EVALUATION OF SELECTED CHEMICALS AS CONDITIONING REPELLENTS FOR BROWN-HEADED COWBIRDS AND HOUSE SPARROWS

By

CHARLES AIDEN NORTH

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University of Missouri

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Thesis Approved:

F. M. Baumgartner
Thesis Adviser

W. H. Irwin

David S. Berkeley

Dean of the Graduate School

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The data presented are the results of a study of the effects of fourteen chemicals on two species of birds. The chemicals were tested, in varying dosages, on Brown-headed Cowbirds [*Molothrus ater* (Boddaert)] and House Sparrows [*Passer domesticus* (Linnaeus)] to determine certain physiological effects produced. The study was begun in October, 1961, and continued until June, 1962. The chemicals were provided by Phillips Petroleum Company, which in running preliminary tests found that all of these fourteen chemicals produced some effects on birds.

The tests were made in a laboratory using captive wild birds. The liquid chemical was injected into the throat of the bird, and the resulting reactions were observed.

The four principal objectives of the study were as follows:

1. the recognition of chemicals that produced specific reactions;
2. the discovery of the most effective chemicals for each species;
3. the determination of the optimum dosage of each chemical for each species; and
4. the development of a rating system, for chemicals causing certain reactions in birds, which may be valuable in the dispersal of non-affected birds.

The Need for Bird Repellents

Bird damage, especially in agricultural areas, has long been a serious problem. Evidence concerning the need for more effective

methods of reducing bird damage is voluminous and conclusive.

Many authors have reported extensive damage caused by blackbirds (cowbirds, blackbirds, and grackles) and House Sparrows. Blackbirds, especially, since they often congregate in large flocks, have been extremely destructive to standing small-grain crops.

According to Wallace (1955), blackbirds congregate in flocks in the late summer and raid grain fields, often doing extensive damage to mature or nearly mature grains, including corn in the milk. Neff and Meanley (1957) report that wherever rice has been grown, blackbirds, cowbirds, and grackles become pests of the ripening crop. In four counties in Ohio, Gilfillan (1958) stated that crop damage by blackbirds totaled $200,000 a year. Arkansas rice growers lost $1,400,000 in rice each year to blackbirds (Neff and Meanley, 1957). In New Jersey, Starnes (1958) reported that the increasing frequence with which farmers were reporting extensive crop damage from blackbirds illustrates the importance of the problem.

The common House Sparrow is generally considered harmful, but its destructiveness often is not fully appreciated. According to Barrows (1889) the House Sparrow has been an acknowledged enemy of mankind for more than five thousand years. When writing was invented, the sparrow was selected for the hieroglyphic character signifying "enemy." Wallace (1955) stated that English Sparrows add to their ill reputation by feeding on the green sprouts in the spring, maturing grain in the summer, shocked grain in the fall, and stored grain in the winter.

Damage by birds is world wide. Thus far no consistently effective method of control has been developed.

Use of Chemicals to Control Birds

It has become necessary either to completely destroy the populations of certain birds or to develop some effective method of control. Many types of chemicals have been utilized to control bird damage. None of the "repellents" has been entirely satisfactory. The development of effective repellents for birds has been hampered by insufficient knowledge of bird physiology. Ridpath and Murton (1956) called attention to the fact that our knowledge of the physiology of the senses of taste, smell, and sight in birds and in other animals is not far enough advanced to give a rational basis on which to choose any particular chemical as a repellent. It is generally thought that such senses as smell, taste, and touch are poorly developed in birds.

The following three major types of chemical repellents have been used on birds: 1. distasteful repellents, 2. sticky repellents, and 3. toxic repellents.

Distasteful Repellents. Distasteful repellents create an aversion through an odious or distasteful nature. The reactions are restricted largely to the senses of taste and smell. The chemicals are usually non-toxic in nature. According to Wallace (1955), taste, as with the sense of smell with which it is often correlated, is of little importance to birds. VanTyne and Berger (1959) conclude that data are too fragmentary and contradictory to warrant positive statements regarding the importance of the sense of smell in birds. Griffin (1960) states that the evidence that birds have a sense of taste is almost as controversial as that for the sense of smell. Kare, Black and Allison (1959) found that the chicken has a sensitive sense of taste, but quite different from that of man. The study of Kare et al. would indicate that some progress could

be made with a distasteful repellent.

Sticky Repellents. Sticky or tacky compounds are used on roosting surfaces in order to repel the birds. Kalmbach (1954) described their use against sparrows, starlings, and pigeons. The sense of touch is also not considered to be well developed in birds (Wallace, 1955).

On the other hand, the vision of most birds is remarkably keen, and birds have always been credited with acute hearing ability. The most effective repellents have usually affected one or both of these two senses.

Toxic Repellents. Toxic repellents are the type discussed in the study, and the effects are termed "conditioned repellency." The chemical repellents are toxic in large doses. Birds eating sublethal quantities only become ill, and upon recovering often refuse to re-enter the treated area (Neff and Meanley, 1957). Not only are the affected birds repelled but also the unaffected birds of the same species when they observe the reactions of the birds that have eaten the repellent (Barrows, 1889).

Buildings and feed lots treated with 1070 and 1861 grain baits have been evacuated by House Sparrows and Cowbirds. In a few cases the habitats have been completely free of any use by such birds for periods as long as ninety days. During the period birds were plentiful in adjoining areas but avoided the treated habitats. (Dr. F. M. Baumgartner, personal communication).

Distress calls in particular are known to repel birds of the same species. Frings (1954) found that the distress call of a live starling caused starlings to depart immediately; and they did not return, even after some months. According to Frings (1955), tape-recorded distress calls drove starlings from their roosts in trees: "The birds left, after

being offered this program for a few evenings, and they stayed away." Frings and Frings (1957) found that the broadcasting of alarm calls caused crows to abandon certain areas. Ridpath and Murton (1956) stated:

> Many birds react automatically and very specifically to certain calls made be other members of the same species, especially the "distress" or "alarm" calls. The distress call of a female Starling, when recorded and played over loudspeakers, causes other members of the species to fly away and can result in the abandonment of roosts and the dispersal of feeding flocks.

Giltz (1959) stated that amplified bird-calls have been found to bother blackbirds that were trying to feed, nest, or roost. The abnormal actions of the affected birds seemed to frighten away other members of the species.

Barrows (1889) stated:

> In dealing with a suspicious a bird as the English Sparrow, in cases where continued use of the poison is required, a slow poison (such as arsenic) is preferable to one of rapid action (such as strychnine), for the reason that the effects of the latter may become apparent in certain individuals while the birds are still feeding, the peculiar actions of the affected birds frightening the others away before they have taken enough of the poisoned grain to insure fatal results. In such cases it has been observed that the frightened birds never return to the grain.

These observations have been verified in part by the field testing of the candidate conditioning repellents. Apparently, the more violent the antics and the louder the voice of the affected birds, the more effectively the chemical repels the unaffected birds of the same species.

History of Bird Control with Chemicals

Neff and Meanley (1956) made a complete review of studies of bird repellents that are non-toxic in nature. The review was tabulated by Griffin (1960). Hockenyos (1958) presented an adequate discussion of

the sticky repellents and deterrents.

Literature is scarce on the conditioned repellency, a treatment that consists of light dosages of toxic substances.

CHAPTER II

METHODS AND PROCEDURES

Capture of Birds

Each species of bird required different methods of capture. Most of the Cowbirds were caught in funnel-type traps baited with grain sorgum. The traps were set in pastures and holding pens used for cattle and other livestock.

House Sparrows were more difficult to trap than Cowbirds. Traps with double funnels were built from hardware cloth (Lincoln and Baldwin, 1929). The traps were effective chiefly for juvenile birds. Most of the sparrows were obtained by means of a "mist" net. The net is made of fine black nylon strands of small mesh loosely strung on a nylon cord frame. Five larger cords run horizontally across the mesh, and a bird hitting the loose mesh forms a "pocket" into which it falls. Mosby (1960) discusses techniques of using the mist net for capturing birds.

Testing Materials

The chemicals were supplied by Phillips Petroleum Company, Bartlesville, Oklahoma. Fourteen candidate conditioning repellents were tested on two species of birds. At the present time the author is not at liberty to divulge the names of the coded chemicals.

A set of scales calibrated in grams was used to weigh each bird. In order to inject the liquid chemicals into the throat of the bird, a one-cubic-centimeter hypodermic syringe was utilized. Six inches of

plastic tubing served as an extension for the needle of the syringe. White paint was used to mark one of the two tested birds if they both were of the same sex. Several small cages of hardware cloth were utilized to hold the treated birds while they were under observation. Numbered bands were placed on the legs of the birds that appeared to recover after treatment.

Procedures

The birds used in the tests appeared to be healthy, judged from their weight, alertness, and physical activities. They had been held captive in reasonably large cages with the different species segregated. Suitable food and sufficient water were available at all times.

Two birds (in many cases a male and a female) were selected for the test of a chemical dosage. Before treatment both birds were weighed to the nearest half a gram, and the sex and weights were recorded.

The needle of the hypodermic syringe was inserted in a thin plastic tube about six inches in length. The tube was then forced as far as possible down the throat of the bird to be treated. Inadequate penetration of the tube often meant premature regurgitation which produced misleading results. Results from such birds were not tabulated. The treated bird was then marked and placed in a small holding cage and observed until recovery or death occurred. The observations for each test were recorded on a separate sheet (Fig. 1). The following data were considered important.

1. Treatment time - The date and exact time of treatment for each bird were recorded.
2. First reactions - The first time that the chemical

showed visible effects on the bird was noted. The effects usually appeared as slight tremors or loss of awareness. Reactions were often followed by loss of balance accompanied by violent tremors.

3. Voice - With some of the chemicals the birds gave distress calls of varying loudness and duration. The quality, duration, and time of first occurrence of the voice were recorded.
4. Convulsions - The time of first occurrence, the duration, and the intensity of the convulsions were noted.
5. Immobility - With the less effective candidate repellents the birds often merely became immobile instead of producing convulsions or distress calls.
6. Death or recovery - Lastly the time of death or recovery was recorded for each treated bird. A bird was considered to have recovered when awareness was regained.

Method of Rating the Chemicals as Repellents

Each chemical was assigned an over-all rating as a conditioning repellent for each species of bird. The convulsions and voice were ranked separately according to their intensity and duration.

LABORATORY TESTS ON BIRD CONTROL

Chemical Used:_____ Species of Bird:_____ Test No.:___

Date:_____ Temperature:_____ Location:_____

Nature of Chemical Treatment:

Amount Given and Concentration:_____

_____

Method of Application:_____

Time of Treatment:_____

Effects: (Indicate time intervals for each reaction).

First Evidence:_____

Description of Reactions:

Tremors_____

Loss of Balance_____

Loss of Flight_____

Weakness_____

Awareness_____

Voice_____

Feeding_____

Drinking_____

Other Reactions and Conditions_____

_____

Recovery_____

Evaluation of Test:_____

_____

Name of Observer(s)_____

Figure 1. Example of the data sheet for laboratory tests.

Convulsions. The following classifications were given the chemicals in regard to the violence and duration of the convulsions.

violence	duration
I (good) — very active	A (good) — continuous
II (fair) — fairly active	B (fair) — periodic
III (poor) — little activity	C (poor) — short
0 (none) — no convulsions	

Voice. The loudness and duration of the voice of the treated birds were classified in the following manner.

loudness	duration
I (good) — very loud	A (good) — continuous
II (fair) — medium	B (fair) — period
III (poor) — weak	C (poor) — short
0 (none) — no voice	

Final rating. The intensity and duration of the convulsions and voice determined the final rating of the chemicals as conditioning repellents. Any chemical that produced convulsions was assigned a rating of I, II, or III according to their violence and duration. When the birds were affected but no convulsions occurred, the chemical was classed as type IV. Chemical type V produced no effect on the treated birds (Table IV). The system used in rating the chemicals as conditioning repellents is shown below.

rating	convulsions	voice
I (good)	IA, IB	adequate
II (fair)	IIA, IIB (IA,IB)	some (inadequate)
III (poor)	IC, IIC, IIIA,B,C	some or none
IV (inadequate)	none	some or none
V (none)	no effects	no effects

Often the effects of the chemicals were not consistent. For example, with two birds tested with equal doses, one might have convulsions and one might have no convulsions. When such results were obtained, the final rating for the chemical as a repellent was III. An asterisk (*) marks the results of each chemical with which convulsions of voice occurred inconsistently. Also further comment is made as to how inconsistent these results were (Table IV).

All the tables from the study are listed in the Appendix. Also given in the Appendix is a list of the abbreviations used in the tables.

CHAPTER III

DATA AND OBSERVATIONS

Responses of the Birds to the Chemicals

1. Brown-headed Cowbird, Molothrus ater ater

Weights. The cowbird, a small blackbird, was the initial species tested. The 99 birds treated ranged in weight from 27.5 to 64.5 grams and averaged 44.81 grams. Males were generally larger than females. The 68 males averaged 47.81 grams and ranged from 35 to 64.5 grams, while the 31 females averaged 38.27 grams and varied from 27.5 to 54 grams (Table I).

General reactions. Cowbirds were more susceptible to the chemicals than were the House Sparrows. Several of the candidate repellents produced satisfactory reactions (Tables I and III). Six chemicals (1861, 1070, 1607, 1931, B7, and 1927) caused adequate convulsions, and three chemicals (1861, 1070, and 1607) produced satisfactory voice reaction.

2. House Sparrow, Passer domesticus domesticus

Weights. The House or English Sparrow was the second species treated with the fourteen candidate chemicals. The weights of 106 treated sparrows varied from 20.5 to 30.2 grams and averaged 25.76 grams. Weights of the 39 males ranged from 20.5 to 30.2 grams and averaged 26.31 grams. The 67 females varied from 21.5 to 29 grams with an average weight of 25.45 grams (Table II).

General reactions. The House Sparrow proved to be more resistant

to the chemicals than the Cowbird, and few adequate effects were produced (Tables II and III). Three chemicals (1861, 1070, and 1607) produced satisfactory convulsions while only two chemicals (1861 and 1070) produced adequate voice reactions.

Conditioned Repellency

The repellency of a chemical can be measured by observing the effects of varying amounts upon individual birds. Unaffected birds appeared to be repelled by hearing the distress cries in the field and seeing the unnatural body movements of the affected birds. The most important criteria for a conditioning repellent are the vocal and physical effects produced. The chemicals, acting upon the nervous systems of the birds, often cause violent reactions. The uncontrollable physical antics of the bird are called "convulsions." The convulsions vary from weak fluttering to violent frenzies. Often occurring simultaneously with the convulsions are distress calls of the affected birds. This "voice" ranges from very weak cheeps to loud screeching. The more violent the convulsions and the louder the voice, the higher the chemical was rated as a conditioning repellent. The length of bird reaction was also recorded.

General Reactions of the Birds

After a chemical was injected into the stomach of a bird, a considerable variety of results was observed. Usually the first observable effects were a lessening of general activity and slight tremors. The reactions gradually became more pronounced and soon resulted in the loss of awareness and balance. Next, the birds usually lapsed into convulsions or became more or less immobile. The birds soon died with large dosages of the

chemicals, but often recovered completely with small amounts. All the chemicals except one were tested and produced some effects on the birds. However, quite often no convulsions resulted from the treatments (Tables I and II).

Effectiveness of the Chemicals

The effects of each chemical on Cowbirds and House Sparrows are described below, and the recommended dosages for each are listed.

#1861

Cowbirds. The chemical (1861) appeared to have all the characteristics of an excellent conditioning repellent for Cowbirds. The convulsions and voice reactions were excellent and were prolonged for a considerable length of time. The convulsions often occurred continuously for a period of half an hour or more. The chemical was rated a type I repellent (Tables I and III).

The dosage of 1861 necessary to produce desirable reactions was extremely light. The chemical was probably the most toxic for Cowbirds. The dosages varied from 0.1 to 0.5 cc of 0.1 per cent solution or from 2 to 11 milligrams of chemical per kilogram body weight (Table III).

House Sparrow. For House Sparrows, 1861 was the most effective repellent tested. The results were not so good as with Cowbirds. The convulsions with 1861 were good (type I), but were more periodic as were the voice reactions. The chemical was extremely toxic to House Sparrows and was rated a type I repellent (Tables II and III).

#1070

Cowbirds. Chemical 1070 was apparently the most suitable conditioning repellent tested on Cowbirds. The violence and duration of the convulsions were excellent and were classed IA. The voice was very loud but usually not continuous. As a repellent, 1070 was rated type I (Tables I and III).

One of the most favorable attributes of the chemical was that a wide variation in dosage still produced adequate effects. Good results were obtained from 0.1 to 1.0 cc of 0.1 per cent solution or from 2 to 22 milligrams per kilogram (Table III).

House Sparrows. With the House Sparrow 1070 proved to be a fair repellent. Convulsions were generally considered type II. The voice was also rated class II. The chemical was classed a type II repellent (Tables II and III).

The effective range of the chemical was more limited with sparrows than with Cowbirds. Some results were obtained with dosages from 0.2 to 0.5 cc or from 8 to 20 milligrams per kilogram (Table III).

#1607

Cowbirds. The chemical 1607 appears to be almost as effective as the two chemicals discussed above. The violence and duration of the convulsions were classed as I and A respectively. The voice was loud but periodic. The chemical was rated a type I conditioning repellent (Tables I and III).

However, this chemical had a rather limited effective range. Suitable effects resulted with dosages from 0.3 to 0.5 cc of 0.1 per cent solution or from 7 to 11 milligrams per kilogram (Table III).

House Sparrows. The chemical was classed a type II repellent for House Sparrows. The convulsions varied from poor to good, as did the voice (Tables II and III).

Effective dosages ranged from 0.2 to 0.5 cc of 0.1 per cent solution or from 8 to 20 milligrams per kilogram. The larger dosages were the more satisfactory (Table III).

#1931

Cowbirds. When 1931 produced convulsions in Cowbirds, results were excellent, but voice reaction did not occur. The chemical was ranked low in type II as a repellent for Cowbirds (Tables I and III).

The effective range was from 0.1 to 0.4 cc of 5 per cent solution or from 110 to 440 milligrams per kilogram. Outside this restricted range no convulsions were produced (Tables I and III).

House Sparrows. The convulsions with sparrows were even more erratic than with Cowbirds, for fewer than half the tests produced convulsions. The convulsions and voice reactions were classed III. As a repellent 1931 was ranked type III for House Sparrows (Tables II and IV).

The effective range was between 0.1 and 0.4 cc of 5 per cent solution or from 200 to 800 milligrams per kilogram (Table III).

#B7

Cowbirds. Chemical B7 seemed more effective than 1931. Convulsions were always produced and were classed type I with type A duration. The voice reactions were generally weak and occurred in only a few birds. The chemical was an excellent repellent for Cowbirds as far as convulsions were concerned. However, B7 was classed a type II repellent since little

voice was produced (Tables I and III).

The chemical was effective in dosages from 0.5 to 1.0 cc of 5 per cent solution or from 550 to 1100 milligrams per kilogram (Table III).

House Sparrows. The chemical B7 was less effective with sparrows than with Cowbirds. The convulsions were weaker but were classed type II. Voice seldom occurred and was very weak. Since convulsions were produced with every test, B7 was considered superior to 1931 for House Sparrows and was rated a type II repellent (Tables II and III).

This chemical had a wide range of effectiveness with sparrows. Dosages from 0.1 to 1.0 cc of 5 per cent solution or from 200 to 2000 milligrams per kilogram were found to be effective (Table III).

#1927

Cowbirds. The effects of 1927 on Cowbirds were sporadic. Convulsions were produced in about half of the tests; voice occurred only once. The convulsions and voice were good when they were produced (Table I).

The effective dosages varied from 0.1 to 0.3 cc of 5 per cent solution or from 110 to 330 milligrams per kilogram (Table III). This was a narrow range, and the convulsions were produced only at the 2.5 cc level (Table I). Chemical 1927 was classed a type III repellent (Table III).

House Sparrows. Few convulsions and only sporadic voice were produced by 1927. The convulsions occurred so seldom that the chemical was considered type IV or completely inadequate as a conditioning repellent (Tables II and III).

The most effective dosages fell between 0.1 and 0.5 cc of 5 per cent solution or from 200 to 1000 milligrams per kilogram (Table III).

#1941

Cowbirds. Chemical 1941 affected Cowbirds much as did 1927. There were no convulsions or voice, and when convulsions did occur they were very weak. The chemical was type IV or inadequate repellent (Tables I and III).

The effective range of 1941 was from 0.8 to 1.0/ cc of 5 per cent solution, or from 900 to 1100/ milligrams per kilogram (Table III).

House Sparrows. Chemical 1941 produced slightly better results with House Sparrows than with Cowbirds. Half of the birds tested developed some convulsions. The convulsions were weak, and the voice was even weaker. The chemical was classed a type III repellent (Tables II and III).

The effective dosage of 1941 ranged from 0.5 to 0.8 cc of 5 per cent solution or from 1000 to 1500 milligrams per kilogram (Table III).

#111

Cowbirds. No convulsions or voice were produced by chemical 111. The birds were affected, and some died; but mostly they remained immobile. Chemical 111 was a type IV repellent (Tables I and III).

House Sparrows. No convulsions occurred in House Sparrows. Some voice was produced, but only with very toxic dosages. Chemical 111 was a type IV repellent with House Sparrows (Tables II and III).

The effective range was from 0.3 to 0.5 cc of 5 per cent solution or from 600 to 1000 milligrams per kilogram (Table III).

#888

Cowbirds. Chemical 888 was unusual in that a considerable period elapsed before any reactions were observed in the treated birds. The delayed reaction extended from half an hour to an hour. The convulsions, though weak, were fairly consistent. No voice was produced. Chemical 888 was rated a type II repellent (Tables I and III).

The effective range was considered to lie between 0.9 and 1.0+ cc of 1 per cent solution or from 200 to 220+ milligrams per kilogram.

House Sparrows. The first reactions with sparrows were also delayed from 30 to 60 minutes. No convulsions or voice were produced, and the affected birds remained immobile most of the time. Chemical 888 was classed a type IV repellent for House Sparrows (Tables II and III).

The effective range varied from 0.5 to 0.1+ cc of 1 per cent solution or from 200 to 400+ milligrams per kilogram (Table III).

#247

Cowbirds. Convulsions and voice occurred so seldom with chemical 247 that it was considered a type IV repellent for Cowbirds (Tables I and III).

The effective range was considered to be between 0.1 and 0.5 cc of 2.5 per cent solution or from 55 to 140 milligrams per kilogram (Table III).

House Sparrows. Chemical 247 produced no convulsions or voice with House Sparrows. The chemical was classed a type IV repellent (Tables II and III).

The effective range was from 0.1 to 0.5 cc of 1.0 per cent solution or from 100 to 200 milligrams per kilogram (Table III).

#1885

Cowbirds. Chemical 1885 produced no convulsions or voice and was classed a type IV repellent for Cowbirds (Tables I and III).

The effective range was considered to be from 0.6 to 1.0 cc of 5 per cent solution or from 670 to 1100 milligrams per kilogram (Table III).

House Sparrows. No convulsions and very little voice were produced, and chemical 1885 was considered a type IV repellent for sparrows (Tables II and III).

The effective range was placed as from 0.5 to 1.0 cc of 5 per cent solution or from 1000 to 2000 milligrams per kilogram (Table III).

#119

Cowbirds. No convulsions in Cowbirds were produced by chemical 119. It was classed a type IV repellent (Tables I and IV).

The effective dosage was considered to be more than 1.0 cc of 5 per cent solution or more than 1100 milligrams per kilogram (Table III).

House Sparrows. Few convulsions and no voice were produced with sparrows. The chemical was considered a type IV repellent (Tables II and III).

The effective range was from 0.5 to 1.0 cc of 5 per cent solution or from 1350 to 2000 milligrams per kilogram (Table III).

#112

Cowbirds. When convulsions were produced with chemical 112, they were extremely poor; no voice occurred. Chemical 112 was classed a type IV repellent (Tables I and III).

The effective dosages were above 1.0 cc of 5 per cent solution or more than 1100 milligrams per kilogram (Table III).

House Sparrows. No convulsions or voice were produced by chemical 112. It was considered a type IV repellent for sparrows (Tables II and III).

The effective range was from 0.5 to 1.0 cc of 5 per cent solution or from 1350 to 2000 milligrams per kilogram (Table III).

#978

Chemical 978 produced no effects with either Cowbirds or House Sparrows. It proved to be the only chemical tested that was not toxic to the birds and was classed a type V repellent for both species (Tables I, II, and III).

CHAPTER IV

DISCUSSION

The Value of Laboratory Testing

The laboratory test appears to be an ideal method for making exploratory measurements of a chemical's effectiveness as a conditioning repellent. Few materials and little equipment are required for making tests, the results give a good indication of how the chemical will perform under field conditions, and the dosages of the chemicals required to produce suitable reactions are determined. When using grain treated with the chemicals, one needs to experiment in order to determine the optimum level of concentration. The correct percentage of the chemical required for effective control of birds is not difficult to estimate from an analysis of laboratory tests.

Problems Involved

Several problems arose in connection with the chemical testing. At times the birds regurgitated the chemical and failed to receive full effects of the particular dose. If the plastic tube were not inserted far enough into the bird's throat, some of the chemical would overflow from the mouth. These two factors caused some variation in the results. Whenever part or all of a chemical dosage was lost by the bird, the results obtained were not recorded.

Variations in the reactions also resulted from the difference in the weights of the birds treated with equal amounts of the chemicals. The

greater the body weight, the more resistant the bird proved to be. In some cases, the sex of the bird seemed to influence the results. The female cowbirds seemed slightly more resistant than the males.

It was difficult to determine with accuracy the actual time of recovery of a bird from the effects of a chemical. The birds would at times die several days after the treatment. Such mortality may or may not have been directly caused by the chemical treatment.

Chemicals Considered Useful Repellents

Of the fourteen chemicals tested on two species of birds, chemical 1861 was the most consistently effective conditioning repellent. Chemicals 1607 and 1070 were generally good repellents but were not adequate for both species of birds.

Cowbirds. Three chemicals -- 1861, 1070, and 1607 — were rated class I repellents for Cowbirds. Of the three, 1861 was probably the most efficient conditioning repellent. However, 1070 demonstrated a considerably wider range of effective dosages.

Two additional chemicals, 1931 and B7, were considered class II repellents. Both produced excellent convulsions, but the vocal reactions were either weak or nonexistent.

None of the other chemicals were considered adequate conditioning repellents for Cowbirds.

House Sparrows. With House Sparrows only one chemical, 1861, was rated a class I repellent. House Sparrows showed poorer reactions to most of the chemicals than did the Cowbirds. For House Sparrows, 1861 was the only chemical that could be fully recommended as a conditioning repellent. Chemicals 1070 and 1607 produced fair convulsions and voice,

and were ranked as class II repellents. All the other chemicals were considered unsuitable as conditioning repellents for House Sparrows.

Applications of Conditioning Repellents

Conditioning repellents can be utilized in a variety of ways. With very light, sublethal dosages the birds are merely sickened and usually recover completely. With slightly larger dosages the affected birds perform violent convulsions and produce considerable voice reactions. The dosage may at times kill the affected bird, but it repels other birds of the same species. Furthermore, large dosages can be used to kill the birds outright.

Conditioning repellents are most useful in repelling large flocks of birds from restricted areas. Flocking birds seem more sensitive to the reactions of affected individuals within the flock. They are also effective repellents for enclosed areas such as buildings. A few pans of treated grain placed in such areas will discourage bird use for considerable periods of time.

Since these repellents are toxic to a wide variety of animal life, they cannot be used safely where domesticated animals or man might ingest large amounts of the baits. If care is observed in the placement of grain treated with the conditioning repellent, the effects can be largely limited to the species of bird to be controlled. It should be noted that since birds under field conditions are likely to receive varying dosages of the repellent, chemicals with a wide range of effectiveness are preferable. With these chemicals good effects are produced no matter how much of the treated grain the birds consume.

Conditioning repellents are useful in a wide variety of situations.

At times their application appears to be the only feasible method known to prevent serious bird damage.

CHAPTER V

SUMMARY AND CONCLUSIONS

It has been determined that the physiological effects upon birds that ingest certain chemicals tend to frighten those individuals as well as unaffected birds away from situations where they are doing damage to crops or creating a nuisance to man. Fourteen toxic chemicals were tested in the laboratory on Brown-headed Cowbirds and House Sparrows. The chemicals were rated as conditioning repellents according to the manifestation of such physiological reactions as violent, uncontrolled movements and distress calls in the treated birds. The ratings of the chemicals as conditioning repellents are listed below.

For Cowbirds	For House Sparrows
1. 1861, I	1. 1861, I
2. 1070, I	2. 1070, II
3. 1607, I	3. 1607, II
4. 1931, II	4. 1931, III
5. B7, II	5. B7, II
6. 1927, III	6. 1927, IV
7. 888, III	7. 888, IV
8. 247, IV	8. 247, IV
9. 111, IV	9. 111, IV
10. 1941, IV	10. 1941, III
11. 1885, IV	11. 1885, IV
12. 112, IV	12. 112, IV

13. 119, IV

14. 978, V

13. 119, IV

14. 978, V

Chemicals given a high rating are worthy of field testing to determine their degree of effectiveness in repelling Cowbirds, House Sparrows, and other noxious species from situations where damage has been demonstrated.

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APPENDIX

ABBREVIATIONS EMPLOYED IN TABLES I - III

I - immobile

IM - immobile most of time

IB - became immobile

FD1 - found dead next day

FD2 - found dead after 2 days

NE - no effects

LE - little effects

DR - delayed reaction

D - died

R - recovered

22/ - more than 22 minutes

22- - less than 22 minutes

NCU - usually no convulsions

NCO - often no convulsions

NVU - usually no voice

NVO - often no voice

VR - reactions vary greatly

TABLE I

EFFECTS OF CHEMICALS ON COWBIRDS

Code no. of Chemical	C.C.	% Soln.	Sex	Wt. (gms.)	Min. 1st Effect	Min. 1st Convul.	Length of Convul.	Convulsion Violence	Convulsion Duration	Voice Loudness	Voice Duration	Min. died/ Recovered	Comments
1861	0.3	.05	F	50.5	13	51	7	III	C	--	--	D 58	IM
	0.3	.05	M	44.0	6	11	29-	II	A	II	C	D 40	IB
	0.1	0.1	M	40.0	9	17	11	I	A	I	A	D 28	
	0.1	0.1	M	54.0	12	90	37-	I	A	I	B	D 127+	FDI
	0.1	0.1	F	36.5	14	101	23-	I	A	I	A	D 124+	FDI
	0.2	0.1	M	43.5	13	17	13	I	A	I	A	D 30	
	0.2	0.1	M	42.0	8	12	13	I	A	I	A	D 25	
	0.1	1.0	M	42.5	3	4	3	I	C	--	--	D 7	
	0.5	1.0	F	37.0	1	--	--	--	--	--	--	D 2	
1070	0.3	0.1	M	54.0	18	38	19	I	B	I	B	D 57	
	0.3	0.1	F	35.0	18	30	16	I	A	I	A	D 47	
	0.3	0.1	M	47.5	10	43	22-	I	B	I	B	R 65	
	0.3	0.1	M	41.0	19	22	27	I	A	I	B	D 49	
	0.4	0.1	M	46.0	17	31	60-	I	B	I	B	R 91+	
	0.4	0.1	M	35.0	15	24	8	I	A	I	B	D 32	
	0.5	0.1	M	46.5	17	22	20	I	A	I	B	D 42	
	0.5	0.1	F	30.5	21	23	11	I	A	I	B	D 44	
	0.1	1.0	F	35.5	15	20	7	I	A	I	A	D 27	
	0.1	1.0	M	38.0	16	23	12	I	A	I	B	D 35	
	.15	1.0	F	39.0	11	15	3	I	A	I	A	D 18	
	.15	1.0	M	36.5	12	21	6	I	A	I	B	D 27	
	.25	1.0	F	33.0	10	17	8	I	A	I	B	D 25	
	.25	1.0	M	43.0	13	15	21	I	A	I	A	D 36	
	.35	1.0	M	40.0	8	18	3	I	A	I	A	D 21	
	.35	1.0	M	41.5	11	17	8	I	A	I	B	D 25	
1607	0.1	0.1	M	62.5	--	--	--	--	--	--	--	R 0	LE
	0.1	0.1	M	61.0	--	--	--	--	--	--	--	R 0	LE
	0.2	0.1	M	60.5	15	20	18	I	A	III	C	D 38	
	0.2	0.1	M	63.5	18	--	--	--	--	--	--	R 53+	
	0.2	0.1	M	37.0	14	24	25	II	A	III	B	D 49	

TABLE I (Continued)

Code no. of Chemical	C.C.	% Soln.	Sex	(gms.) Wt.	Min. 1st Effect	Min. 1st Convul.	Length of Convul.	Convulsion Violence	Convulsion Duration	Voice Loudness	Voice Duration	Min. died/ Recovered	Comments
1607	0.2	0.1	F	37.5	9	27	65-	II	B	II	C	R 92/	
	0.3	0.1	M	48.0	16	20	10	I	A	I	A	D 30	
	0.3	0.1	M	52.5	18	19	22	I	A	I	B	D 41	
	0.3	0.1	M	46.5	16	20	9	I	A	I	A	D 29	
	0.3	0.1	F	31.0	20	28	36	I	B	I	B	D 64	
	0.5	0.1	F	40.0	14	19	5	I	A	II	C	D 24	
	0.5	0.1	M	52.5	10	13	17	I	A	I	B	D 30	
1931	1.0	1.0	M	50.0	2	—	—	—	—	—	—	R 31	
	1.0	1.0	M	46.0	2	—	—	—	—	—	—	R 25	FD4
	0.1	5.0	M	44.0	2	2	5	I	A	—	—	D 7	
	0.4	5.0	M	44.0	3	7	93-	I	A	—	—	D 100/	FD1
	0.4	5.0	M	41.5	18	33	63-	I	A	—	—	D 96/	FD1
	0.5	5.0	M	40.0	3	5	—	—	—	—	—	D 5	
	1.0	5.0	F	35.8	1	1	—	—	—	—	—	D 3	
B7	0.2	5.0	M	64.5	—	—	—	—	—	—	—	R 0	NE
	0.3	5.0	M	62.5	—	—	—	—	—	—	—	R 0	LE
	0.5	5.0	M	46.0	19	19	12	I	A	II	C	D 31	
	0.5	5.0	M	44.0	16	21	10	I	A	II	B	D 31	
	0.7	5.0	F	39.5	16	16	5	I	A	—	—	D 21	
	0.7	5.0	M	46.5	15	23	2	I	A	—	—	D 25	
	1.0	5.0	M	46.0	16	17	11	I	A	—	—	D 28	
1927	0.1	5.0	M	61.5	3	—	—	—	—	—	—	D 25	I
	.25	5.0	M	45.0	4	16	40-	I	A	I	B	D 56/	FD1
	.25	5.0	F	31.5	2	28	25-	I	A	—	—	D 53/	FD1
	0.3	5.0	M	52.0	5	—	—	—	—	—	—	R 16	FD2
	0.3	5.0	F	27.5	3	—	—	—	—	—	—	D 30	I
111	0.2	5.0	F	35.0	8	—	—	—	—	—	—	R 23	
	0.5	5.0	F	37.0	2	—	—	—	—	—	—	R 83	FD7 IM
	0.5	5.0	M	44.0	1	—	—	—	—	—	—	R 61	I
	0.6	5.0	M	54.5	2	—	—	—	—	—	—	R 45	IM
	0.6	5.0	F	54.0	1	—	—	—	—	—	—	R 41/	I
	0.8	5.0	M	56.0	1	—	—	—	—	—	—	D 80/	IB, FD1

TABLE I (Continued)

Code no. of Chemical	c.c.	% Soln.	Sex	(gms.) Wt.	Min. 1st Effect	Min. 1st Convul.	Length of Convul.	Convulsion Violence	Convulsion Duration	Voice Loudness	Voice Duration	Min. died/ Recovered	Comments
1941	1.0	1.0	F	46.0	—	—	—	—	—	—	—	R 0	NE
	1.0	1.0	M	44.0	—	—	—	—	—	—	—	R 0	NE
	.25	5.0	F	37.0	2	—	—	—	—	—	—	D 2	
	0.5	5.0	M	41.5	—	—	—	—	—	—	—	R 0	NE
	0.5	5.0	F	36.0	—	—	—	—	—	—	—	R 0	NE
	0.7	5.0	M	44.0	59	—	—	—	—	—	—	D 100+	FD2
	0.7	5.0	F	44.0	—	—	—	—	—	—	—	R 0	NE
	0.8	5.0	F	45.5	20	38	18+	III	C	—	—	D 56+	FD1
	1.0	5.0	M	49.5	51	—	—	—	—	—	—	R 91	
	1.0	5.0	F	33.0	43	43	12	I	C	II	C	D 55	
888	0.5	1.0	M	50.0	—	—	—	—	—	—	—	R 0	NE
	0.7	1.0	M	50.0	—	—	—	—	—	—	—	R 0	NE
	0.7	1.0	F	45.0	—	—	—	—	—	—	—	R 0	NE FD1
	0.9	1.0	M	53.0	30	39	2	III	C	—	—	D 101	DR
	0.9	1.0	M	52.0	55	67	5	III	C	—	—	D 132	DR
	1.0	1.0	M	47.0	50	55	15	III	C	—	—	D 70	DR
	1.0	1.0	F	41.5	45	50	5	III	C	—	—	D 52	DR
	1.0	1.0	M	46.5	76	—	—	—	—	—	—	D 81	DR
247	0.1	2.5	M	49.0	—	—	—	—	—	—	—	R 0	NE
	0.1	2.5	M	53.0	2	2	14	III	C	—	—	D 16	
	.15	2.5	M	45.0	3	—	—	—	—	—	—	R 10	
	0.2	2.5	M	57.5	2	—	—	—	—	—	—	D 4	
	.25	2.5	M	47.0	3	6	19	III	C	III	B	D 25	
	0.5	2.6	M	38.0	—	—	—	—	—	—	—	D 2	
	1.0	2.5	M	41.0	1	—	—	—	—	—	—	D 3	
1885	0.5	5.0	M	49.5	3	—	—	—	—	—	—	R 32	
	0.5	5.0	F	39.5	1	—	—	—	—	—	—	R 25+	
	0.6	5.0	M	45.5	1	—	—	—	—	—	—	R 48	
	0.6	5.0	F	41.0	4	—	—	—	—	—	—	D 25+	FD1
112	1.0	5.0	F	39.0	10	15	1	III	C	—	—	D 16	
	1.0	5.0	M	45.5	—	—	—	—	—	—	—	R 0	NE

TABLE I (Continued)

Code no. of Chemical	C.C.	% Soln.	Sex	(gms.) Wt.	Min. 1st Effect	Min. 1st Convul.	Length of Convul.	Convulsion Violence	Convulsion Duration	Voice Loudness	Voice Duration	Min. died/ Recovered	Comments
119	1.0	5.0	M	53.5	24	--	--	--	--	--	--	R 102	
	1.0	5.0	M	42.5	17	--	--	--	--	--	--	D 110	I
978	1.0	5.0	M	52.0	--	--	--	--	--	--	--	R 0	
	1.0	5.0	F	38.0	--	--	--	--	--	--	--	R 0	
	1.0	5.0	F	35.0	--	--	--	--	--	--	--	R 0	
	1.0	5.0	M	48.0	--	--	--	--	--	--	--	R 0	

TABLE II

EFFECTS OF CHEMICALS UPON HOUSE SPARROWS

Code no. of Chemical	C.C.	% Soln.	Sex	(gms.) Wt.	Min. 1st Effect	Min. 1st Convul.	Length of Convul.	Convulsion Violence	Convulsion Duration	Voice Loudness	Voice Duration	Min. died/ Recovered	Comments
1861	0.1	.005	F	25.5	--	--	--	--	--	--	--	R 0	LE
	0.1	.005	F	27.5	--	--	--	--	--	--	--	R 0	LE
	0.2	.005	M	28.5	--	--	--	--	--	--	--	R 0	
	0.2	.005	M	26.0	3	27	24-	II	B	III	B	D 51/	FD1
	0.3	.005	F	28.0	7	--	--	--	--	III	C	D 50	IM
	0.3	.005	M	28.5	5	--	--	--	--	III	C	D 35	IM
	0.5	.005	M	30.2	4	17	1	I	C	III	C	D 18	
	0.5	.005	F	25.0	7	19	16	I	A	I	B	D 35	
	0.1	.01	M	20.5	9	23	1	I	C	I	B	D 24	
	0.1	.01	F	25.0	8	70	57-	II	B	II	B	R 127/	
	.15	.01	F	26.0	11	13	12	I	A	I	A	D 25	
	.15	.01	F	25.0	10	30	20	I	B	II	B	D 50	
	0.2	.01	F	25.0	13	30	1	I	C	I	C	D 31	
	0.2	.01	F	23.5	11	21	25	I	A	I	A	D 46	
	0.5	.01	M	25.5	5	9	2	I	C	I	C	D 11	
	0.5	.01	F	28.5	4	9	1	I	C	I	C	D 10	
1070	0.1	0.1	F	26.5	14	64	60-	III	B	III	C	R 124/	FD1
	0.1	0.1	F	26.5	14	64	58-	III	B	III	C	R 122/	FD2
	.15	0.1	F	24.0	9	--	--	--	--	--	--	D 18	
	.15	0.1	M	26.5	6	--	--	--	--	--	--	D 36	
	0.2	0.1	M	24.0	15	--	--	--	--	III	C	D 20	
	0.2	0.1	F	21.5	10	17	13	I	B	I	B	D 30	
	0.3	0.1	M	25.5	11	25	8	I	B	I	A	D 33	
	0.3	0.1	F	22.5	7	32	30	III	B	II	B	D 64	
	0.5	0.1	F	27.5	10	36	4	I	C	II	B	D 40	
	0.5	0.1	M	25.5	7	22	1	II	B	III	C	D 23	
1607	0.1	0.1	F	25.0	23	--	--	--	--	--	--	R 65/	
	0.1	0.1	F	23.0	21	--	--	--	--	--	--	R 55/	
	0.2	0.1	F	27.5	29	37	148-	III	C	**	--	R 185/	
	0.2	0.1	F	25.0	19	29	18	III	A	III	C	D 47	

TABLE II (Continued)

Code no. of Chemical	C.C.	% Soln.	Sex	Wt. (gms.)	Min. 1st Effect	Min. 1st Convul.	Length of Convul.	Convulsion Violence	Convulsion Duration	Voice Loudness	Voice Duration	Min. died/ Recovered	Comments
1607	.25	0.1	F	24.5	17	22	6	I	B	I	B	D 28	
	.25	0.1	M	26.5	23	--	--	--	--	--	--	R 185+	
	0.3	0.1	F	27.3	22	47	1	I	C	I	B	D 48	
	0.3	0.1	F	28.0	11	17	5	I	B	I	B	D 22	
	0.5	0.1	F	25.5	9	23	5	III	A	III	C	D 28	
	0.5	0.1	F	23.0	8	19	4	III	A	III	C	D 23	
1931	0.1	5.0	F	22.5	5	12	60	III	A	III	C	R 67+	
	0.2	5.0	F	26.0	--	--	--	--	--	--	--	R 0	LE
	0.2	5.0	F	28.0	--	--	--	--	--	--	--	R 0	LE
	0.3	5.0	F	27.0	2	--	--	--	--	III	C	D 3	
	0.3	5.0	M	26.0	2	4	24	I	A	III	B	D 28	
	0.3	5.0	M	29.5	2	5	3	I	B	III	B	D 8	
	0.4	5.0	M	25.0	1	--	--	--	--	III	C	D 2	
	0.4	5.0	M	24.5	3	--	--	--	--	--	--	D 7	
	0.5	5.0	M	25.5	4	4	--	--	--	--	--	D 4	
B7	0.1	5.0	M	25.5	18	33	16-	III	C	--	--	D 19	IM
	0.1	5.0	F	26.5	114	114	16-	III	C	--	--	R 130+	DR
	0.1	5.0	F	26.5	94	99	2	I	B	--	--	D 101	DR
	0.2	5.0	M	27.5	8	28	5	III	C	--	--	D 33	
	0.2	5.0	M	23.0	7	37	15	III	B	--	--	D 52	
	0.5	5.0	M	30.0	25	31	9	I	B	III	C	D 40	
	0.5	5.0	F	24.0	20	20	30-	III	B	--	--	D 50	IM
	0.7	5.0	F	23.0	23	28	4	II	C	--	--	D 32	
	0.7	5.0	M	29.0	24	63	22	I	B	I	C	D 85	
1927	0.1	5.0	M	29.0	39	44	14	I	B	I	B	D 58	
	0.1	5.0	F	25.0	2	--	--	--	--	III	C	D 25	I
	0.2	5.0	M	29.5	2	87	7	II	B	III	C	D 94	IM
	0.2	5.0	F	25.5	3	--	--	--	--	--	--	D 80	IM
	0.5	5.0	M	28.5	4	--	--	--	--	--	--	D 80	I
	0.5	5.0	F	26.5	2	--	--	--	--	III	A	D 94	I

TABLE II (Continued)

Code no. of Chemical	C.C.	% Soln.	Sex	(gms.) Wt.	Min. 1st Effect	Min. 1st Convul.	Length of Convul.	Convulsion Violence	Convulsion Duration	Voice Loudness	Voice Duration	Min. died/ Recovered	Comments
1927	0.5	5.0	F	26.0	6	--	--	--	--	--	--	R 110/	I
	0.5	5.0	M	28.5	4	--	--	--	--	III	B	D 112	I
	1.0	5.0	M	28.5	2	--	--	--	--	--	--	D 16	I
	1.0	5.0	F	25.0	1	--	--	--	--	--	--	D 8	I
1941	0.1	5.0	M	24.5	--	--	--	--	--	--	--	R 0	NE
	0.5	5.0	F	22.5	--	--	--	--	--	--	--	R 0	NE
	0.5	5.0	F	24.5	30	30	1	III	C	--	--	D 31	
	0.7	5.0	F	26.0	10	15	12	III	B	III	B	D 27	
	0.7	5.0	F	26.5	12	--	--	--	--	--	--	D 24	I
888	0.3	1.0	M	25.5	60	--	--	--	--	--	--	D 81	DR, I
	0.3	1.0	F	28.5	--	--	--	--	--	--	--	D 200/	FD1, NE
	0.5	1.0	F	27.0	32	--	--	--	--	--	--	D 60/	DR
	0.5	1.0	F	27.5	58	--	--	--	--	--	--	D 83	I, DR
	0.5	1.0	M	24.5	53	--	--	--	--	--	--	D 79	I, DR
	1.0	1.0	F	27.0	--	--	--	--	--	--	--	D 25/	FD1, DR
247	0.3	0.1	F	26.5	--	--	--	--	--	--	--	R 0	NE
	0.3	0.1	M	24.0	--	--	--	--	--	--	--	R 0	NE
	0.5	0.1	M	25.0	1	--	--	--	--	--	--	D 2	
	0.5	0.1	M	27.0	--	--	--	--	--	--	--	R 0	NE
	0.5	0.1	F	25.0	4	--	--	--	--	--	--	R 36	I
	1.0	0.1	M	27.5	1	--	--	--	--	--	--	D 2	
	0.1	1.0	F	29.0	1	--	--	--	--	--	--	R 48	
	0.1	2.5	F	27.0	1	--	--	--	--	--	--	D 3	
	0.5	2.5	F	27.5	1	--	--	--	--	--	--	D 1	
111	0.1	5.0	F	24.0	3	--	--	--	--	--	--	R 25/	
	0.1	5.0	F	27.0	--	--	--	--	--	--	--	R 0	NE
	0.2	5.0	F	25.5	--	--	--	--	--	--	--	R 0	NE, FD2
	0.2	5.0	M	25.0	5	--	--	--	--	--	--	R 90	I
	.25	5.0	F	27.0	--	--	--	--	--	--	--	R 0	NE
	.25	5.0	F	26.0	1	--	--	--	--	--	--	R 63/	I
	0.3	5.0	F	26.5	1	--	--	--	--	III	C	D 4	

TABLE II (Continued)

Code no. of Chemical	C.C.	% Soln.	Sex	(gms.) Wt.	Min. 1st Effect	Min 1st Convul.	Length of Convul.	Convulsion Violence	Convulsion Duration	Voice Loudness	Voice Duration	Min. died/ Recovered	Comments
111	0.5	5.0	F	21.5	1	--	--	--	--	III	A	D 3	
1885	0.3	5.0	F	24.5	8	--	--	--	--	--	--	R 95	I
	0.3	5.0	F	22.5	2	--	--	--	--	III	C	D 88/	I, FD1
	0.5	5.0	F	23.0	2	--	--	--	--	--	--	D 103/	I, FD1
	0.5	5.0	F	29.0	1	--	--	--	--	--	--	R 100/	I
119	0.5	5.0	F	23.0	2	4	1	I	C	--	--	D 19	
	0.5	5.0	F	25.5	3	--	--	--	--	--	--	R 65	FD1
	0.7	5.0	F	25.0	3	--	--	--	--	--	--	R 53/	FD4
	0.7	5.0	F	23.0	4	--	--	--	--	--	--	D 10	
112	0.5	5.0	F	23.5	2	--	--	--	--	--	--	R 6	FD1
	0.5	5.0	F	27.0	1	--	--	--	--	--	--	D 1	
	0.7	5.0	M	24.0	15	--	--	--	--	--	--	D 23	
	0.7	5.0	F	23.0	--	--	--	--	--	--	--	R 0	NE
978	1.0	5.0	M	24.0	--	--	--	--	--	--	--	R 0	NE
	1.0	5.0	M	25.5	--	--	--	--	--	--	--	R 0	NE

TABLE III

RATINGS AND EFFECTIVE RANGES OF THE CHEMICALS AS CONDITIONING REPELLENTS

Code no. of Chemical	Bird Species	Effective Dosage C.C.	%soln.	Mg/Kg	Convulsions Violence	Convulsions Duration	Voice Loudness	Voice Duration	Rating	Comments
1861	Cowbird	0.1-0.5	0.1	2-11	I	A	I	A	I	
1070	"	0.3-1.0	0.1	7-22	I	A	I	B	I	
1607	"	0.3-0.5	0.1	7-11	I	A	I	B	I	
1931	"	0.1-0.4	5.0	110-440	I	A	0	0	II	
B7	"	0.5-1.0	5.0	550-1100	I	A	II*	C*	II	*NVO
1927	"	0.1-0.3	5.0	110-330	I*	A*	I*	B*	III	*NCO,*NVU
111	"	0.5-1.0	5.0	550-1100	0	0	—	—	IV	I
1941	"	0.8-1.0/	5.0	900-1100	III*	C*	II*	C*	IV	*NCU,*NVU
888	"	0.9-1.0/	1.0	200-220/	III	C	0	—	III	DR
247	"	0.1-0.25	2.5	55-140	III*	C*	III*	B*	IV	*NCU,*NVU
1885	"	0.6-1.0	5.0	670-1100	0	—	0	—	IV	
112	"	1.0-1.0/	5.0	1100-1100/	III*	C*	0	—	IV	*NCU
119	"	1.0-1.0/	5.0	1100-1100	0	—	0	—	IV	
978	"	— —	5.0	— —	0	—	0	—	V	NE
1861	House Sparrow	0.05-0.5	0.01	0.2-2	I	B	I	B	I	
1070	"	0.2-0.5	0.1	8-20	II	B	II	B	II	
1607	"	0.2-0.5	0.1	8-20	II	B	III	C	II	
1931	"	0.1-0.4	5.0	200-800	II	B	III*	C*	III	*NCO,*NVO
B7	"	0.1-1.0	5.0	200-1000	II	B	III*	B*	II	*NVU
1927	"	0.1-0.5	5.0	200-1000	II*	B*	III*	B*	IV	*NCO,*NVO,I
111	"	0.3-0.5	5.0	600-1000	0	—	III	C	IV	
1941	"	0.5-0.8	5.0	1000-1500	III*	C*	III*	B*	III	*NCO,*NVU
888	"	0.3-1.0	1.0	200-400	0	—	0	—	IV	DR, IM
247	"	0.1-0.5	1.0	100-200	0	—	0	—	IV	
1885	"	0.5-1.0	5.0	1000-2000	0	—	0	—	IV	I
112	"	0.7-1.0	5.0	1350-2000	0	—	0	—	IV	
119	"	0.7-1.0	5.0	1350-2000	0	—	0	—	IV	
978	"	— —	5.0	— —	0	—	0	—	V	NE

VITA

Charles Aiden North

Candidate for the Degree of

Master of Science

Thesis: EVALUATION OF SELECTED CHEMICALS AS CONDITIONING REPELLENTS FOR BROWN-HEADED COWBIRDS AND HOUSE SPARROWS

Major Field: Zoology

Biographical:

Personal Data: Born at Kingston, Rhode Island, August 24, 1932

Education: Attended University of Missouri, 1950-1951; State University of Iowa, 1951-1953; University of Missouri, 1953-1954, received Bachelor of Arts degree with a major in Wildlife Management; attended Oklahoma State University, 1958-1960; Oregon State University, 1960-1961; attended Oklahoma State University, 1961-1962, completed requirements for a Master of Science degree with a major in Zoology in May, 1963.

Professional experience: Served two years (1955-1957) in the United States Army; worked summers of 1951, 1953, 1954, and 1957 for the United States Forest Service in Montana and Idaho; employed by Fish and Wildlife Service in Sport Fisheries during summers of 1958, 1959, and 1960 in Wyoming, Colorado, and Arizona; research assistant, Research Foundation, Oklahoma State University, 1961-1962.

Organizations: Wildlife Society