

STUDIES ON POSSIBLE EFFECTS OF MIREX BAIT ON THE BOBWHITE QUAIL AND OTHER BIRDS ¹

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The imported fire ant (*Solenopsis saevissima richteri* Forel) has been in the United States since about 1920 and has spread widely in the Southeast. A cooperative control program, federally supported, was begun in 1957. Details of the history of the ant and early control attempts in the United States were reviewed by Allen (1958) and George (1958).

Initially, 2 pounds per acre of heptachlor or dieldrin were used, but heptachlor soon came to be used more commonly. Adverse side effects of this treatment soon became apparent. Baker (1958), Clawson and Baker (1959), Glasgow (1958), Lay (1958), Rosene (1958) and Arant, Hays and Speake (1958) are among those reporting losses of wildlife following treatment with 2 pounds of heptachlor per acre. These losses, plus the presence of residues in agricultural products, stimulated the search for improved methods of ant eradication.

Application rates of heptachlor were scaled down to 1.25 pounds per acre and later to 2 applications of 0.25 pounds spaced six months apart. This modification did not solve the residue problem. Rusoff, *et al.* (1963) found that residues persisted in the flesh of cattle up to 4 months after a 0.25 pound of heptachlor per acre was applied to pasture land. These findings further spurred the search for new and improved eradication and control techniques.

Hays and Arant (1960) described the Kepone-peanut butter bait method of fire ant control. They reported that 4 to 6 pounds of the bait, containing 0.125 per cent of Kepone, gave 100 per cent control of the ant in limited field tests. In the first extensive field tests, however, mortality of bobwhites and meadowlarks was noted (Hill and Baker, 1962). This bait was never used in the eradication program.

Subsequently, Lofgren, Stringer and Bartlett (1962) and Lofgren, Bartlett and Stringer (1963) developed another poisoned bait composed of finely ground corn cobs as the carrier, and a new chemical, GC-1283, later named Mirex, dissolved in oil as the toxicant. Mirex, an analogue of Kepone, is a perchlore condensed ring polycyclic hydrocarbon with the chemical designation: dodecachlorooctahydro-1,3,4-metheno-2H-cyclobuta (cd) pentalene.

¹ A contribution of the Alabama Cooperative Wildlife Research Unit, Auburn University Agricultural Experiment Station, The Alabama Department of Conservation, the U. S. Fish and Wildlife Service and the Wildlife Management Institute, cooperating.

The purpose of the present study was to determine whether the use of Mirex bait is a hazard to certain wildlife species.

The Mirex Bait Formulation.—The formulation (Mirex bait) that was used in the tests reported herein was as follows: corn cob grits, 85.000%; soy bean oil, 14.925% and Mirex, 0.075%. This formulation proved to be cheap, effective and readily handled by existing equipment.

Tests Conducted.—Two separate tests were made of Mirex bait, as follows: (1) a field test made under operational conditions, and (2) controlled field-pen tests, conducted later, using various rates of application of the bait.

The Field Test

The first extensive field test of the effectiveness of Mirex as an ant eradication chemical was made by the Agricultural Research Service, U. S. Department of Agriculture, near Gulfport, Harrison County, Mississippi, in September and October, 1961. Studies were made by Agricultural Research Service personnel to ascertain effects of the Mirex treatment on populations of the imported fire ant. Concurrent studies were made by the author² to detect possible effects of the treatment on some forms of wildlife.

Description of the Area.

The test area, three-fourths mile wide and 2 miles long, was held in small ownerships with numerous gardens and orchards but no extensive cultivated areas. Approximately one-third of the area was in swampy forest, one-fourth in open pine woods, one-fourth in orchards of tung and pecan, and the remainder of the area in building lots, pastures and cultivated land. The major soil types in the area were Norfolk fine sandy loam in the uplands and Plummer fine sandy loam in the swamps.

Treatment

The area was treated by aerial application on September 21 to 23, 1961, using 10 pounds per acre of the Mirex bait formulation previously described. Thus, 0.0075 pounds or about 3.4 grams of Mirex per acre were used. Catch samples indicated a reasonably uniform distribution of the bait.

Methods and Results of Field Study

Preferably, the field test should have been made in the winter when reliable censuses with dogs or trapping, banding, and retrapping would have been a possible means of measuring mortality, or in mid-summer when trapping, banding, and retrapping of broods would have been possible. Since none of these techniques could be reliably applied at the time of the treatment, the following 3 methods were used to detect possible effects of the Mirex treatment: (1) repeated counts of quail broods or coveys that could be dependably relocated on a small part of the treated area, (2) observation of quail kept in pens on treated and untreated soil, and (3) collection of specimens for food habits analysis.

Repeated Counts.—Beginning 2 weeks before the time of treatment, daily observations with help of a bird dog were made to locate broods or coveys. After the first few days these efforts were concentrated in an area of about 200 acres in the central part of the treated area. Daily observations were continued for 2 weeks after the date of treatment.

Four broods or coveys of quail were found that could be reliably relocated. All of these were seen 2 weeks after treatment. No quail or other forms of wildlife were seen that exhibited toxic symptoms nor

² Mr. Jacob Valentine, Branch of Refuges, Bureau of Sport Fisheries and Wildlife, gave valuable assistance in this field test.

were there any unusual fluctuations in numbers noted. There was no indication of any loss of wildlife attributable to the treatment.

Studies of Penned Quail—To supplement the study of the wild quail, pen-reared bobwhites, 10-12 weeks old, were placed in small open-bottomed wire pens on the treated area and on untreated soil. These birds were observed for 2 weeks, droppings were collected for analysis, and the birds were then sacrificed for study of crop and gizzard contents to determine presence of corn cob grits.

The pens used were 40 inches square, and three quails were placed in each pen. The birds were provided food and water, and the pens were moved twice a day to expose them to more treated ground and to encourage them to feed on natural foods on the ground. This procedure exposed each bird to an average of 7.26 sq. ft. of treated soil per day. The test birds were placed on a newly mowed millet field, and they fed largely on the millet. The control birds were placed in a fallow field, and fed mostly on the commercial feed provided them.

Among the quail kept in pens, no losses occurred in either the test quail or checks. Seven of 12 fecal samples from the test birds were positive for grits. In no case did the amount exceed a trace—about as would be expected of fine gravel. Traces of cob grits were found in 7 of 18 gizzards of the penned quail at the end of 2 weeks of observation. It would seem, that small amounts of the bait were ingested, but probably not as a result of the birds developing a "taste" for the bait. No harmful effects were noted.

Food Habits Study—Eleven specimens of three species were collected within 12 days after the treatment and the contents of their crops and gizzards examined for the presence of corn cob grits.

Results of the 11 crop and gizzard examinations were as follows: 1 bobwhite had a trace of grits, whereas 4 bobwhites, 3 meadowlarks and 3 mourning doves showed no trace of grits. The bait, in one individual that had eaten it, made up less than 1 per cent of the crop and gizzard contents. The occurrence of grits in only one of 11 birds examined would indicate that there was probably no tendency for these species to develop a "taste" for the bait. With the low percentage of active toxin in the bait, only large quantities would be expected to produce toxic symptoms.

Field Pen Tests

It seemed desirable to supplement the field tests made at Gulfport with further pen studies wherein the rate of application was varied. This work was done at Auburn in 1962 and 1963.

Methods and Materials—Twenty-four A-shaped pens (Hart and Mitchell, 1947), each 9 x 10 feet were placed in an enclosure of 1.5 acres. The enclosure fence was of 1 inch mesh fox wire extending 5 feet above and 1 foot below ground level with an electric wire above it. It was effective in eliminating problems related to mammalian predators. The 24 pens were divided into 8 groups of 3 pens each, each group being on a plot of ground treated with Mirex bait as indicated in Table 1. There were, thus, 4 levels of treatment, with one replication at each level, and 3 pens for each replication. Each treatment site was of a size and shape to permit weekly movement of each pen for 8 weeks. This was considered necessary for sanitation and to expose the birds to as much treated soil as practicable.

Each pen was provided with a small tar paper shelter tacked to the frame of the pen and with a few pine boughs for cover. Water was provided in each pen. Feed, consisting of game bird ration and chicken scratch feed, was placed on the ground as often as necessary to provide the needs of the birds.

By November 6, 1962, the sites were treated, pens were in place, and 2 male and 2 female immature pen-reared bobwhites were placed

Table 1. Fertility and Hatchability of 503 Eggs From Quail Wintered on Treated Plots.

Group No.	Treatment	Pen	Infertile		Did Not Hatch		Hatched	
			Number	Per Cent	Number	Per Cent	Number	Per Cent
1	100 pounds per acre	A	26	36.1	24	33.3	22	30.5
		B						
		C						
2	10 pounds per acre	A	8	11.1	8	39.6	16	59.2
		B						
		C						
3	1000 pounds per acre	A	16	72.7	6	27.3	0	0.0
		B						
		C						
4	0 pounds per acre	A	5	13.8	11	30.6	20	55.6
		B						
		C						
5	10 pounds per acre	A	10	13.3	27*	36.0	38*	50.7
		B						
		C						
6	10 pounds per acre	A	4	16.0	8	32.0	13	62.0
		B						
		C						
7	10 pounds per acre	A	12	75.0	2	12.5	2	12.5
		B						
		C						
8	10 pounds per acre	A	6	40.0	3	20.0	6	40.0
		B						
		C						
9	10 pounds per acre	A	22	39.3	13	23.2	21	37.5
		B						
		C						

Mislabeled, identifiable only to group.

Table 1—(continued)

6	0 pounds per acre	A	2	66.6	1	33.3	0	0.0
		B	5	14.2	14	40.0	16	45.7
		C	6	50.0	3	25.0	3	25.0
			13	26.0	18	36.0	19	38.0
7	100 pounds per acre	A	4	17.4	6	26.1	13	56.5
		B	10	38.5	12	46.2	4	15.3
		C	14	63.6	5	22.7	3	13.7
			28	39.4	23	32.4	20	28.2
8	1000 pounds per acre	A	6	26.1	6	26.1	11	47.8
		B	4	50.0	3	37.5	1	12.5
		C	8	57.1	5	35.7	1	7.1
			18	40.0	14	31.1	13	28.9

*A few egg shells could be identified only to group after hatching. These are included in the group totals, but not in the pen totals.

in each pen. Thereafter, each pen was moved once each week for 8 weeks at which time the first or acute phase of the test was considered complete.

These quail were maintained in the pens, on the treated plots until the following breeding season. Because of intolerance of the birds to each other it was necessary to reduce the number to one pair per pen shortly after egg laying began. Eggs were collected every 2 or 3 days and kept at a room temperature of about 75°F. A setting of 187 eggs was made May 8, 1963, in a small electric incubator. A second setting of 316 eggs was made June 2, 1963. Incubation was continued until hatching; the eggs were candled at 5 or 6 days incubation, and infertile eggs were removed. Each egg was marked as to its pen of origin and after the hatch, success was ascertained by counting the marked empty shells. Data from one group was of limited value because variation between pens was not known.

Results of the Field Pen Test—One quail died during the first 8 weeks of the test. This death was determined by Dr. Charles Roberts, Director of the Alabama State Diagnostic Laboratory, as the result of coccidiosis. No toxic symptoms were exhibited by any of the 96 quail.

Results of the fertility and hatchability tests are given in Table 1. There is a tendency for the percentage of infertility by groups to increase with the rate of application, and the hatchability to be inverse to the rate of application.

DISCUSSION

The field tests at Gulfport, Mississippi, failed to indicate any adverse effects of the treatment on quail or other wildlife species. As previously indicated, there were some weaknesses in this study related to the time of the year it was made. The preliminary pen tests made at Gulfport were an effort to augment the field observations of wild birds under operational use of Mirex. These pen tests demonstrated that the limited exposure (7.26 sq. ft. of treated soil per bird per day) had no immediate adverse effect on the birds. The fact that these birds ate some of the bait, but only a fraction of that available to them, indicates there is little danger of quail of the age used ingesting lethal quantities of the bait under field conditions.

The finding of the known coveys 2 weeks after treatment indicates that no acute toxic effect occurred among birds old enough to act as coveys. Lack of effect of the treatment is also indicated by the failure to find quail or other species with symptoms of Mirex poisoning. It appears, therefore, that the treatment had effect neither on quail that were old enough to fly and behave as coveys nor upon other forms of wildlife.

Some incidental observations of younger quail were made. One brood was seen with the hen for the only time, September 23, when they were estimated to be 10-14 days old. This brood was along the edge of the millet field where the Gulfport pen-test was conducted. Two chicks, presumably from this brood, took up with the penned quail and were seen daily for 10 days after treatment. The first indication of another brood was on September 7 when a hen flushed in a decoying manner, but no chicks were found. Subsequent sight records of a brood in this vicinity were on September 23, 26, and 28. This brood range was treated on September 21; the brood was probably 2 weeks old at the time of treatment and was known to be present 1 week after treatment. Considering the density of the ground cover and the difficulty of finding quail broods of this age, failure to relocate this brood on October 2, 4, and 16 is not considered significant in relation to the test.

Data from the Auburn field pen tests (Table 1) show a tendency for those groups receiving the heaviest treatment to have a lower percentage of hatchable eggs and to have a higher rate of infertility. It is

obvious, however, that this is not consistent and also that variation in percentage of hatch within groups (0.0% to 45.7% in a check) was greater than variation between groups (50.7% for a check and 20.7% for a group treated at the rate of 1000 pounds per acre). The ninety-five per cent confidence limits of these group percentages, as read from Adams (1951:18), overlap extensively, indicating that these apparent differences are not significant at that level. Neither effect nor lack of effect on reproduction can be ruled out from these data.

In conclusion, no direct effects of Mirex were found, in field or pen tests, on adult or nearly grown quail, or other wildlife. Considering the extreme treatment of 1000 pounds per acre in the pen studies at Auburn, it seems safe to extend this finding to conditions that exist in the field under operational conditions of the eradication program. The absence of known newly hatched quail in any of the tests makes it impossible to eliminate the possibility that newly hatched quail might be effected by Mirex treatment. Finally, the hatching tests were inconclusive, possibly because of the long time lapse between treatment and measurement of effect.

There remains need for investigation of possible effects on reproduction and on newly hatched chicks.

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A SURVEY OF THE WETLANDS INVENTORY AND ITS APPLICATION TO AGRICULTURAL DRAINAGE

A Presentation from the Committee on Water Use
Southeastern Section, Wildlife Society

By

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In accordance with a Water Use Committee assignment, a questionnaire was submitted to all states in the Southeastern Region. Following is a summary of the replies:

The twelve states reporting were equally divided as to whether they considered the Wetlands Inventory adequate for their needs.

Six states claimed to have wetlands that qualify as types 3, 4 and 5 but which were not listed in Circular 39.¹ Others indicated they were not certain where such types were, or that if there were any they would not be significant.

Seven states reported having no agreement or understanding with agricultural agencies (Soil Conservation Service and Agricultural Stabilization and Conservation Service) regarding cooperative pre-drainage project studies of wetland types as listed in Circular 39. Some stated that agreements, either written, verbal or by liaison were in effect but most pertained primarily to Public Law 566 watershed projects.

Only the state of Florida reported that some proposed drainage projects were denied subsidies because of their being in wetland types as listed in Circular 39.

Drainage is reported to have been conducted under P. L. 566 despite protests in some states. Of interest is the fact that at least four states had not protested any agricultural drainage.

All states, two indicating it was not considered urgent, recommended updating the Wetlands Inventory with intent to supplement Circular 39 and amend legislation pertaining to it. Several reasons were cited, such as: to show the losses of wetlands in the past ten years, and to extend coverage of legislation to include other wetland types. Types of particular interest were one and seven, (Bottomland Hardwoods and Wooded Swamps) which are the more important types in the Southeast and which constitute the major types subjected to destruction by agricultural drainage in the Southeast.