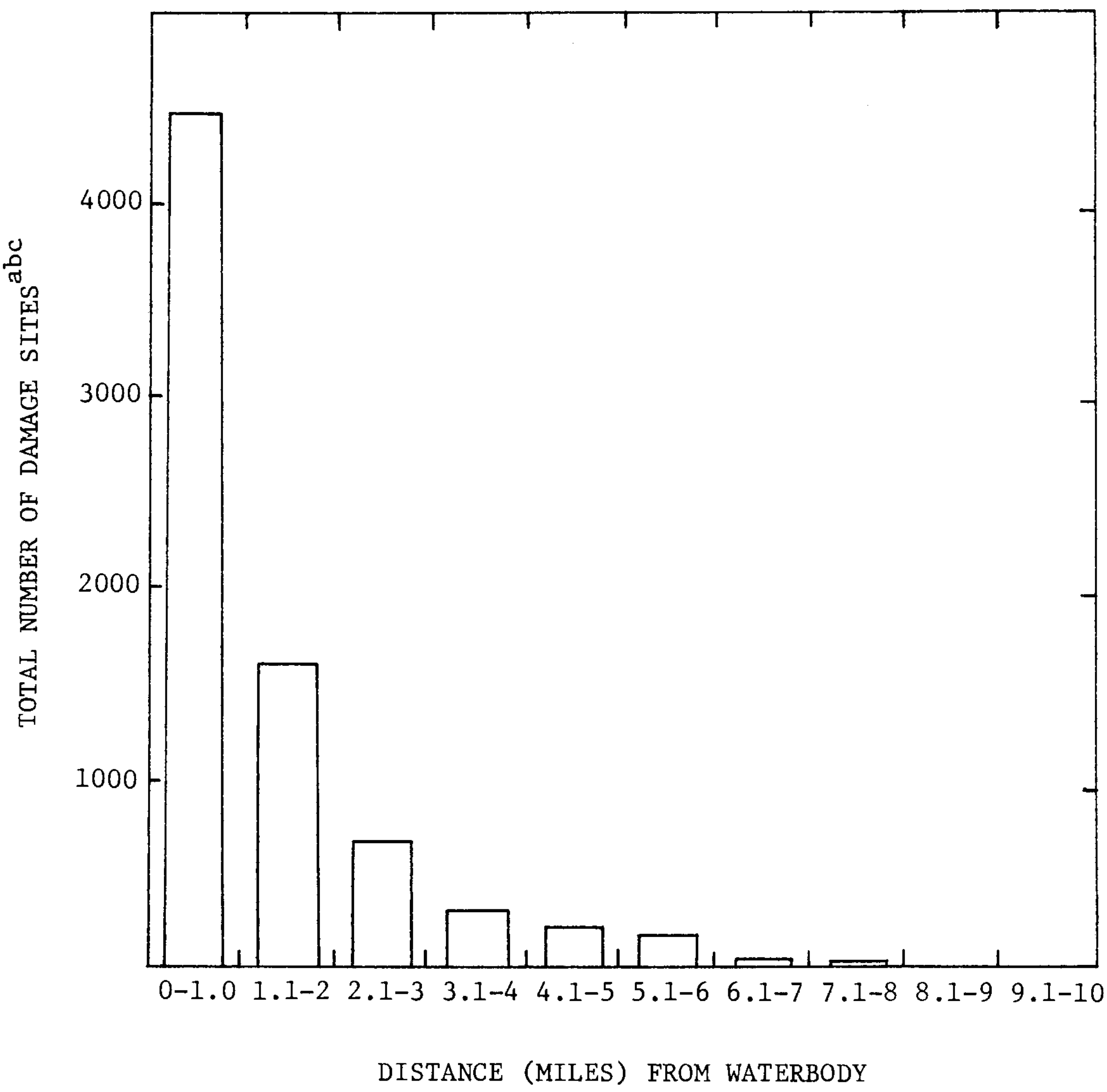
as 100% of the crop (MacLennan 1973) while some fields in damaged areas remain untouched (Hochbaum et al. 1954).

The distribution and size of waterbodies used by foraging flocks determines the intensity of damage in any one area. Prior to migration, waterfowl move from small potholes and concentrate on larger waterbodies which are used as staging areas. Other ducks use large waterbodies as resting areas during migration. Statistically, greatest damage occurs near waterbodies of 30 to 50 acres, and then near waterbodies of 320 acres or more (Jakimchuk 1969).

Damage decreases with increasing distance from the waterbody (Fig. 7). Greatest damage occurs within 1 or 2 miles from a waterbody utilized by concentrations of ducks (Bossenmaier and Marshall 1958, Jakimchuk 1969, Stephen 1961a), with the chance of having damage within 1 mile being much greater than if the distance is 1 to 2 miles. If a field used for feeding is adjacent to a waterbody, ducks may walk to it to feed (Bossenmaier and Marshall 1958). Not all fields close to waterbodies used by ducks will suffer damage, however (Bossenmaier and Marshall 1958, Hochbaum et al. 1954, MacLennan 1973, Stephen 1961a). For instance, a farm 1 mile distant from a marsh utilized by ducks was seldom visited although fields closeby were damaged annually (Hochbaum et al. 1954). Ducks that are disturbed while in fields close to a waterbody will feed further away from the waterbody (Bossenmaier and Marshall 1958). However, fields closest to the waterbody will be used during inclement weather even if the ducks are in the habit of flying greater distances.

Crop depredation is related to the time of migration and time of harvesting. Damage begins at harvest and ends when the last swath is picked up. Greatest crop damage occurs during

Fig. 7 Damage intensity compared with distance (miles) from waterbody. (adapted from Jakimchuk 1969)



[a] a damage site is a quarter section (160 acres) for which crop damage by ducks has been reported.

[b] for 5 years.

[c] data from Alberta Hail Insurance Board claims records.

August, September, and October during the period of peak migration, which coincides with the grain harvest (Fig. 8). However, crop damage may also occur in July and November. Jakimchuk (1969) said that greater damage occurs when an area such as northwest Alberta is harvested at the time numbers of migrants peak, than in areas such as southeast Alberta where harvesting is mostly finished before the peak of migration. It is in those areas along the flyways and with duck concentrations that greatest crop damage is reported, with greatest damage being related to flyway paths and not necessarily to numbers present.

The date of grain harvest within a province varies considerably since the date of seeding, usually from April to June, depends upon the location and season. Generally, wheat is sown early, and oats and barley are sown later. Poor weather conditions can delay planting and retard maturation of cereals.

Severity of damage to crops is directly related to the length of time that they are left exposed in the swathed condition and the number of field-feeding ducks present (Stephen 1961a). Rain, flooding, cool temperatures, and other poor drying conditions can make it necessary for the swaths to remain exposed to duck damage for a longer time than usual. For instance, after a light rain 2 to 5 days are required to dry the grain before harvest (MacLennan 1973). Crops might not be harvested until the following spring if they are continually wet or are covered with snow.

The number of fields uncut, swathed, in stubble, and ploughed at any one time will influence the amount of duck damage sustained at that time. This condition occurs because crops are cut and threshed at different times throughout a region. This matter is discussed in greater detail on pages

Fig. 8 Harvest chronology of the southeast and northwest districts of Alberta during 1968, a wet year. (from Jakimchuk 1969, page 75)

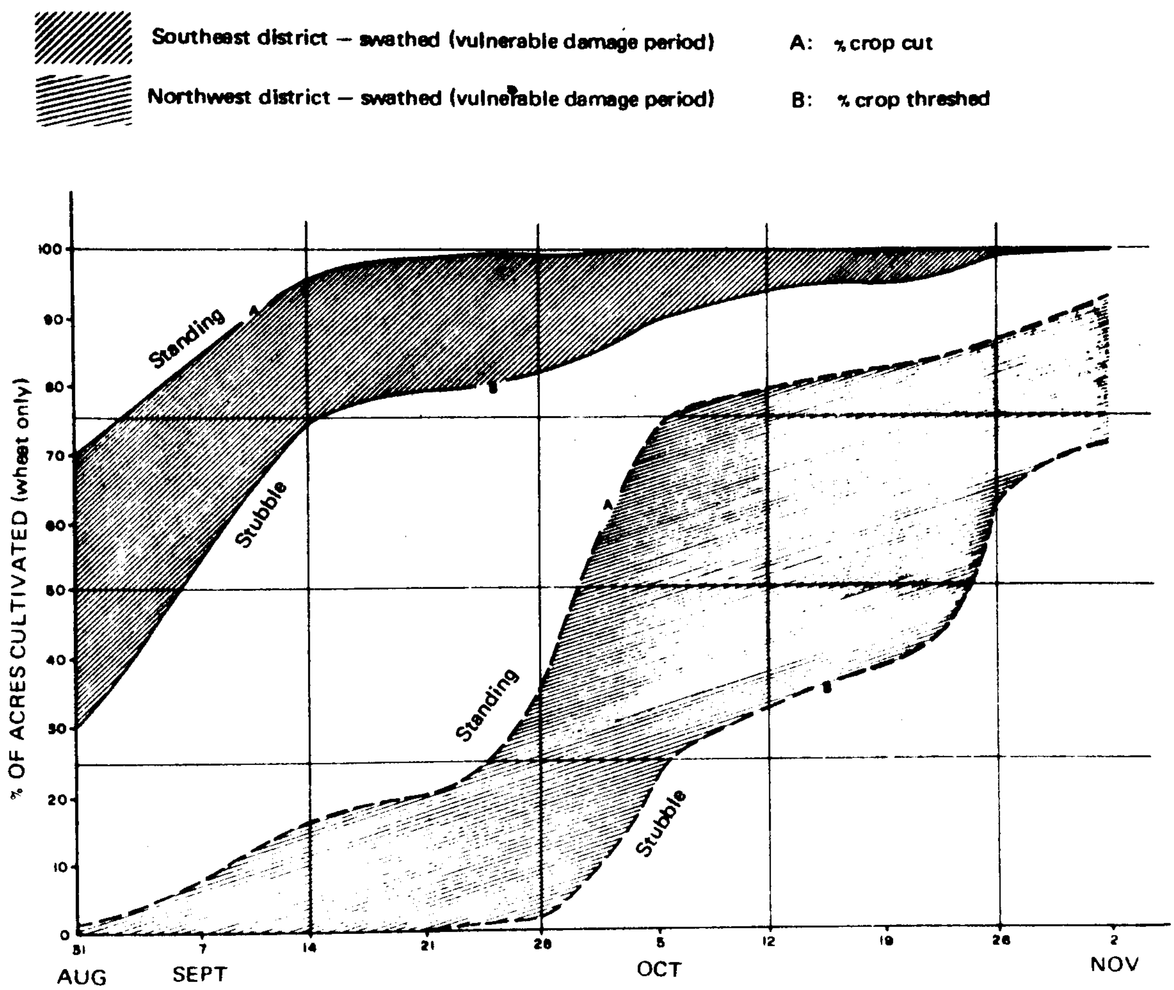


Figure 2
A comparison between the harvest chronology of the southeast (No. 1) and northwest (No. 15) districts of Alberta, 1968.

50-51. Crops subject to control programs are less likely to be damaged than unprotected crops, however.

A combination of factors can cause intensive crop damage even with abnormally low numbers of ducks. Colls (1951) reported that a drought in Manitoba during 1949 caused ducks to concentrate in large water areas. Heavy rains then flooded natural foods, delayed picking up of swaths and stooks, and beat down some standing crops. This combination of factors resulted in extensive depredation even though duck numbers were "low".

DAMAGE PREVENTION

Introduction

Damage to crops is reduced when ducks are scared off the fields whereas duck damage is prevented by not permitting ducks to land. It is essential not to allow a feeding pattern to become established, and to break the pattern when it has been established. Many days of repeated harassment might be required to make ducks leave an established feeding site permanently.

Current methods of preventing crop damage include scaring ducks from crops or preventing them from landing through the use of patrols, scarecrows, and directed sound from firearms, acetylene exploders, and rockets. These control methods provide an effective means of damage reduction when used in connection with diversionary feeding areas, even if there is a high possibility for serious crop depredation. For instance, Hammond (1950) reported that good control was achieved during a poor harvest season by using these methods. The poor harvest season was caused by delayed planting due to a late spring and wet conditions. There was also an early arrival of large numbers of migrants. In Alberta, 50% of the farmers surveyed in 1968 used shooting as a method of damage control, 31% used scarecrows, 23% chased ducks, 16% left machinery in the field, 2% used acetylene exploders, and 36% used no controls (Jakimchuk 1969).

Patrols

Patrols are conducted by Conservation Officers or farmers using vehicles or airplanes, or on foot or horseback. They are done in the early morning and evening, the times associated with regular feeding-flights to the fields. Patrols are required continually during inclement weather, however.

Ducks are scared from fields by the patrol, or the patrol contacts the affected farmer so that he can take corrective action. Field-feeding is thereby stopped and feeding patterns do not become established or are broken.

Crop Protection Permits

Permits are required in order to use firearms to protect crops or other property from damage by birds. This matter is dealt with by the Migratory Birds Regulations, sections 24 through to 27 (Appendix A). The Migratory Birds Regulations are contained within the Migratory Birds Convention Act. Permits are not required if equipment other than firearms is used to scare ducks from crops that are being, or that may be, damaged (section 24). However, permits are required to use firearms to scare (subsection 24(2), section 26) or kill (sections 25, 26) ducks before the hunting season. Individuals issued with a permit are allowed to have others assist them, as stated in section 26. The people that live in a specified province or in a portion of it, may be allowed to kill ducks in a problem area for a specified time period (section 25). Decoys, calls, or blinds cannot be used (subsection 27(2)), and ducks can only be killed on fields which contain the susceptible crops (subsection 27(3)(a)). However, a person acting under the authority of a permit issued in accordance with either section 25 or 26 does not require a migratory game bird hunting permit, and there is no limit to the number of birds that can be killed (subsection 27(4)). The damage-kill permit is free.

Holders of permits allowing unrestricted shooting report that crop damage is prevented or reduced if the fields are watched constantly and if the numbers of ducks present are significantly reduced. For instance, Day (1944) reported that the issuance of community permits to reduce crop damage worked well because ducks were dispersed and damage was subsequently reduced. Unfortunately, other fields in the vicinity susceptible to damage might have suffered depredation from the displaced birds. Jakimchuk (1969) found that in some areas extensive use of permits was related to low damage although the use of permits could not be proven to reduce damage.

Some farmers who use permits to prevent crop damage do not consider the expense of shells and the effort expended as being worthwhile unless dead birds are obtained. However, killing depredating ducks will not reduce crop damage unless the population is drastically reduced, a practically impossible task. In one study on the use of community permits, Day (1944) reported that hunters were found to average a kill of only 9 ducks, which subsequently reduced a duck population of

815 thousand by only an estimated 1.3%.

The use of permits issued to reduce crop depredation has been abused by both farmers and hunters (Hochbaum et al. 1954, Jakimchuk 1969, Wagar 1946). Farmers might apply for permits even though no crop damage had occured in order to enable duck hunting out of season. For example, greater numbers of permits were obtained in areas close to major cities than away from major cities, regardless of the number of damage claims (Jakimchuk 1969). Hunters and farmers would often be solely concerned with killing ducks instead of scaring them from fields. For instance, ducks would not be fired upon until within range. If ducks were in other portions of the field out of range, they would be left undisturbed even if feeding. Decoys and duck calls have reportedly been used to bring ducks into range.

Some farmers did not trust city hunters who would help prevent duck damage (Hochbaum et al. 1954). Such hunters would show general disregard for the farmer's property by walking on swaths, constructing blinds from swaths, and discarding cans and bottles which would damage farming equipment. Hunters would come long distances in order to get pre-season hunting and sometimes would not obtain permission from the landowner to hunt on the fields. After bagging some ducks, the hunter might leave and not return to help the farmer protect his crop.

Hunting season dates and bag limits have been influenced by duck depredation of crops (Lostetter 1960, Stephen 1961a). Pressure on field-feeding ducks can be brought to bear with extended hunting seasons or dates made to coincide with crop harvesting. Bag limits might also be increased.

Visual

Scarecrows

The only requisite of scarecrows is that they be effective in scaring ducks and not that they be fancy. Ducks are wary of unfamiliar moving objects and will fly away when this action occurs. An effective scarecrow has been found to consist of an angled 10 foot pole with an onion or potato sack stuffed with straw placed on the top end, thereby providing an object that moves with any air disturbance (Canadian Wildife Service [1972?], Hochbaum et al. 1954). Streamers of coloured plastic or of other substances such as metal reflectors can be attached to the top end to provide additional movement and to attract attention. Orange and orange-yellow colouring give maximum effectiveness as these colours are apparently easily seen by ducks in poor light conditions associated with dawn or dusk (Hammond 1951). The described scarecrow is simple to construct and its light weight makes it easy to move and install.

The number of scarecrows required to protect a field vary with the availability of grain, with numbers of ducks, with whether or not the field is an established feeding area, and with the field's proximity to loafing areas. Generally, scarecrows are described as being effective at a distribution of 1 to every 10 to 15 acres (Paynter and Stephen 1964, Canadian Wildlife Service [1972?]). The number of scarecrows required for effective control can be determined by experiment. For instance, Hochbaum et al. (1954) reported that 3 to 4 were generally needed to stop feeding (no density figure provided). However, at well established feeding sites or at sites near waterbodies, scarecrows would be added until control was achieved.

One scarecrow for every 3.75 acres was required for one field.

Other objects such as oil barrels and farm machinery left in fields can be used as scarecrows (Hammond 1951, Paynter and Stephen 1964). Although the unfamiliar objects are effective at first, the ducks learn that they pose no threat and will eventually feed near them. Moving the objects to different areas at frequent time intervals will help keep ducks from the fields.

Light

Revolving beacons, flashing lights, spinner reflectors, pyrotechnics, and other devices utilizing light have been used to frighten depredating ducks. Revolving beacons were effective during low light intensity conditions at dawn and dusk, or at night (Uhler and Creech 1939). Some searchlights could effectively cover 640 acres of flat land (Horn 1949). A flashing, revolving light was reported to be more effective than a steady beam (Imler 1944). Ducks would shy from the protected areas and would not approach any closer than 240 yards to the flashing, revolving light. Spinner reflectors were capable of scaring ducks from crops during the day as well as during the night (Uhler and Creech 1939). Unfortunately, the paired reflectors were on a T-bar and could only be a maximum of 50 to 60 yards apart. They also had to cover all portions of the field to be effective. Lanterns shining on the reflectors at night caused flashes of light and scared ducks away. Inflammable devices such as pyrotechnics that produce light, and possibly sound, have been used to frighten ducks from crops at night (Kalmbach 1935). However, some types were not advised for use over cereal crops because of the fire hazard.

Sound

Introduction

Sound alone will scare ducks from a field. A sharp report will prevent ducks from landing as they fly over the boundary of a field, and loud sounds will also cause feeding ducks to depart. However, not all duck species are equally scared by an intense noise. Stephen (1961a) found that Green-Winged Teal were more likely to land on a field protected by an acetylene exploder than Mallard or Pintail. It has also been reported that during the early summer, small flocks of yearlings were not easily frightened by gun reports, even at close range (Hochbaum et al. 1954). However, ducks frightened easily when larger flocks were encountered or during the late summer.

Because almost anything totally strange produces an avoidance response in ducks for a time, association of this stimulus with unpleasant circumstances will enhance the response. For example, ducks can be frightened for a certain length of time by scarecrows and lights, but when this visual stimulus is combined with intense noise, the effect of scaring ducks from crops is enhanced (Benson 1952, Hochbaum et al. 1954, Imler 1944). Ducks associate loud sounds with hunters, therefore, a combination of "hunter silhouette" scarecrows and sharp reports should be very effective (Arnold [?], cited by Hammond 1951, Canadian Wildlife Service [1972?]).

Firearms

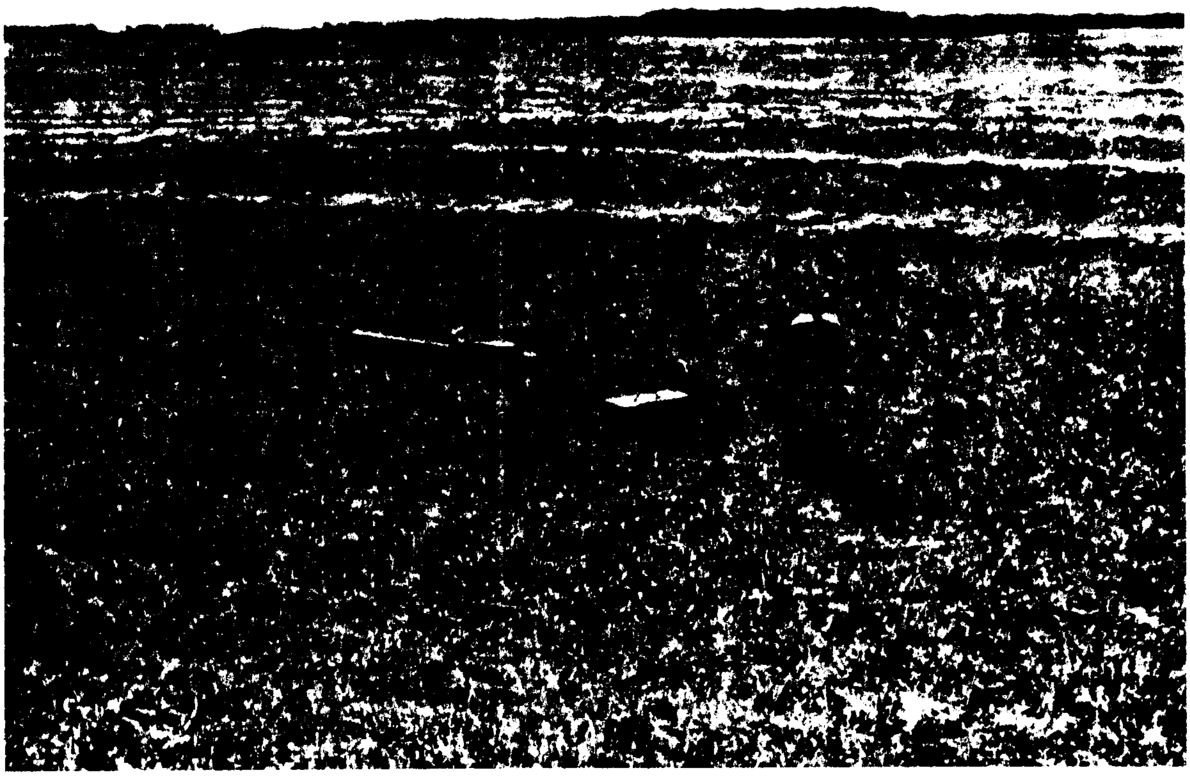
Shotguns and rifles produce enough sound to scare ducks. The firearm should be directed toward the ducks because the sound is most effective in a 30 degree arc from the muzzle (Benson 1952). A report from a 12 gauge shotgun effectively turns ducks away from a field at a distance of one-half mile during calm weather (Hochbaum _et_ _al_. 1954). Good results are obtained using shotguns with live ammunition, blanks, or firecracker shells that explode after leaving the shotgun barrel. However, there are disadvantages of using firearms to prevent duck damage to individual fields. Shells are expensive, the firearm requires an operator, time is needed to conduct a proper patrol, and it is costly for the farmer to hire someone to patrol his fields. Rifles are not recommended near habitated areas because of the hazards of discharging bullets.

Acetylene Exploders

Automatic acetylene exploders (Fig. 9) produce a sound similar to that of a shotgun, and their efficiency and reliability make them a desirable method of control (Canadian Wildlife Service [1972?], Stephen 1961a). Sound intensity and the timing of explosions can be controlled. The report could be further amplified by directing the exploder to fire through a hole in the end of a small steel drum which has the opposite end removed (Bird and Smith 1963). Maintenance is reduced with the incorporation of refillable bottles, which also facilitate refueling. The cost of an acetylene exploder with a refillable bottle is less than 200 dollars, and operating costs per day are minimal.

Stephen (1961a) reported on the use of acetylene exploders to prevent and reduce duck damage. The number of exploders needed to protect a field was not directly proportional to its size. Fields with an average size of 67 acres were protected

Fig. 9 An acetylene exploder with refillable tank and battery in a swathed field. (from Canadian Wildlife Service [1972?], page 8)



with 1 exploder. Fields with an average size of 83 acres required 2 exploders for protection, and fields with an average size of 86 acres needed 3 exploders. More acetylene exploders were required in fields near areas of duck concentrations or after their effectiveness of scaring ducks decreased. For example, 1 exploder per 44 acres was required within 1.5 miles of a loafing area, whereas only 1 exploder per 60 acres was needed in the remainder of the 209.5 square mile study area. A corresponding increase in numbers of exploders per field were required when duck numbers increased. Moreover, additional exploders were necessary when few stubble fields were present to feed upon and no alternative areas for feeding were available. The scaring effect of exploders also varied with flock size. One, 2, or 3 grouped ducks would land close to exploders because flocks of less than 100 ducks land more quickly than flocks of 100 or more ducks. Therefore, a quick rate of explosion (1 per minute) was required to prevent small flocks from landing between explosions.

Miscellaneous

Many other devices including exploding rockets, military rifle grenades, sound bombs, and fuse-timed firecrackers have been used to scare ducks. T. E. Burgess (personal communication)[1] said that small rockets are very effective for frightening ducks, are easy to handle, and are readily available from distributors. However, their use is restricted in specific areas near airports. Authorization is required from the

[1] British Columbia Fish and Wildlife Branch, Burnaby, British Columbia

Minister of Transport and can be obtained for most restricted locations.

High intensity, low frequency sound using an air raid siren was found to frighten some ducks but was not expected to be a practical control agent (Thiessen et al. 1957).

Other Devices

An acetylene flash gun that combined the effectiveness of both a loud sound and flashing light was described by Kalmbach (1935). The machinery rotated and bobbed after each explosion and light was directed about the field from a combined pilot light and reflecting mirror apparatus.

Illuminated scarecrows of different shapes were suggested for experimentation (Hammond 1950). This would allow sighting of scarecrows by ducks when they arrive during reduced light intensity.

Fog-making machines have been tried with some success (Lostetter 1960), and bombs that liberate dense smoke have also been used (Kalmbach 1935).

People moving about on foot, on horseback, on farm machinery, or in vehicles can scare ducks off fields. These control methods may cause damage if swaths are trampled upon or driven over. However, aircraft do not cause damage to crops and can effectively reduce duck damage (Hammond 1961, Horn 1949, Lostetter 1960). Areas up to 15 thousand acres in size can be covered by a single airplane (Horn 1949). Aerial hazing works well when the ducks are herded to other areas such as a feeding site. Unfortunately, hazing with aircraft can be dangerous and has resulted in crashes and deaths (Hammond 1961).

Chemicals

Chemicals applied to crops to prevent duck damage must not change the colour or taste of grain and must not affect grain quality. They should be non-toxic, inexpensive, and easy to apply. Presently, repellents or antifeedants are not used to prevent or reduce duck damage.

No effective repellent has been found to control duck damage although repellents have been discovered for other bird species. Ducks have readily eaten whole barley soaked in gum turpentine and in kerosene, as well as barley dusted with the commercial repellent Pestex (Neff and Meanley 1956). Kear (1964) reported that wheat grain treated with Morkit, a bird repellent made in Germany, reduced food intake of captive Mallard from an average of 15.7 grams per bird per trial period (2 weeks), to an average of 5.25 grams per bird per trial period. However, when both treated and untreated grain was available during another test period, from 3.1 to 25.2% of the diet was composed of treated grain.

Soporifics induce sleep or distress patterns in affected individuals and could be tested for use as repellents in swathed grain fields. A mixture of diazepam and alpha-chloralose anaesthetic was used to capture waterfowl and was reported to cause departures of up to all ducks from a feeding station (Crider et al. 1969). Affected individuals attempting to fly from the feeding station would frighten away others. Some ducks would leave when aggresive behaviour was displayed towards the partially anaesthetized ducks.

Chemicals that are toxic to ducks might have repellent action. For instance, Neff and Meanley (1956) reported that foodstuff treated with the insecticide lindane repelled ducks.

Ingestion of a sub-lethal dose could cause aberrant behaviour with results similar to those achieved when using soporifics. It would be necessary that the toxic chemical have no secondary poisoning effect.

The use of persistant repellent chemicals on swaths could prevent ducks from feeding on waste grain in stubble and cultivated fields. This matter must be brought into consideration if stubble fields are designated as feeding areas to reduce or prevent damage to susceptible swaths (as described in the section "Stubble Fields", page 50).

Putting chemical ripening agents on crops might allow them to be straight-combined thereby preventing crop damage (Mair 1953).

Farming Practices

Straight-Combining

The straight-combining method involves cutting and threshing grain at the same time, and thereby prevents crop depredation by ducks. A "special" climate is necessary as the whole grain crop must mature at the same time. Level land with no variations in water levels is also required for even ripening. To allow maturation, a longer standing time is needed than when the crop is swathed. However, the longer the grain remains standing the more likely it might be knocked down by hail, rain, or wind, or be affected by frost. Most crop harvesting is therefore done by the windrow-combine method because of the many requirements and hazards associated with straight-combining.

Timing and Type of Crop

Farmers experiencing cereal crop depredation by ducks may be able to alleviate the amount of damage by changing their farming practices. Planting crops earlier or planting crops that mature earlier may enable harvesting prior to damage. Crops that are less likely to be damaged, such as rape and flax as compared to wheat and barley, could be planted (Paynter and Stephen 1964).

It may be practical to change the crop to one that will not be damaged. For example, some farmers have changed from small grain to grass-legume rotation (Paynter and Stephen 1964). However, many factors complicate the situation of growing different crops, such as the dollar value, requirement of different machinery, and others. If damage occurs in areas of low agricultural capability, their use as a duck production area may be more suitable.

Grain with a higher moisture content than desired can be combined instead of leaving the cereal to dry in the fields. This not only reduces crop losses from natural and mechanical causes, but also enables the crop to be harvested earlier and reduces the exposure time of wet swaths (Friesen 1972). A dryer would be used to reduce the moisture content of the grain to an acceptable level. Proper drying of wet grain can be accomplished. For instance, wheat with a moisture content of 20% can be dried without any grade loss if it is done according to the prescribed methods (Friesen 1972). Grain can be dried by using farm dryers, commercial dryers, or dryers in elevators (Kirk et al. 1948).

Stubble Fields

Fields left in stubble will be utilized as feeding grounds by ducks. The amount of grain left on a stubble field depends on many variables, such as the natural grain loss while standing, loss during cutting, loss while in the swathed condition, loss from combining, and loss caused by the weather conditions throughout these periods. Consequently, much waste grain may be available in the fields. Bossenmaier and Marshall (1958) studied fields after combining and gave estimated figures of 1.5 to 3.6 bushels of waste grain per acre on 3 wheat fields, and 4.7 to 7.1 bushels of waste grain per acre on 2 barley fields. McCuen and Huber (1952) reported cutterbar losses of 3.4 to 4.2% during combining, while Hurst and Humphries (1938), reporting on straight-combining, showed an average 10% loss of wheat (2.4 bushels per acre) and a 19% loss of oats (8.9 bushels per acre) during an unfavourable year, and an average 3% loss of wheat (0.7 bushels per acre) and a 5% loss of oats (1.5 bushels per acre) in a favourable year. The unfavourable year was described as one in which rains delayed harvest, plant growth was rank, the yield was poor, crops lodged, and weeds were abundant. The favourable year had a hot and dry season, a good crop yield, almost no lodged grain, and practically no weeds. The length of time ducks can feed in a stubble field before the food supply is exhausted can be determined from an estimate of the amount of waste grain present.

Stubble may be ploughed soon after harvest to enable fall planting or early spring seeding, or to allow the field to lie fallow. As ploughing covers most of the seeds, ducks previously feeding on the affected stubble field then feed on swathed fields or available stubble fields. Therefore, this practice should not be allowed in areas with a high incidence of crop damage (Bossenmaier and Marshall 1958, Canadian Wildlife Service [1972?], Hammond 1951, Hochbaum et al. 1954, Stephen 1961a). Ploughing might be halted until the danger of damage has passed or until the number of swathed fields are greatly reduced. Stephen (1961a) illustrated the necessity of this practice when he found that fields requiring protection increased with an increasing number of ducks when the ratio of unharvested to harvested fields was 4:1 or greater.

If stubble fields are available for feeding ducks, food quantities at a diversionary feeding site could be reduced once a sufficient number of fields have been harvested. Stubble fields used for feeding should be posted to prevent hunting, and swathed fields should be hunted upon to protect them from damage and to encourage ducks to feed at the desired locations.

Diversionary Feeding Areas

Introduction

Harassment does not drive ducks from a region (Stephen 1961a). Continually displaced ducks can increase the total damage sustained in a locality because the number of damage sites are increased (Jakimchuk 1969). It is therefore necessary to provide grain at a specific site where ducks can feed undisturbed if other feeding areas are not available.

Diversionary feeding areas consist of either a lure crop or bait station where grain is provided for ducks. These alternate feeding sites have great success when techniques ensure their use by most ducks in the region. For example, Hammond (1961) reported a 98.5% reduction in crop damage from an average of 20 thousand bushels per year before feeding sites were put into operation, to a loss of only 300 bushels during 1956 when shoreline feeding stations were employed. It is essential that the ducks should not be frightened from diversionary feeding places while the site preference habit is being established (Hammond 1950). Hunting must be prevented by posting the area. Predation prevention by fencing the area may also be required. Once the ducks are accustomed to the spot any unusual activity will probably not scare them away (Hammond 1950). However, ducks may abandon the location for other reasons, such as locating another feeding site nearby (Burgess 1973). Diversionary feeding areas are highly effective when scaring programs are conducted on nearby crops (Canadian Wildlife Service [1972?], Hammond 1950).

Food should be provided before crops are harvested so that feeding patterns can be established before the ducks fly to susceptible fields (Burgess 1973). Once begun, the feeding program should continue until the danger of crop depredation is reduced. It is essential that sufficient quantities of grain be available for each feeding and throughout the program; otherwise ducks will feed in the fields. For example, Hammond (1950) reported that less field damage occured in 1950 because, even with over 200 thousand ducks present (mostly Mallard and Pintail), more grain was available at feeding stations during that year than during earlier years. Daily or weekly duck counts will help ensure that enough grain is provided. The cereals should also be dispersed in such a manner as to allow the maximum number of ducks on the site. Care must be taken to ensure that the food provided is being eaten and that flights to the fields from the feeding station do not occur. However, damage to the crops may occur whether or not feeding sites are provided because of continual flights to the fields during poor weather conditions.

Diversionary feeding areas should be located near places of duck concentrations (loafing or feeding areas) or on established flight lines, so that they may be easily and quickly found and utilized (Burgess 1973, Hammond 1961). This will also reduce exposure of vulnerable crops. However, good sites can be developed away from areas of duck concentrations and still be effective as flight paths might be established to them once they are recognized. For instance, Hammond (1957) reported that new flight lines of at least 10 miles were established after feeding stations were provided. Ducks may be herded to areas set aside for them by airplane hazing, supplemented with scaring devices fired from the aircraft. Decoys, wooden blocks, or ducks in holding pens might be used to attract ducks until a feeding pattern has been established (Burgess 1973, Hammond 1951). These techniques will also help influence ducks to return to an abandoned feeding area. Fortunately, feeding areas do not appear to increase the total number of ducks in the region as the duck population tends to follow the trend of the flyway population (Hammond 1961).

Each bushel fed to ducks at a feeding location saves that bushel from being eaten in the farmer's field, as well as preventing considerable grain loss from damage to swaths. Hammond (1950) determined from approximate maximum crop capacities that 210 Mallard or 450 Pintail could be fed with 1 bushel (30,280 cubic centimeters). Bossenmaier and Marshall (1958) calculated from gullet measurements that 226 Mallard could be fed with 1 bushel of common wheat. The amount of grain required at a feeding site will depend upon the variations in populations caused by weather conditions and migrations, the proportion of Mallard and Pintail and their sex ratios, changes in consumption rates due to the weather, the availability of natural foods and the amount fed upon, and the acreage of stubble fields available for feeding.

Diversionary feeding areas may attract from less than 50% to almost 100% of the potential damage causing ducks in a region (Woynarski 1973). Burgess (1973) found that feeding areas in Alberta may attract 45 to 65% of the ducks present in a region, and up to 80% at peak times. Therefore, hunters can have reduced hunting success because of reduced opportunity. Consequently, appeasement of hunters whose bag is diminished might be required. Alternatives such as abandonment of feeding areas, scaring ducks from feeding locations during the hunting season, and controlled hunting areas near feeding sites would provide hunters with a satisfactory duck kill.

Lure Crops

Crops that are cut and set aside specifically for ducks are defined as lure crops, and may be either dry or flooded. Experiments were first conducted with lure crops in North Dakota during 1940 (Hammond 1957), and they were first used in Canada in Manitoba during the early 1950's (Woynarski 1973).

Lure crops can be grown on Crown land or on private land by farmers who are under contract, or can be purchased from commercial growers (Burgess 1973, Munro 1965). They can be up to 160 acres in size (Burgess 1973), or can be 2 to 10 acre blocks or strips operated on lands of marginal grain production where harvest is not normally assured (Nero and Oetting 1973). A continuous food supply for migrants can be provided by staggering planting of one cereal species or by planting grain crops that mature at different times. For instance, barley matures before wheat and can be used for the first incoming migrants. Emergency lure crops could be purchased when the food supply at permanent lure crops is expended or when severe crop damage is expected in a region which does not normally require a lure crop (MacLennan 1973).

Certain measures can be taken to ensure the use of a crop as a lure and to help reduce or prevent damage in other fields. Crops that have been damaged may be purchased to permit continual feeding. Grain can be spread in fields where feeding has occured to encourage establishment of a feeding pattern or to keep ducks on fields in which all the grain has been eaten.

It is important that a crop should not be used both for luring ducks and as a farmer's crop. Horn (1949) reported that share-cropping of barley between ducks and farmers on land adjacent to a ponded area was not successful because ducks ate the barley regardless of whether it "belonged" to them or to the farmer. Other problems associated with the use of lure crops are: the crop may not be found by ducks; when all the grain is eaten the ducks must find or be given new food; strays may use other nearby fields for feeding; and the attractiveness of the lure crop is reduced because grain is trampled or dislodged from heads and becomes irretrievable.

Flooded crops may be used for feeding and to prevent other bird species from consuming grain provided for ducks. Bossenmaier and Marshall (1958) reported that ducks preferred flooded fields to dry fields, and Hammond (1957) stated that flooded grain was especially damaged by ducks. These observations were attributed to the similarity of the flooded field to the normal habitat, among other reasons.

The use of a flooded field for feeding or the distribution of grain under water does not have serious deterimental effects on the seeds. Shearer et al. (1969) found that the deterioration rates for spring wheat, barley, and oats were 36%, 34%, and 26% respectively when submerged for 90 days, and were less for shorter times of inundation. The swollen, fermented seeds were readily consumed by Mallard. Neely (1956) suggested that new cereal strains might be bred from seeds which showed no signs of deterioration after submergence for 90 days. More food would then be available if flooded fields were used for feeding or if grain was distributed in water at feeding stations.

Flooding can be expensive and undependable. It requires a depression or enclosed area and entails the ready availability of water to permit inundation to depths of less than 6 inches. Burgess (1973) reported that portions of lure crops, about 15 acres, required flooding by irrigation.

Ducks feeding on submerged grain can die because of botulism poisoning or blue-green algal poisoning (Burgess 1973, Hammond 1957). Dry land feeding might therefore be necessary. However, these problems are not expected to be serious in Canada as their occurence should not coincide with the time of duck concentrations on feeding areas.

Bait Stations

Experiments with bait stations were first conducted in 1944 in California (Horn 1949). Grain is distributed on the shore of a lake or marsh (Fig. 10), or on fields. The size of the site may be about 2 acres (Burgess 1973), or 4 to 9 acres (Hammond 1950). Greater success in reducing duck damage has been achieved with shoreline feeding than with lure crops (Burgess 1973, Hammond 1961). The feeding station can be more easily found by ducks; the delay between operation and use for successful sites is usually 0 to 4 days, compared with 2 to 6 days for lure crops (Burgess 1973). Contact with susceptible fields is minimized because ducks do not have to fly over fields to reach the feeding site. Feeding of harvested grain improves food utilization since losses of bait from trampling and knocking kernels off plants are eliminated or reduced. The stations can be used at any time provided that food is available, and they can therefore be used for a longer time than lure crops. Hammond (1961) suggested that shoreline feeding encouraged greater use of natural foods, although this was not proven. Leitch (1951) had previously reported that growing smartweed (Polygonum sp.) appeared to have some effect in reducing duck damage in nearby fields. If natural food use was increased less grain would be required for feeding.

Many factors must be considered to effectively operate bait stations. Vegetation on the shore should be cut so that ducks will not avoid the area. Gravel feeding banks should be nearby or gravel should be mixed with grain to provide necessary "crop" material. This will prevent possible searching in fields for this necessary aid to digestion, and will also help prevent ingestion of lead shot with consequent lead poisoning. Sufficient quantities of food should be available during the normal feeding periods in the morning and evening. Preferred grains may be mixed with less preferred grains, such as oats, to give greater bulk and to reduce expenses.

Fig. 10 A bait station beside a lake. (from Canadian Wildlife Service [1972?], page 9)

All-weather roads or trails to the feeding area are necessary to allow grain transportation, and storage bins should be near the station. Feeding on grain meant for Mallard and Pintail by other ducks such as Blue-Winged Teal (*Anas discors* Linnaeus), American Widgeon, and by American Coot (*Fulica americana* Gmelin) may occur at bait stations but can be discouraged (Hammond 1961).

Projects

The numbers of diversionary feeding programs in active operation during 1972 in the Prairie Provinces were: 5 in Alberta; several in 5 areas in Saskatchewan; and 33 in Manitoba (Canadian Wildlife Service [1972?]). A 3 year experiment in Alberta to compare the costs and attractiveness of flooded lure crops, dry lure crops, and bait stations was completed in 1972 (Burgess 1973). The Alberta Government intends to increase the number of bait stations by about 10 projects per year to a total of 40 by 1976 (Woynarski 1973). These damage control units would control just over one-half the total annual crop loss in Alberta.

Beginning in 1958, birds were fed experimentally on lure crops planted by the Saskatchewan Government on Crown land, and the program was operational in 1970 (Woynarski 1973). Also, the federal government through the Canadian Wildlife Service has planted lure crops at Last Mountain Lake in Saskatchewan since 1961. Presently, lure crops on Crown land next to waterbodies are used to reduce crop damage by ducks. N. M. Korol (personal communication)[1] mentioned that the

[1] letter dated 4 March 1974, Fisheries and Wildlife Branch, Regina, Saskatchewan.

Saskatchewan Government will expand crop damage control programs in the future by increasing acreage for lure crops and by setting up bait stations in heavily damaged areas.

Woynarski (1973) reported that a crop protection program with feeding of ducks and patrols has been conducted in Manitoba since the early 1950's. Patrols by Conservation Officers warned farmers of probable crop depredation by ducks. Provincial assistance in construction and operation of scaring devices was also provided. He also mentioned that lure crops are presently being used and that feeding stations will be included in 1973-1974.

Education of the Farmer, and Public Relations

Unless the farmer is aware of the methods presently available for preventing or reducing crop damage by ducks, as well as their effectiveness, he will continue to suffer crop depredation. Distribution of pamphlets such as "Uninvited guests, the prairie duck problem" (Canadian Wildlife Service [1972?]), and holding of lectures and discussions are important means of disseminating information. Government assistance in initiating and maintaining control methods can be instrumental in getting the farmer interested in helping himself. Bird movements during migration should be reported to farmers so they can determine when their crops are most likely to be damaged. This would help the farmer to time harvesting so that damage to his crop is reduced and so that he will know when to protect his crops.

In order to obtain the assistance and support of farmers, hunters, and the public, they must be made aware of control programs and their objectives. This has been attempted by distribution of brochures, by broadcasting on radio and television, and by articles in the newspapers (Burgess 1973). Hunting restrictions on diversionary feeding areas and on stubble fields must be seen as requirements in order to have an effective crop damage control program.

The success of control programs should be communicated to farmers in the area so they will not think that the duck problem no longer exists. If field-feeding begins during the control program, farmers should be notified in case they have ceased checking their fields.

INSURANCE

The problem of crop depredation by ducks was initially that of the farmers. However, ducks are protected by federal law and are the property of the province once within its boundaries. Federal and provincial government agencies were therefore thought to be at least partially responsible for reducing crop damage caused by ducks, especially as government agencies assisted in controlling other pests such as grasshoppers and foxes (Bossenmaier and Marshall 1958). Some farmers believed that damage or protection costs should be undertaken by the people and agencies having and working for the interests of waterfowl (Stephen 1960). Meanwhile, farmers were suffering unnecessary hardship because they were not organized and they did not know how to attack the problem to their best interests.

Crop insurance for damage sustained to crops by wildlife was eventually initiated in all three Prairie Provinces (Table IV). The surcharge on hunting licenses vary in each province and are the means of financing the programs. Saskatchewan is the only province that requires a premium from the farmer.

Table IV Wildlife crop depredation insurance programs for Saskatchewan, Alberta, and Manitoba, 1973.

Province	Year Initiated	Addendum to Hunting License (Dollars)	Premium Rate (Percent)	Maximum Compensation per Acre (Dollars)
Saskatchewan	1953	1.00	2	25
Alberta	1961	3.00		15[a]
Manitoba	1972	2.25		25[b]

[a] inspection fee of 25 dollars.

[b] inspection fee of 25 dollars, refundable if claim is valid.

Compensation payments are expected to reimburse a farmer for his operating expenses, and they are lowest in Alberta.

Paynter (1955) discussed the insurance program instituted by the Saskatchewan provincial government. The possibility of providing crop insurance was surveyed as a result of farmers' complaints about crop depredation by ducks. Consequently, crop insurance for damage caused by wildlife was made available beginning in 1953. Organized hunters were willing to help finance the insurance scheme through an increased cost of hunting licenses.

Alberta was next to pass a wildlife crop damage insurance act in 1961, as described by Smith (1968). The crop damage compensation program was initiated as a result of representation to the Alberta Government by the Alberta Fish and Game Association. The 5% insurance premium initially required was soon discontinued and the money was obtained thereafter from the sale of Wildlife Certificates. These certificates must be bought by hunters before they obtain hunting licenses.

Woynarski (1973) described the crop damage alleviation program involving the federal government and the governments of the three Prairie Provinces which was initiated in 1972. Losses to farmers from cereal crop depredation by migratory birds was to be reduced. Money totaling 1.796 million dollars was provided for the program on a 50:50 cost sharing basis. Sixty percent of the money was for prevention programs and 40% was for compensation. The provincial agencies would make payments directly to farmers while both federal and provincial government employees would conduct programs to prevent duck crop depredation. Evaluations of the results of the program and dissemination of information was also required. It was with the initiation of this program that Manitoba began a compensation program in 1972 for crop damage sustained by waterfowl. Money for Manitoba's contribution to the compensation program was obtained from the sale of Wildlife Certificates to all licensed hunters.

ECONOMICS

A survey in 1964 showed that 30% (1,589 of 5,327) of responding prairie farmers suffered damage by wildlife (Stephen 1965b). Sixteen percent (879 of 5,327) of the total crop damage reported was caused by ducks. The most duck damage was sustained in Alberta (20%, 350 of 1,761), then in Saskatchewan (16%, 396 of 2,535), and the least in Manitoba (13%, 133 of 1,031). The total amount of damage caused by ducks on 825 farms was estimated at 227,749 dollars, an average of 276 dollars per affected farm. However, only 34% (299 of 879) of the farmers reported damage of 201 dollars or more.

Total crop damage losses because of waterfowl are high. Stephen (1961b) reported that during 1959 an estimated 44.7 thousand farms (19.3%) on the Canadian Prairies lost approximately 12.6 million dollars because of ducks. This was a mean loss of 283 dollars per affected farm. He also reported that in 1960 about 24 thousand farms (10.4%) lost an estimated 6.9 million dollars, which was a 287 dollar average loss per affected farm. Approximately 27 thousand farmers lost an estimated 4.3 million dollars in 1961 as a result of duck damage (Paynter and Stephen 1964). An average of 159 dollars was lost by each farmer. Three to 6 million dollars of the 425 million dollar crop (1 to 1.5%) was estimated lost during 1968 in Alberta (Jakimchuk 1969).

MacLennan (1973) reported that in Saskatchewan during

1970 and 1971, wheat losses averaged 9.8 to 11.3 bushels per damaged acre, and barley losses averaged 16.0 to 18.7 bushels per damaged acre. Costs ranged from averages of 14 to 16 dollars per damaged acre for both wheat and barley. The minimum figure representing the average damage per duck was 3.4 cents per day. All the figures were obtained and calculated from data describing insured crop losses.

Even in areas with considerable duck damage, few insurance policies may be purchased. Jakimchuk (1969) reported that about 35% of Alberta farmers sustain crop depredation in any one year, of which only about 1 in 6 claim compensation. He also mentioned that 87% of the farmers surveyed in Alberta during 1968 who reported duck damage had never claimed compensation. Some farmers simply do not claim damage as they accept crop depredation by ducks as a natural hazard.

Few claims were paid with the advent of a duck crop depredation insurance program in any of the Prairie Provinces because most farmers were unaware of the program (Tables V, VI, VII). As public awareness of the program increased, more policies were taken out and the number of claims increased. The peak number of claims in Alberta was during 1969 and in Saskatchewan during 1971. One hidden cost in these tables is that expenditures may exceed revenues. The remainder would be made up from money assigned for compensation under the 1972 federal-provincial agreement. Farmers that receive compensation were found to be reimbursed for only 33% of the actual crop loss, when the loss is expressed in dollars (Jakimchuk 1969).

Farmers will not be interested in using accepted damage-prevention techniques unless the cost of materials and their maintenance are shown to be less than expected crop losses.

Table V Duck crop depredation insurance compensation for Saskatchewan, 1953 to 1972[a].

Year	Number of Policies	Number of Claims	Amount Paid (Dollars)	Average Payment per Claim (Dollars)
1953	20		2,388	
1954	30		8,566	
1955	144		14,725	
1956	250	122	43,200	354
1957	335	173	63,900	369
1958	432	207	76,900	372
1959	407	275	161,800	588
1960	822	264	71,100	269
1961	285	102	28,200	277
1962	292	79	34,500	437
1963	422	119	48,900	411
1964	319	179	29,600	517
1965	642	258	143,900	558
1966	824	321	148,100	461
1967	660	224	130,900	584
1968	592	397	398,900	1,005
1969	1,237	594	365,600	616
1970	1,178	624	426,500	684
1971	1,637	791	521,800	660
1972[b]		650	544,000	837

[a] 1953 to 1955: Paynter 1966 (cited by National Academy of Sciences 1970).
1956 to 1971: MacLennan 1973.
1972: Woynarski 1973.

[b] incomplete.

Table VI Duck crop depredation insurance compensation for Alberta, 1961 to 1972[a].

Year	Number of Claims	Amount Paid (Dollars)	Average Payment per Claim (Dollars)	Acres Damaged	Average Payment per Acre (Dollars)
1961	2	140	70	28	5.00
1962	10	1,485	148	177	8.39
1963	22	5,448	248	604	9.02
1964	743	321,841	433	33,119	9.72
1965	531	207,752	391	21,188	9.80
1966	477	158,130	332	15,800	10.01
1967	76	28,222	371	3,180	8.87
1968	822	387,945	472	23,690	16.38
1969	1,719	802,742	467	90,201	8.90
1970	1,095	419,737	383	23,874	17.58
1971	887	338,850	382	52,411	6.46
1972[b]	1,065	509,160	478	73,842	6.90

[a] 1961 to 1966: Jakimchuk 1969, Smith 1968.
1967 to 1972: personal communication, letter dated 8 April 1974, from D. J. Neave, Fish and Wildlife Division, Edmonton, Alberta.

[b] incomplete.

Table VII Duck crop depredation insurance compensation for Manitoba, 1972 to 1973[a].

Year	Number of Claims	Amount Paid (Dollars)	Average Payment per Claim (Dollars)	Acres Damaged	Average Payment per Acre (Dollars)	Average Percent Damage
1972	22	6,567	298	737	8.91	71
1973[b]	93	36,213	389	2,184	16.58	79

[a] personal communication, letter dated 18 February 1974, from J. Ewanek, The Manitoba Crop Insurance Corporation, Winnipeg, Manitoba.

[b] incomplete.

The time required to conduct and maintain control methods must also be shown to be worthwhile. The time spent could be expressed monetarily to persuade those who doubt the eventual economic return.

In areas suffering high duck damage, the costs of diversionary feeding programs combined with scaring are less than the costs of only providing compensation payments (Burgess 1973). Woynarski (1973) described part of the results of the 3 year study in Alberta. At successful feeding sites such as Grand Prairie in Alberta, damage was reduced by 88% from the 6 year mean loss of 81,988 dollars to 9,929 dollars after introduction of feeding areas. At a control area near Falher in Alberta, damage prevention treatments consisting of diversionary feeding sites were discontinued and crop damage increased 199%. That is, to 70,350 dollars from the 6 year mean of 35,323 dollars when damage prevention treatments were used.

It must be determined if a proposed diversionary feeding site will be economical before it is established. If the average compensation costs for previous years are more than the expected control costs, a feeding program would most likely be economical. The size of the locality suffering damage, the exact locations of crops being damaged within the area, and the number and type of feeding areas required must be considered before feeding programs are begun. Costs for operating a diversionary feeding area and field patrol include: the initial cost of the site and its development, site maintenance, signs, fencing, the crop or grain, granaries, vehicles, gasoline, field equipment, and wages. The length of time required to run the control project will also influence costs. Less than 7 weeks may be required for operation of a control project in northern prairie regions of Alberta, and approximately 5 weeks in central and southern areas of Alberta (Burgess 1973). Costs of feeding areas have been reported as averaging from 0.7 cents to 2.3 cents per bird per day (Woynarski 1973).

MacLennan (1973) said that the minimum figure of prevented damage required to make a quarter section of lure crop economically feasible is 1,650 dollars per year. As a result, only areas that have continual heavy damage would be able to support this type of program, such as the area mentioned by MacLennan which suffered an annual average insured loss of 26 thousand dollars. Hammond (1961) reported that a feeding station program is a good economic investment if it attracts 50 thousand or more ducks per day. However, operation of feeding units with the new federal-provincial cost share program permits economical operation of many units that would be uneconomical for the provincial government to operate alone (Burgess 1973).

Costs for operation and land rights of bait stations are less than for lure crops (Burgess 1973, Hammond 1961). Bait station costs (1.8 cents per duck per day, or 142 dollars per day of duck use) were almost one-half of lure crop costs (3.2 cents per duck per day, or 280 dollars per day of duck use) in Alberta during 1970 to 1972 (Burgess 1973). Hammond (1961) found that a change to shoreline stations from dragging down, mowing, or burning refuge crops produced an annual saving of about 30 thousand dollars. Prior to the use of effective shoreline feeding stations in 1953, control procedures and operations cost 5 thousand dollars more per year than the later cost of about 20 thousand dollars per year. Also, crop losses by farmers were about 26 thousand dollars annually compared to the later losses of 1.2 thousand dollars annually.

Purchase of lure crops from farmers during poor weather conditions or during situations which result in heavy crop depredation would be an inexpensive control measure. Costing from 25 to 35 dollars per acre, the purchased crops would prevent or reduce damage in regions that do not normally contain diversionary feeding areas (MacLennan 1973), or would be used in areas where lure crops no longer have grain.

Once the feeding program is in operation the duck damage rate can be used to determine the effectiveness of the feeding area. Two methods to determine the duck damage rate as given by Burgess (1973) are presented here. In the first, each field-feeding duck seen per day is considered equivalent to 4.5 pounds (2,041 grams) of damaged barley. In the second method, an area with damage prevention control is compared to one without controls. Both methods produce figures which are not more than 10% different when the duck damage rate for one area is determined. Some figures obtained by Burgess (1973) using the 4.5 pound constant are: at Beaverhill/Whitford Lakes in Alberta during 1972 the total government cost for control and compensation was 37.6 thousand dollars, a projected government loss in absence of the project was 47,697 dollars, and a projected farmer loss in absence of the project was 103,691 dollars, whereas for 1970 the total government cost for control and compensation was 25,556 dollars, the projected government loss in absence of the project was 27,742 dollars, and the projected farmer loss in absence of the project was 53,351 dollars.

CONCLUSIONS AND RECOMMENDATIONS

1. Cereal crop depredation by ducks is done principally by Mallard and Pintail, is a continuing problem, represents high economic loss, and requires control programs to reduce or prevent damage. It is not recommended that duck populations be reduced to alleviate the damage.
2. Damage to grain occurs during the autumn when swaths are fed upon, and corresponds with the time of bird migration and grain harvesting.
3. Damage prevention methods that are effective consist of:
   (a) scaring;
   (b) patrols;
   (c) diversionary feeding areas;
   (d) farming practices;
   (e) a combination of (a) to (d).
4. Funds for the purchase of emergency lure crops should be available.
5. Wherever possible, stubble fields should not be ploughed and should be posted to prevent hunting.
6. The use of grain dryers should be maximimized to permit earlier harvesting and to reduce the time wet swaths are exposed to ducks.
7. Farmers should have guidance and assistance, preferably sponsored by a government department, in preparing and operating control methods suitable for their fields. The same service should be available for farmers wishing to determine the consequences of changing farming practices.
8. Government agencies should have a stockpile of scarecrows, acetylene exploders, devices utilizing light, and other damage prevention devices so that any duck pest situation

can be controlled. The equipment could be lent to a farmer for a small fee. If a farmer wished to retain the equipment, he could pay the balance of the retail price.

9. Farmers in areas likely to suffer crop damage and who have taken out a policy on wildlife damage to crops should be required to protect their fields by an acceptable damage prevention method. Insurance companies could enforce this policy by examining the control technique when checking a claim. Payments would then be allowed only if damage control methods were used in an acceptable manner. Also, patrols should be required in areas that usually experience duck damage.

10. The duck problem and the corrective measures that are being conducted must be brought to the attention of the public in order to obtain their assistance and support.

11. Proper timing of the opening and closing dates of hunting seasons, as well as having variable bag limits, should be used as a means of reducing crop damage by ducks.

12. Provision should be made to prevent diversionary feeding programs from reducing the duck kill of hunters using that area.

13. Flight paths of ducks, time of greatest crop damage, the amount and cost of damage, and other factors regarding crop damage by ducks should be determined and recorded for areas that suffer, and are likely to suffer, from duck damage. This research will enable and provide for effective control programs. Emergency damage control programs could be quickly implemented if this information was readily available.

14. The effect of planting trees or shrubs on preferred

feeding sites to obstruct the view of ducks should be ascertained. The vegetation might make the location undesirable as a favoured feeding spot.

15. A vehicle with mounted directional sound equipment broadcasting loud sounds should be tested for use on ground patrols.

16. The possibility of reducing duck damage by using model hawks or other predator models should be considered.

17. The effectiveness of Av-Alarm and of broadcasting alarm calls or distress calls of ducks to reduce crop damage should be determined.

18. Research into the discovery of chemical repellents for ducks should be encouraged. They should be developed for application to swaths and should breakdown rapidly.

APPENDIX A

Portions of the Migratory Birds Convention Act, and the Migratory Birds Regulations.

The portions used have been taken from the "Office consolidation of the Migratory Birds Convention Act, R.S., 1970, c. M-12, and the Migratory Birds Regulations, established by P.C. 1971-1465, as amended by P.C. 1971-1968, P.C. 1972-1606, P.C. 1972-2310, P.C. 1973-2586, administered by the Canadian Wildlife Service, Department of the Environment, Ottawa, 1973".

THE MIGRATORY BIRDS CONVENTION ACT

CHAPTER M-12

An Act respecting a Convention between His Majesty and the United States of America for the protection of migratory birds in Canada and the United States

SHORT TITLE

1. This Act may be cited as the Migratory Birds Convention Act. R.S., c. 179, s. 1.

CONVENTION

2. The Convention of the 16th day of August 1916, which is set forth in the schedule, is hereby sanctioned, ratified and confirmed. R.S., c. 179, s. 2.

INTERPRETATION

3. In this Act,

"close season" means the period during which any species of migratory game, migratory insectivorous, or migratory nongame bird is protected by this Act or any regulation;

"migratory game birds" means

(a) Anatidae or waterfowl, including brant, wild ducks, geese and swans,

(b) Gruidae or cranes, including little brown, sandhill and whooping cranes,

(c) Rallidae or rails, including coots, gallinules and sora and other rails,

(d) Limicolae or shorebirds, including avocets, curlew, dowitchers, godwits, knots, oyster catchers, phalaropes, plovers, sandpipers, snipe, stilts, surf birds, turnstones, willet, woodcock, and yellowlegs, and

(e) Columbidae or pigeons, including doves and wild pigeons;

"migratory insectivorous birds" means bobolinks, catbirds, chickadees, cuckoos, flickers, flycatchers, grosbeaks, humming birds, kinglets, martins, meadowlarks, nighthawks or bull bats, nuthatches, orioles, robins, shrikes, swallows, swifts, tanagers, titmice, thrushes, vireos, warblers, waxwings, whip-poorwills, woodpeckers, and wrens, and all other perching birds which feed entirely or chiefly on insects;

"migratory nongame birds" means auks, auklets, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, and terns;

"Minister" means the Minister of the Environment, R.S., c. 179, s. 3; 1953-54, c. 4, s. 12; 1966-67, c. 25, s. 40.

REGULATIONS RESPECTING THE PROTECTION OF MIGRATORY BIRDS

Short Title

1. These Regulations may be cited as the *Migratory Birds Regulations*.

Interpretation

2. (1) In these Regulations,

"Act" means the *Migratory Birds Convention Act*;

"bait" means corn, wheat, oats or other cultivated grain or any product thereof or any manufactured product or material that may attract migratory game birds and includes plastic corn and any other imitation grain;

"Chief Game Officer" of a province means a person appointed as chief or director of a provincial agency concerned with the administration of a provincial wildlife act;

"Convention""means the Convention set out in the Schedule to the Act;

"crop" means an unharvested agricultural crop, whether standing or cut, but does not include stubble fields or other fields from which the crop has been removed;

"cultivated lands" means lands tilled for the production of crops other than grass or hay;

"Director" means the Director General of the Canadian Wildlife Service of the Department of the Environment;

"eggs" means the eggs of migratory birds and includes parts of such eggs;

"Eskimo" includes

(a) a male person who is a direct descendant in the male line of a male person who is or was of the race of aborigines commonly referred to as Eskimos,

(b) the legitimate child of a person described in paragraph (a),

(c) the illegitimate child of a female person described in paragraph (b), and

(d) the wife or widow of a person described in paragraph (a), (b) or (c),

but does not include the Eskimo wife of a person other than an Eskimo, unless she has been deserted by or divorced from that person or has become the widow of that person;

"export permit" means an export permit referred to in section 3 of the Game Export Act;

"game officer" means a person who is appointed a game officer under section 5 of the Act;

"hunt" means chase, pursue, worry, follow after or on the trail of, stalk, or lie in wait for the purpose of taking a migratory bird, and any trapping, attempting to trap or shooting at a migratory bird, whether or not the migratory bird is then or subsequently captured, killed or injured;

"Indian" has the same meaning as in the Indian Act;

"lure crop area" means an area of crop land that, pursuant to an agreement between the Government of Canada and the government of a province, remains unharvested for the purpose of luring migratory birds away from other unharvested crops;

"migratory birds" or "birds" means migratory game birds, migratory insectivorous birds and migratory non-game birds as defined in the Act, and includes any such birds raised in captivity that cannot readily be distinguished from wild migratory birds by their size, shape or colour, and any part or parts of such birds;

"migratory bird sanctuary" means an area described in the Schedule to the _Migratory Bird Sanctuary Regulations_;

"migratory game bird hunting permit" means a Canada migratory game bird hunting permit issued under the authority of the Minister;

"Minister" means the Minister of the Environment and includes any person authorized by him to act on his behalf;

"nest" means the nest of a migratory bird or any portion thereof;

"open season" means the period during which it is lawful to hunt a migratory bird;

"permit" means a valid permit issued under these Regulations:

"permit holder" means a person to whom a permit is issued;

"power boat" means any boat, canoe or yacht equipped with an electric, gasoline, oil or steam motor as a means of propulsion;

"Regional Director" means a Regional Director of the Canadian Wildlife Service of the Department of the Environment;

"residence" means the chief, or habitual place of abode of a person;

"resident" means, in relation to any area or place, a person whose residence is in that area or at that place; and

"taxidermist" means any person who engages in the business of the preservation or mounting of migratory birds or their eggs.

Permits Respecting Birds Causing Damage or Danger

24. (1) Any person may, without a permit, use equipment, other than firearms, designed to scare migratory birds that are causing or are likely to cause damage to crops or other property.

(2) The Chief Game Officer of a province with the concurrence of the Director may grant a permit to any person residing in the province to use firearms, in the area designated and during the time specified in the permit, for the purpose of scaring migratory birds that are causing or likely to cause damage to crops or other property in the area.

(3) No person shall, while scaring migratory birds pursuant to subsection (1), kill, wound or take such birds.

25. (1) Where the Chief Game Officer of a province and the Director are satisfied that scaring migratory birds is not a sufficient deterrent to prevent the birds from causing serious damage to any property, the Chief Game Officer may grant a permit authorizing all persons residing in that province or a part of that province to kill, during the time specified and in the area designated in the permit, migratory birds described in the permit.

(2) A permit issued under subsection (1) is valid from the date of issue to the expiry date specified in the permit or, if it is cancelled by the Chief Game Officer, to the date of cancellation.

26. (1) A game officer may, with the prior concurrence of the Director, issue to a person who owns, leases or manages an area of land, a permit that describes the area and authorizes that person and his nominees to scare or kill within that area migratory birds that are causing or are likely to cause damage therein.

(2) A permit issued under subsection (1) is valid from the date of issue to the date specified in the permit or until cancelled by a game officer or the Chief Game Officer of the province in which the area is situated, whichever occurs earlier.

(3) A person to whom a permit is issued pursuant to subsection (1) may nominate, from among the residents of the province in which the area described in the permit is situated, as many nominees as are specified in the permit.

(4) A nomination by a permit holder shall be in writing and the nominee shall carry the nomination with him at all times while he is hunting on the land of the permit holder.

(5) A person to whom a permit is issued under this section shall, within fifteen days after its expiration or cancellation,

(a) return the permit to the game officer who, or office that, issued it; and

(b) report to the game officer such information with respect to the birds killed pursuant to the permit as the game officer may require.

27. (1) A person who holds a permit to kill migratory birds pursuant to section 25 or 26 and the nominees of that person shall act only as authorized by the permit and at the times specified therein.

(2) No person while acting under the authority of a permit issued under section 25 or 26 shall use decoys, duck or goose calls or blinds or other concealment.

(3) Where a permit is issued under section 25 or 26 to kill migratory birds that are causing or likely to cause damage to cereal crops, no person shall

(a) shoot migratory birds elsewhere than on fields containing such crops, or

(b) discharge firearms within fifty yards of any water area.

(4) Subsection 5(3), and sections 7 to 9 do not apply to a person while he is acting under the authority of a permit issued pursuant to section 25 or 26.

(5) No person shall hunt in a lure crop area unless the area has been declared open for hunting by the Chief Game Officer or the Regional Director.

General Prohibitions

5. (3) No person shall hunt a migratory game bird unless he is the holder of a migratory game bird hunting permit.

Bag Limits

7. Subject to section 8, no person shall in any area in Canada kill, in any one day, a number of migratory game birds of any species that, in the aggregate, exceeds the number specified as the bag limit for that area and that species in Schedule A.

8. Any person who hunts in more than one province or area in any one day, may kill in that day a number of migratory birds of any species that, in the aggregate, does not exceed the number specified as a bag limit in Schedule A for that species in the province or area having the highest bag limit of those provinces or areas in which the person hunts.

9. No person shall hunt migratory game birds in any day after he has killed the number of birds he is permitted to kill under section 7 or 8.

SCHEDULE B

Permit Fees

Type of Permit	Annual Fee
1. Migratory Game Bird Hunting Permit..............	$2.00
2. Scientific Killing Permit.......................	free
3. Scientific Banding Permit.......................	free
4. Scientific Capture Permit.......................	free

5. Avicultural Permit.............................. free
6. Damage-Kill Permit.............................. free
7. Airport-Kill Permit............................. free
8. Taxidermist Permit.............................. $10.00
9. Eiderdown Permit................................ free
10. Special Permit................................. free
11. Cap Tourmente Permit........................... $30.00

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