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THE EFFECTS OF ORNITROL ON WILD POPULATIONS OF RED-WINGED BLACKBIRDS AND GRACKLES

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For the past three years the New Jersey Department of Agriculture, in cooperation with the New Jersey Agricultural Experiment Station, has conducted field evaluations on the effects of reproductive suppressants on wild populations of red-winged blackbirds. These studies have been performed in conjunction with the North East 49 (a Federally sponsored regional project which presently has nine states in the North East and Ohio cooperating to develop means to combat bird damage to agricultural crops) regional project on control of bird depredations.

Field evaluations in 1968 and 1969 centered around the effects of TEM (tri-ethylene melamine) on the reproductive rates of red-winged blackbirds. At the close of the 1969 season further field testing of the chemical was discontinued because of the material's apparent lack of effectiveness as a reproductive inhibitor.

In 1970 the field evaluations were conducted to determine the effects of Orni-trol (20, 25-diazocholesterol dihydrochloride, supplied by G. D. Searle and Company, Chicago, Illinois) on the reproductive rates of red-winged blackbirds. A small colony of common grackles was also studied during this same investigation.

Study Area

Four separate study sites were located on the salt water marshes near Tuckerton, Ocean County, New Jersey. Two of these sites were located along Great Bay Boulevard. This particular road extends more than five miles from Tuckerton on a southeasterly direction over the salt water marshes. The road, densely bordered by vigorous growth of marsh-elder, groundsel-tree and bayberry, provides excellent nesting habitat for the redwing. The area most distant to the mainland was chosen for the 0.1 percent treatment area while the site nearest to the mainland was selected for a control area (Wood's Island). These two study sites were approximately .8 of a mile apart. The remaining two areas were situated approximately one mile northeast of the Boulevard and were separated by a distance of approximately one mile. A small one-acre portion of land on Story Island was selected for another control area while a portion of land located on a point between Little Sheepshead Creek and Big Sheepshead Creek was chosen for the 0.05 per cent treatment area.

Material and Dosage

The Ornitrol was offered to the birds at two different dosage levels, 0.1 per cent and 0.05 per cent, by weight, on cracked corn. The 0.1 per cent bait, prepared by Searle and Company, contained ingredients to help prevent leaching while the bait was exposed. The 0.05 per cent Searle mix, with similar ingredients, arrived too late for early field use. Consequently, a mix, formulated in the New Jersey Agricultural Experiment Station laboratory, was prepared by adding a solution of Ornitrol and water to the cracked corn as it was being agitated in a cement mixer.

Both the treated and the untreated cracked corn was presented to the birds on 2' by 4' elevated feeding platforms. These feeders, approximately 4 feet above the ground, were located throughout both the treated and the control areas. The distances between the various feeders in the treated and untreated areas varied from 260 feet to 725 feet, depending on the density of the vegetation. The number of feeders in the treated and untreated areas also varied according to the vegetation and size of the area; five feeders being erected in the 0.1 per cent treatment area; two feeders in the 0.05 per cent treatment area; three feeders on Story Island (control) and five feeders on Wood's Island (control).

Methods

Following a three-week prebaiting period, the treated bait was offered on April 24. Each feeder was replenished on Monday, Wednesday, and Friday with a two-pound supply of bait. The supplying of cracked corn to the feeders in the control areas was conducted on an identical schedule. A change in the 0.05 per cent bait occurred on June 15 when the New Jersey Agricultural Experiment Station mix was replaced by the Searle mix.

Acceptance of the treated bait by both redwings and grackles was satisfactory until June 10. Prior to that time most of the feeders were empty at the time of replenishment. However, after June 10 the acceptance of both the treated and the untreated corn was markedly reduced. For the past three years the change in active feeding on the platforms has occurred on either June 9 or June 10. Baiting at all feeders was discontinued after July 6, 1970.

Nesting surveys were started on May 11, 1970 and were continued until August 5, 1970. Every known active nest in both the treated and the control areas was inspected on Monday, Wednesday and Friday throughout the nesting season. Each nest was marked by a plastic tape and an aluminum tag which aided in identifying and relocating the nest on return visits. Each nest location also was placed on a map which served as an additional aid for proper maintenance of nest records. Nests along Great Bay Boulevard in both the treated and the control areas were labeled in accordance with the sections in which they were located. Electric poles numbered consecutively, have been erected along the entire length of the Boulevard. The various section numbers coincide with the electric pole numbers. Nest numbers in the 0.1 per cent treatment area extend from 49-1 to 29-1 while nest numbers in the control area (Wood's Island) extend from 97-1 to 64-8.

Nest contents were tabulated as to numbers of whole eggs, broken eggs and young present. For red-winged blackbirds, 13 days were considered as the incubation

period. All eggs broken or lost during the initial 13-day observation period were classified as either being broken or lost; no attempt was made to judge these eggs as being affected by the Ornitrol treatment. Those eggs which remained in the nests for more than the 13-day observation period were classified as unhatched. Eggs in the grackle nests were classified in the same manner, the only exception being that the observation period for judging incubation was lengthened to 14 days.

Nest contents in nests which contained young at the time of discovery were not used in the hatching success analyses because the total nest content at the completion of the egg laying period was not truly known. Consequently, data from 12 nests were omitted from the analyses. Three of these nests were in the 0.1 per cent treatment area, while three nests were in the 0.05 per cent treatment area, five nests on Wood's Island (control) and one nest on Story Island (control). During the course of the survey a total of 292 nests (272 red-winged blackbird and 20 grackle) was kept under close surveillance. The nestlings from the study areas were banded with Fish and Wildlife Service bands and released.

Although the original intent of the field evaluations was to study the reproductive inhibiting effects of Ornitrol on red-winged blackbirds, data was also collected from a small colony of grackles which nested in the 0.1 per cent treatment area. Unfortunately, no control group was available because no other grackle colony was known to exist within a close distance of the study areas. However, nesting success of grackles nesting in the same area was collected in the summer of 1969. The 1969 surveys and data collection were the same as those of 1970. Consequently, the 1969 grackle nesting information should serve well for comparison purposes.

RESULTS

0.1 Per Cent Treatment Area

This particular area contained nesting populations of red-winged blackbirds and grackles. The hatching successes of these two species are quite dissimilar and should be viewed separately.

The grackle colony was located on the outer limits of the 0.1 per cent treatment area, approximately 1,300 feet from the nearest feeder. Of the 20 nests observed in this area, 11 nests produced a total of 34 eggs and of these eggs only one young bird hatched (2.9 per cent hatching success). Nesting surveys conducted in this same location during the 1969 TEM trial disclosed a total of 19 nests, of which 14 nests produced 65 eggs, from which 55 young birds hatched (84.6 per cent hatching success).

The red-winged blackbird population was distributed throughout the entire treatment area. The hatching success of the birds in this area varied in relation to the distances from the feeders. The overall hatching success of the red-winged blackbirds in this area was 42.9 per cent. However, it was evident that some of the birds on territories more distant from the feeders were not using the treated bait. With this in mind the treatment data was divided into two groups; namely, the data from the areas where birds were more likely to be under the influence of the Ornitrol (nests 49-1 to 37-5) and the data from the area where the birds were less likely to be under the influence of the Ornitrol (nests 36-1 to 29-1). The former area which

contained all the feeders had a hatching success of 29.7 per cent. The latter area which did not have any feeders had a hatching success of 63.2 per cent.

0.05 Per Cent Treatment Area

Hatching success in this area was 28.4 per cent. This section of land was limited in size and the two feeders erected in this area were easily accessible to all birds.

Story Island (Control)

Hatching success in this area was 77.5 per cent. Although limited in size this section of land had a high population of nesting birds. The three feeders on the Island were well within the range of all the nesting birds.

Wood's Island (Control)

This portion of land, quite similar to the 0.1 per cent treatment area, had a hatching success of 67.8 per cent.

DISCUSSION

Certainly today's environmental problems compel all scientists in the bird control field to fully analyze the effects of each new chemical on our environment. This study was made to evaluate the effects of Ornitrol on the reproductive rates of red-winged blackbirds and grackles. Other studies will be necessary if this compound is to be used for a population control chemical. Our first year's study of this compound is highly encouraging. The Ornitrol, fed to wild populations of red-winged blackbirds and grackles at both 0.05 per cent and 0.1 percent dosage levels, was successful in reducing reproductive rates.

The acceptance of the treated cracked corn on elevated feeding platforms was encouraging. The noticeable disinterest in the cracked corn, treated or otherwise, after June 10 was of great interest. This date also coincides rather closely with the egg hatching date. The change in food preferences might be brought about by the emergence of young birds. However, this does not explain why birds without young also neglected the corn. The reduced acceptance of the bait might be meaningful when there are second nesting attempts.

The limited distances covered by the red-winged blackbird while searching for food during the nesting season will require that feeding stations be established close to the nesting areas. The birds move about rather freely before the establishment of territories. However, after this time the movement is severely restricted. It was quite evident that the grackles range over a larger area of land. Baiting sites for this species can be established at greater distances from the nesting areas.

The effects of the Ornitrol on the shell thickness was only partially studied. Although many of the grackle eggs were thin shelled, no collections were made.

Some red-winged blackbird eggs also exhibited this same thin shell characteristic, but not on such a large scale. However, shell collections were made from many of the red-winged blackbird nests (59) at the end of the season. Unfortunately, analyses of the shell thickness of these eggs are not available at the time of this report.

Data from the 0.1 per cent treatment area (nests 49-1 to 37-5) indicated that a large percentage (29.1 per cent) of the eggs were lost. No explanation can be given for this abnormal egg loss except that the eggs might have been crushed or removed by the nesting birds. Certainly eggs which are lost or broken contribute to the lowering of the reproductive rate as well as those eggs which are infertile or unhatched.

At least two problems are encountered with a chemical suppressant program. The first problem is that of practicality. Can this material be used in all nesting areas in North America? And who will distribute it? These two questions need to be answered. The second problem is that of environmental contamination. What about the other species of animals and birds? What effect will these chemical suppressants have on the nontarget organisms? Initial studies show that a reproductive suppressant is available. Now we must seek answers to the other questions which have been raised.

ORNITROL EVALUATION -- 1970 -- RED-WINGED BLACKBIRDS
TUCKERTON, NEW JERSEY

LOCATION	EGGS LAID	EGGS LOST/[1]	EGGS BROKEN/[2]	EGGS UNHATCHED/[3]	EGGS HATCHED
TREATED					
TREATED 0.1%					
Nest Nos. 49-1 to 37-5	158	46(29.1%)	7(4.4%)	59(37.3%)	47(29.7%)
	95	10(10.5%)	0(0.0%)	24(25.3%)	60(63.2%)
Nest Nos. 36-1 to 29-1*	253	56(22.1%)	7(2.8%)	83(32.9%)	107(42.9%)
TREATED 0.05%	67	7(10.4%)	3(4.5%)	38(56.7%)	19(28.4%)
UNTREATED					
STORY ISLAND	80	6(7.5%)	0(0.0%)	12(15.0%)	62(77.5%)
WOOD'S ISLAND	236	35(14.8%)	2(0.8%)	39(16.5%)	160(67.8%)

1 Eggs lost--eggs which disappeared during a 13-day observation period which followed first observation of eggs in the nest
2 Eggs-broken--eggs which were broken during the same 13-day observation period
3 Eggs unhatched--eggs which did not hatch after the 13-day observation period
Figures in parenthesis ( ) are percentages of eggs laid

* Nests No. 36-1 to 29-1 were believed to be under less influence of the Ornitrol

TEM EVALUATION–1969–GRACKLES
AND
ORNITROL EVALUATION–1970–GRACKLES
TUCKERTON, NEW JERSEY

YEAR	MATERIAL	EGGS LAID	EGGS LOST/[1]	EGGS BROKEN/[2]	EGGS UNHATCHED/[3]	EGGS HATCHED
1969	TEM	65	6(9.2%)	0(0.0%)	4(6.2%)	55(84.6%)
1970	ORNITROL	34	18(52.9%)	6(17.6%)	9(26.5%)	1(2.9%)

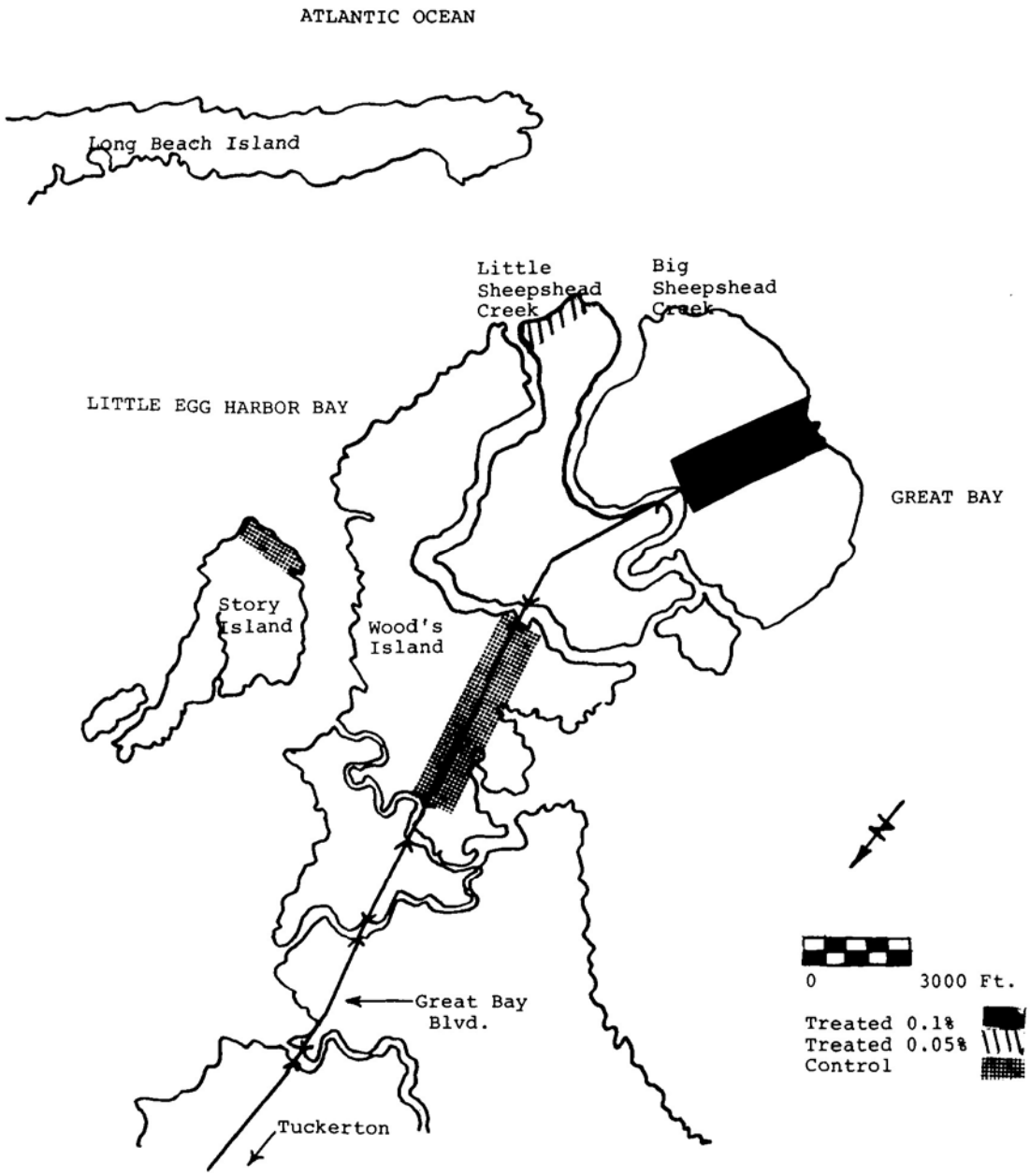
1 Eggs Lost--eggs which disappeared during a 14-day observation period which followed first observation of eggs in the nest

2 Eggs Broken--eggs which were broken during the same14-day observation period

3 Eggs Unhatched--those eggs which did not hatch after the same 14-day observation period Figures in parenthesis ( ) Figures in parenthesis ( ) are percentages of eggs laid

1970 ORNITROL EVALUATION-RED-WINGED BLACKBIRDS

TUCKERTON, NEW JERSEY



DISCUSSION OF M. R. WOULFE AND ROBERT FRINGER

R. SMITH: Many of our pigeon populations in the Midwest are urban populations, but they feed in the farming areas surrounding the cities. If they have Ornitrol in their systems and they feed in the outside areas where they are subject to predation by raptors, what effect could this have on the raptors? Certainly in the case with Bob where he is working in marsh areas, where red-winged blackbirds are being treated, there are raptors available to feed on them. I am interested in knowing if Searle is going to do any work in this area to find out if these are a secondary poisoning hazard in raptors.

M. R. WOULFE: The level we found in livers was 3 ppm. I don't know what the weight of a pigeon's liver is, but I would think that this would constitute a very, very minute quantity of active compound. Early work done by Elder involved the use of varying doses for varying time, including up to three hundred milligrams of material in one single dose, which would have been very nice, if effective. Unfortunately, it wasn't. We have found by experience that you have to feed this material for a period of ten days to build it up to a plateau effect where it is effective. Lesser periods of time have shown it to be appreciably less effective as to the duration of effect. With a level of three parts per million in a pigeon liver, the total amount of compound which would be ingested by any given raptor during the ten day period would be very minute, I'd think.

R. SCHWAB: A question for Dr. Woulfe. You mentioned that Ornitrol had certain effects on the avian adrenal and these might in turn influence hypophyseal function. Now, rather a multiple question. First of all, what are these effects on the avian adrenal, and are these a direct result of circulating levels of this compound or are they more of a secondary nature resulting from a stress situation?

M. R. WOULFE: One of our endocrinologists has postulated this. We know it has an effect on the adrenals. They have done some measurements of adrenal action on the pituitary, but what this was I'm not sure, and I can't really answer the question very clearly. When Elder fed this material to male pigeons, he found a duration of inhibition of sexual activity for around six weeks. We do not know if this is a direct effect on testicular tissue or whether it is an effect through the hormonal system generally.

R. SCHWAB: Are you now working on mode of action of this compound?

M. R. WOULFE: Not any further at this point. If we find that the material does have application in other species, and if we find acceptance of Ornitrol on a large scale for pigeon control and it becomes worthwhile economically, then we would probably go into more details in research.

T. PETERLE: Recently there has been some suggestion that part of the effect of this compound on pigeons in captivity has been the result of reducing food intake rather than the effect of the compound directly.

M. R. WOULFE: Yes, this suggestion was made, and the work in Amhurst indicated that there was some reduction in the total intake of food. Elder noticed this also; and when we evaluated the possibility of a commercial product, one of the first things our director of research said was, "Well, have you tried this thing out on a free-living population on a large scale?" We said, "No." So, he said we had better go and do that--which we did in Bangor, Maine. The material was made available to a free-living population. We have found that enough of the material is ingested to produce inhibition of reproduction for perhaps six months. But you are quite correct in saying that there is a reduction in total feed intake in pigeons.

M. DYER: There is some evidence that this material is quite toxic; can you give us an indication of its toxicity?

M. R. WOULFE: Well, I wouldn't say quite toxic; it depends on what you put it into. The LD-50 in rats is somewhere around 450, that is, intragastrically. Parenterally it is around 250 mg/kg, and dermally it is functionally nontoxic. We did work on this problem of absorption in rabbits, in abraded and non-abraded skin, with up to six grams per animal for a period of three weeks. Dermally, there is very little problem. On long-term ingestion, you begin to run into problems on account of the build-up situation. Work done in Germany indicates that somewhere in the region of around 113 milligrams given to birds (pigeons) over about six weeks does begin to produce toxicity, and levels above that definitely produce toxicity. Now these fellows who have fed the material to free-flying pigeon populations in Urbana and to caged sparrows in Plainview, Texas, for six weeks or longer, have obviously been just underneath a toxic level with this material, to the point of possibly causing atrophy of the gonads. If they had continued on further, whether the liver would have been affected or not is a question. It may well be that in the six weeks we had reached the threshold of the ability of the liver to hold the material and it was going in one side and out the other. This is possible.

D. POWER: Does Searle or any other agency to your knowledge intend to test the possible accumulative effects of this compound on raptors, to get back to the first question?

M. R. WOULFE: Well, Searle wouldn't be able to. It is beyond their capability. I imagine you could get some raptors and feed the material to them directly and measure the intake; you could spike liver and other tissue, and feed that to them at a given level for a given time. But we don't exactly know what we are feeding or what the raptor is getting when he is feeding on Ornitrol baited pigeons or blackbirds. We don't really know what the thing has been metabolized into in the blackbird or in the pigeon or if it is the same in both birds. What we need to do, I think, is to feed the material to pigeons in captivity and then subsequently sacrifice the pigeons and feed them to raptors. Okay, what are we going to measure in the raptors?

D. POWER: Is there reproductive failure?

M. R. WOULFE: In captivity?

D. POWER: Well, what about an anatomical investigation? Perhaps the development of gonads, follicles in gonads or calcium metabolism. Any of these related functions?

M. R. WOULFE: Yes, you might be able to do this. The histopathology done on pigeons which had been fed for ten days by Murton's group indicated very little change in any of the organs that could be measured under a microscope or to some degree biochemically.

R. SCHWAB: A comment corresponding to the comment made by Dr. Peterle; in California, we have found that feeding starlings on a bare maintenance or perhaps slightly below this diet will cause an appreciable delay in the onset of the gonadal cycle. And it could well be, I'm guessing of course, that some of the effects that you observe are the result of a lower dietary intake than a direct effect of the compound. Is this at all consistent with what you have observed?

M. R. WOULFE: Well, I think here again we have to go to free-flying populations. Inasmuch as all this work was done in and around feedmills and railroad yards and work was done in Florida in the month of April when natural feed was becoming more acceptable and available, we still got an effect. There is a possibility of a physiological action on the part of the drug which might diminish appetite.

R. SCHWAB: Now this was my point. Was the intake of food drastically down in all foods or just with the treated food?

M. R. WOULFE: Well, we don't really know because we didn't catch any of the free-flying population to see what else they had in their crops.

R. FRINGER: Perhaps Dr. Granett can answer that?

P. GRANETT: Well, I wouldn't have anything on pigeons. We did a little study on redwings and grackles in cages. What we were trying to do was compare the .1% of Searle to .05% Rutgers mix to see what they were feeding on and how much they were feeding on untreated, cracked corn. We found that there was a decrease in feeding as far as the .05% Searle mix and .1% Searle mix compared to the untreated, a significant difference, but there was no significant difference between our own mix of .05% and untreated, so that here we felt perhaps there was some addition that Searle was putting into the mix that we were not. It may be the sticker that was having an effect. We have yet to test this. There was, of course, a difference that we noticed in the results in the field in that the .05% was having the same effect or better of our treatment than the .1% in the field. This may have something to do with the amount of feed they were taking in and its effect on the birds. The effect was, of course, on the redwings, so that there may be a decrease in feeding both in grackles and in redwings where they are accepting it off a platform.

M. R. WOULFE: Let me comment here. I'm sure there is an effect brought on by our coating process. Part of the problem is, of course, that we can put the material onto bait, whatever kind it is, by a direct water solubility process. There we bump into two problems right away. One is tremendous difficulty in developing assaying

methods which are acceptable by the federal government. The other one is that we get material washed out under heavy rain conditions. If it is water soluble when you put it on, in the rain, it washes out again!

DELEGATE: I wanted to ask Bob if he censused the other seed eating species in the test areas, and if any of them were utilizing the feeding platforms.

R. FRINGER: The only seed eating species that we had during our baiting season were some song sparrows. I did not check their nesting success.

R. SMITH: Did you see any on the feeding platforms?

R. FRINGER: Yes, I saw perhaps five song sparrows throughout the course of the summer. Earlier in the season we get migrating populations of juncos, grosbeaks, and so on.

R. SMITH: The one bait available was available only to song sparrows?

R. FRINGER: Yes.

J. SEUBERT: Dr. Woulfe, can you identify the breakdown products of Ornitrol?

M. R. WOULFE: We're doing that research now.

DR. GILTZ: One thing that comes to mind is the difference between redwing and pigeon breeding. One difference is that the pigeon will breed in any season, especially in Florida, where with the redwing you only have to get there early enough in the spring. Between the two of you, can you come up with the date in New Jersey and the date in Florida for the redwing that you think would be the right time to apply Ornitrol?

M. R. WOULFE: I don't know about the redwing in Florida, but I do know that for pigeons you should put the material out by the first of February. We have done no work with redwings in Florida.

M GILTZ: The big difference is that the redwing will lay three to four eggs and the pigeons probably fewer. Do they have to copulate between each egg?

R. FRINGER: I've questioned this on the redwing, on the behavior of the redwing. How soon before the first egg is laid must copulation occur, and does it have to occur for each egg? I don't know. I haven't seen anything in the literature on this.

J. KERLAN: If you read Robert Paine's report, who is now connected with the University of Michigan, you'll find that information available. He studies red-winged and tricolored blackbirds in California.

T. STOCKDALE: This is in response to your question, Dick. In northern Ohio, on Ornitrol platforms, we observed only house sparrows utilizing the bait with one exception; we had one robin visit a platform during 24 total hours of observation spread out through the entire day on two platforms. Now, Bob, two quick questions. Your control area and your baited area were separated about a mile, you indicated.

R. FRINGER: Yes. Eight-tenths I think was the shortest.

T. STOCKDALE: Do you feel that this is sufficient separation of the two areas to make the comment that redwings remain fairly close to the nesting territory during the nesting period? Was this accompanied by any color marking or anything?

R. FRINGER: Yes, we did quite a bit of color marking. I think this year we marked 134 birds throughout the various areas. To say eight-tenths of a mile is sufficient would be wrong. It clearly depends on the area. We found at Story Island that the birds would go to that little portion of land which we called Sheep's Head. Between Sheep's Head and Story Island was a small area of brush and the birds seemed to use that brush. Between our control and our treated area on Great Bay Boulevard, there was quite an expanse of barren land, no vegetation. Consequently, there was little movement there, but just to say eight-tenths of a mile would be incorrect.

T. STOCKDALE: What was the date the first nest building activity was observed in your study area as compared to the April 24th day of introduction of the Ornitrol material? What was the stage of reproduction at the time you introduced the material?

R. FRINGER: We waited until the birds were on territory before we started putting the material out because these birds seemed to group on Great Bay Boulevard before they would hit any of the other areas. We didn't want to get any of the birds from Story Island. We started treating on April 24, and I think our first nest was right around May 10.

T. STOCKDALE: Was your 1967, 77% hatching success fairly typical? Has this been the experience in past years? The reason I ask this question is that our experience in the Lake Erie Marshes over the past two years would indicate that in untreated areas, nesting success was between 50 and 55%. I'll explain that our Ornitrol work started very late this year. Nesting was well along before we had the material in the marsh.

R. FRINGER: I would say that our nesting success in New Jersey is considerably higher. It averages in the 70's. It varies with the area. One area we used in a project several years ago had a severe problem with raccoons, and I think our nesting success in that area was around 50%. It's run up 50, 66, 72, 76, and I think in one area 82%. I've read articles where disturbance will cause problems as far as nesting success goes, but I don't see it, at least not in our areas. We were in there three days a week, and to me there was no noticeable effect. Nesting success seemed to be rather high.

T. PETERLE: I would like to make a comment here. There is a paper coming out in the October issue of the Journal of Wildlife Management that states that the coefficient of variation of bait on cracked corn is quite high. In terms of feeding platforms with cracked corn, the bait adhering to the pericarp as opposed to the endosperm is quite different. The amount of bait per feed for cracked corn, depending on the size of the kernels, is extremely variable as opposed to other bait, such as oat groats or wheat. In terms of a day's intake in a bird, I think your variations would be extreme.

R. FRINGER: During the year, Dr. Woulfe came down one day and we looked throughout our feeding platforms. We noticed there was some shelling of corn with the outer layer left on the platform. Now what that means, I don't know. I didn't pay that much attention, as to whether it was dirty corn, rough corn, or what. But there was some shelling. Now whether this would affect the bait I don't know.

DELEGATE: Was there a difference in bait acceptance from grackles to redwings, and was there a different size bait used?

R. FRINGER: I don't know. They used the same feeder and to say that there was a difference between grackles and redwings I couldn't say. It was the same bait, and they were using the same feeder, but the grackles certainly would range further than the redwings. Those grackles would go from one end of the treated area to the other, which was a distance of at least seven-tenths of a mile, and they would be seen throughout all of the five feeders.

DELEGATE: What size bait was used? What size cracked corn?

P. GRANETT: Most of it ranged between four and six mesh. By the way, we ran a little study on the mesh sizes that they might prefer, and we found that they did prefer the smaller sizes; but there was no significant difference between sizes as far as the amount fed. There really were no significant differences between the four, six, eight, and ten mesh that we tried.