areas. The studies consisted of: (1) a summer small mammal sampling study, (2) a large mammal sampling study, (3) a songbird sampling study, (4) a summer quail and dove breeding population sampling study, and (5) a wintering quail population sampling study.

None of the studies showed any significant effect of the treatment upon bird and mammal populations on the treated area. Also no effect of the ants themselves on bird and mammal populations was noted.

LITERATURE CITED

Couch, L. K. 1946. Effects of DDT on wildlife in a Mississippi River bottom woodland. Trans. 11th N. Amer. Wildl. Conf., 323-329.

Rhoades, W. C, 1962. A synecological study of the effects of the imported fire ant eradication program. Alcohol pitfall methods of collecting. Accepted for publication in Florida Entomologist, Oct. 1962.

Rogers, I. 1948. The effect of DDT on a bird population. Condor, 50(2): 89-90.

Rosene, W. R., Jr. 1958. Whistling-cock counts of bobwhite quail on areas treated with insecticide and on untreated areas, Decatur County, Georgia. Proc. 12th Ann. Conf. S. E. Assoc. of Game and Fish Comm., 240-244.

Springer, P. F. and J. R. Webster. 1951. Biological effects of DDT applications on tidal salt marshes. Mosquito News, 11(2) :67-74. (Also Trans. 16th N. Amer. Wildl. Conf., 383-397.)

EFFECTS OF KEPONE PEANUT BUTTER BAIT ON THE BOBWHITE QUAIL AND CERTAIN OTHER BIRDS *

By EDWARD P. HILL, III and MAURICE F. BAKER

Methods utilizing heptachlor and dieldrin in the early stages of the program to eradicate the imported fire ant (*Solenopsis saevissima richteri*) resulted in losses of wildlife sufficient to create concern among conservationists. [See George (1958) for a review of this subject.] Entomologists who were concerned with the problem conducted research to find safe and effective methods of controlling the fire ant. Beginning in 1957, Hays and Arant (1960) tested over 400 possible bait materials and 27 toxicants and found that kepone in peanut butter was effective as a fire ant bait. Work being done in 1960 by Smith (1961) indicated that bobwhite quail (*Colinus virginianus*) would not consume lethal amounts of this bait in the laboratory.

Kepone is a complex chlorinated polycyclic ketone ($C_{10}Cl_{10}0$). It is a stable white solid that is readily soluble in acetone and certain vegetable oils. As an insecticide it works mostly as a stomach poison. Its solubility in oil and its low toxicity as a contact poison were points in its favor as a prospective fire ant bait material.

Following many small-scale tests of kepone-peanut butter bait (Hays and Arant (1960), arrangements were made between the Plant Pest Control Division of the United States Department of Agriculture and Auburn University for a field test of this material wherein possible effects on wildlife would be an integral part of the test. High mortality to bobwhites during this test indicated the need for further laboratory work. It is the purpose of this paper to report the effects on birds during the field test and the results of subsequent laboratory tests.

FIELD TEST

Methods

The test area was located south of Camden, Wilcox County, Alabama. It was composed of a series of ancient river terraces and was mostly flat open land either in pasture or cultivation with small areas in woods. The best sum-

* A contribution of the Alabama Cooperative Wildlife Research Unit, Auburn University, the Alabama Department of Conservation, the U. S. Bureau of Sport Fisheries and Wildlife and the Wildlife Management Institute, cooperating.

mer quail habitat was around the edges of cultivated fields, all in one part of the area. Approximately 480 acres were treated.

Application of the poison bait was started on August 9, 1960 and continued as weather permitted until completed on August 19. Rains were frequent and sometimes intense in this period. The bait was prepared by dissolving the kepone in peanut oil and then mixing the solution into the proper quantity of peanut butter. The rate of application was 3.5 grams of kepone in 6 pounds of peanut butter per acre. This is a 0.125 per cent mixture. All further references to "the bait" refer to this mixture. Pastures were treated with motor-powered spreaders mounted on jeeps, while croplands and woodlands were treated by hand application. In open areas this bait was dribbled in broken lines 6 feet apart. In hand-treated areas the bait was placed in dabs a few feet apart.

The basic plan of the wildlife study was to trap, band, and retrap bobwhite quail and such other birds as could be caught in quail traps. It was thought that by trapping before, during, and after treatment any mortality or changes in numbers might be detected. Everyday observations, but not systematic search for dead specimens, was planned to supplement the trapping data. Search for brood ranges in which to trap was begun on July 26, 1960. The entire area was surveyed and over 30 possible trapping sites were baited. Thirteen trap sites attracted quail, and wire traps, 4 feet square, with funnel entrances were set beginning July 27, 1960. Commercial chicken scratch was used for bait. Trapping was continued during the following periods: July 26-29, August 2-4, 8-10, 14 to September 1, and September 7-9. Field work was done by the junior author assisted at times by his sons, Whitney, Steven, and Sidney except for 2 days when Dan W. Speake conducted the field work. Following the treatment a fall and winter census of the area was made with dogs, and hunters were interviewed to obtain hunting and band data.

No quail broods were found in open pastures during the study. Therefore, trapping efforts were concentrated in about one-third of the area where broods of quail were found around cultivated fields. A few adults were trapped in pastures. In the following presentation, a trap day is equal to one trap operated from daylight to dark on one day. When a trap was operated only part of a day, records were kept to the nearest quarter day.

Results

Two hundred and twelve individual birds were caught a total of 462 times (Table 1) in all traps set. In six traps around field borders, 83 quail were caught 193 times. These six traps are discussed separately.

TABLE 1

ALL BIRDS CAUGHT IN THE FIELD TEST AT CAMDEN, ALABAMA

Kind of Bird	*Number of Individuals*	*Total Number of Catches*	*Maximum Number of Captures* *
Quail	83	205	8
Colinus virginianus			
Cardinal	40	91	9
Richmondena cardinalis			
Blue Jay	27	89	12
Cyanocitta cristata			
Brown Thrasher	20	31	5
Toxostoma rufum			
Mocking Bird	18	18	1
Mimus polyglottos			
Mourning Dove	13	14	2
Zenaidura macroura			
Towhee	11	14	2
Papilo erythrophthalmus			
Total	212	462	...

* Maximum number of times any one individual was caught.

Quail. One or more quail were caught at 10 of the 13 sites selected for trapping. At four sites only a few adults were caught, and none of these showed any effects of the treatment. At the other six sites, fair success was attained; both juvenile and adult quail were caught repeatedly.

Trap 3 was located in an idle field that was cleared and converted to pasture while the test was being made. No quail were caught here after the vicinity was treated, but since no affected birds were seen, it was assumed that this group moved off the area when their range was cleared and converted to pasture. The one known survivor here was shot about one-fourth mile off the area in January, 1962.

First evidence of kepone poisoning in quail was found at trap 4. The vicinity of this trap was treated about August 12. No catches were made here from August 14-18, even though the trap was operated at least part of each day. Late on August 18 a brood of practically grown quail was flushed at the trap. These birds seemed to gain an unusual height while covering only a short distance, and flew in a loose-jointed manner with unusual amount of a twittering. The next morning this trap contained 6 quail including one dead and 5 with extreme tremors. According to Mr. Sidney Hays, who had seen kepone-poisoned quail in the laboratory and who saw these birds, the tremors were characteristic of those seen in kepone-poisoned quail. About noon on the 19th, several quail were flushed from near the trap. These could not fly well enough to get out of the underbrush, and one was caught by hand. A similar experience was recorded on the 20th when 5 severely affected birds were seen near the trap. On the 21st, 2 affected quail were trapped here, and thereafter the only quail taken here was an apparently normal adult female caught on the 24th. In Table 2 this bird is listed as having survived. This trap was operated 9.25 days after August 21 with only this one catch.

Twenty-four quail banded at trap 5 were caught a total of 104 times. Of these, 21 individuals and 97 captures were juveniles. Fourteen juveniles disappeared on or before August 19. Of the remaining 7 juveniles, 5 died with tremors on or before August 26. After August 26, only the 3 adults were captured. There were no band recoveries from these 24 quail in the ensuing hunting season.

One of the 5 adults caught at trap 6 was a trap fatality at trap 5, the last day of trapping. This bird is considered to have survived the experiment and accounts for the apparent discrepancy in Table 2. Another adult was shot near the trap site on February 11, 1961. There were no young quail banded at trap 6.

TABLE 2

QUAIL CAUGHT AT SIX TRAPSITES DURING CAMDEN FIELD TEST

Trap No.	*Trap Days*	*Total No. of Catches*	*Total Individuals Banded*	*Trap Mortality*	*Observed Number of Quail Affected*	*Dated*	*Surviving***
3	16.25	23	19	3	0	0	1
4	22.00	32	18	3	8	4	1
5	16.75	61	24	1	6	6	3
6	16.75	23	5	1	0	0	2
10	6.25	8	8	0	8	1	1
30	13.75	46	9	0	3	3	0
Totals	92.75	193	83	8	25	14	7-8

* Trapping mortality includes those quail that died as a direct result of being trapped.
** Survivors are birds trapped in the last 3 days of trapping or birds that were shot later and the bands recovered

Events at trap 10 were somewhat different from those previously cited. A brood was known to be in the vicinity, but would not come to bait until late in the trapping period. All 8 birds caught were extremely lethargic and unable to fly. One adult from this group survived until the following hunting season. Survival of the others is doubtful.

Of the 8 juveniles trapped at trap 30, 2 died with tremors, 2 were seen last on August 16th, and 4 on the 25th. The only adult caught here died in hand when being banded on the 25th. No further catches were made here after August 25.

Figure 1 illustrates trends in trapping success for all traps. In this figure, data for 10 to 12 trap days were averaged to locate the points representing average catch per day. The upturn at the end is the result of the belated success at trap 10.

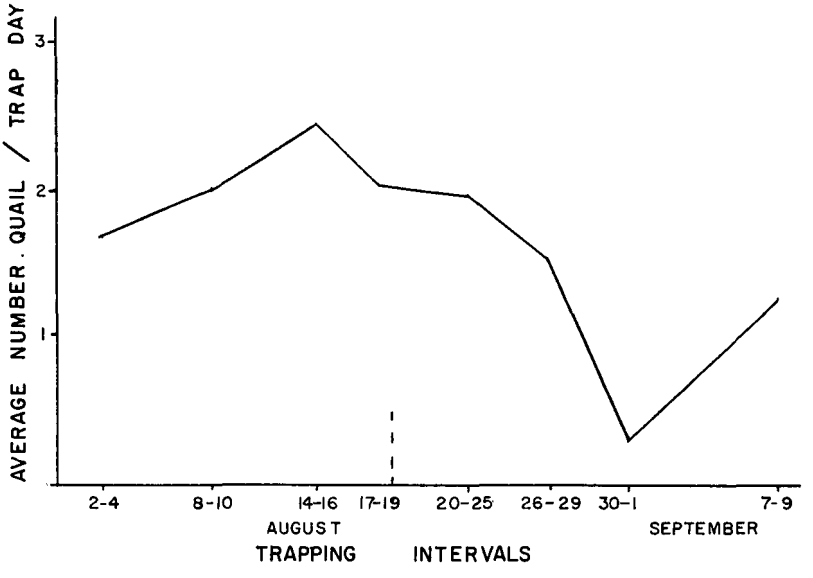

FIGURE 1. Trapping Success Before, During, and After Treatment.

A census with dogs on November 18 revealed no quail on the area. On December 6, however, two coveys were located that totalled 30 to 32 birds. These were in the vicinity of traps 4, 5, 6, and 30.

Seven local hunters used the area in the 1960-61 quail season. They reported killing 26 quail, only two of which were banded. It is probably significant that both of these were adults, since trapping experience indicated young quail to be more affected than old quail. This test received considerable local publicity, and it seems unlikely that many other banded quail were shot.

From the results of trapping, known mortality and associated symptoms, the lack of quail in early fall and the recovery of only 2 bands during the following hunting season, it seemed likely that most of the quail that were on the area at the time of treatment were dead or absent at the end of the test.

Effects on other birds. While we are concerned primarily with quail here, some of the observed effects on other birds seemed to shed light on the possible mode of entry of the poison into the quail. The most pronounced effect was on meadowlarks (*Sturnella magna*). On August 22, 1960, in an area treated 6 days earlier, a meadowlark was seen to fly with great difficulty. This bird was walked down, caught, and found to exhibit tremors. It died 2 hours later. Later that day another was seen to be affected, but could not be located after it made a short labored flight. In the next 5 days, 52 meadowlark sightings were recorded, 14 of them being of birds exhibiting abnormal flight, tremors or both. Thereafter, an occasional affected meadowlark was seen.

Of the 119 songbirds handled at the traps, only 3 bluejays exhibited symptoms of poisoning. It is possible that some tremoring birds may have been overlooked in the traps. However, this seems unlikely, since all captures were banded or handled to read the bands. One crow (*Corvus brachyrhynchus*) was observed to exhibit moderate tremors and appeared lethargic. In general it appeared that the more granivorous species were less affected than the more omnivorous or insectivorous ones.

In summary of the field tests, quail were definitely affected and suffered heavy mortality during the test. Juvenile quail were more affected than adults. Meadowlarks were definitely affected and suffered some mortality. Blue jays and crows were affected, but not known to have suffered mortality. Other birds were not known to have been affected. Since preliminary reports of tests by Smith (1961) indicated little likelihood of birds eating lethal quantities of this bait, the possibility of secondary poisoning through the ingestion of poisoned insects suggested itself. This seemed possible since dead and dying insects were commonly seen during the test. Also, the extent to which a species was affected by the bait seemed related to the food habits of the species, i. e., the more insectivorous species or age classes were more affected than others.

It seemed appropriate at this point to conduct further laboratory tests to seek answers to the following questions: (1) can birds be killed by eating kepone-poisoned insects, and if not, (2) under what circumstances will birds, especially quail, eat lethal quantities of the bait?

LABORATORY TESTS [1]

The initial laboratory phase of this work was based on the assumption that affected birds in the Camden study had acquired the kepone poison secondarily through ingestion of poisoned insects. Tests were planned to simulate secondary poisoning conditions as they might have occurred in the field. The basic plan was to poison large numbers of an insect species with the kepone bait, have some of these analyzed for kepone content, and feed others to quail. A 14-day feeding period was considered similar to the period during which poisoned insects might be available following a field application of the bait.

Preliminary tests revealed that the house cricket, *(Acheta domesticus)*, would be a suitable insect for these tests because of its availability through local bait dealers and because it was readily consumed by bobwhite and coturnix quail. Preliminary results also revealed that there would be a need for many kepone-killed crickets.

Cages were made of screen wire stapled over a 11" x 12" x 16" wood framework. The bottom was one-fourth inch plywood and a funnel shaped cloth was stapled around one end. This arrangement provided a door that would minimize the loss of live crickets while the investigator removed dead crickets or replenished food.

A synthetic sponge was cut to fit inside a petri dish that was then filled with water. This arrangement provided a surface over which the crickets could crawl and drink without drowning or becoming entangled.

Some difficulties were encountered in feeding kepone bait to crickets. The crickets would become entangled in the bait and scatter it around the floor of the cage. Although this action might have more closely paralleled field conditions, it introduced errors in measuring bait consumption. Planchets [2] were used to solve this problem. Seven of them were filled with the bait and weighed on an electronic balance. Then they were fitted into one inch holes bored into a piece of plywood. The rims of the planchets, the peanut butter bait, and the upper surface of the plywood thus provided a flush surface over which was stapled a piece of one-fourth inch mesh hardware cloth. This arrangement presented the bait at a convenient feeding level so it could be eaten with a minimum of bait loss from scattering.

Crickets were purchased 2,000 at a time and divided among 4 cages. Two of these cages (the treatment) were provided with kepone-peanut butter bait.

[1] A more detailed presentation of the laboratory portion of this work will comprise a thesis by the senior author

[2] Planchets were one inch diameter, stainless steel containers with one-fourth inch vertical sides.

The other two cages (check) were provided with plain peanut butter. Mortality occurred in both groups, but at a negligable rate in the check group. Dead crickets were removed twice daily and frozen. When approximately 95 per cent of the treatment crickets had died, the check group was quick frozen for future use. About 6,000 crickets were fed to treatment quail and a like number to check quail.

One hundred grams (353 crickets) of the poisoned crickets were analyzed by chemists of Allied Chemical Company. These were divided into three groups and each group was analyzed separately. The three groups yielded 34.6, 35.0, and 34.8 ppm. kepone. The average kepone-killed cricket from this sample, then, contained 9.8 micrograms of kepone. As the average cricket in the sample consumed 19.7 micrograms of kepone, this analysis shows a recovery rate of 50 percent. The other 5,414 kepone-killed crickets used in the feeding tests ate 87.10 grams of kepone peanut butter. Therefore, the average cricket used in these feeding tests consumed approximately 21.4 micrograms of kepone chemical. Based on a 50 percent recovery rate, the average kepone-killed cricket used in the feeding tests contained 10.7 micrograms of kepone.

Feeding Crickets to Quail

Cages were provided in which quail could be fed individually. Four tests were conducted wherein crickets were fed to quail.

Test I, Crickets. In the first test 17 6-week-old bobwhite quail were placed in separate cages and given game bird ration and water. Nine of these quail were fed kepone-killed crickets and the remaining eight were fed freezer killed crickets. Each afternoon feed trays were removed. Each morning kepone-killed and freezer-killed crickets were removed from the freezer and allowed to thaw. Then they were fed one at a time to the treatment and check quail, respectively, as long as they were consumed. The feed trays were then replaced. This procedure was continued for 14 days. Observations were continued through the test and for 21 days thereafter.

The treatment quail consumed an average of 104 crickets each or 7.45 crickets per quail per day, while the check quail consumed an average of 142 crickets each or 10.14 crickets per quail per day. Two quail in the treatment group ate only 36 and 41 crickets, respectively, thus lowering the average consumption rates of treatment quail; otherwise, consumption rates of treatment and check quail appeared to have normal distribution.

Test II, Crickets. The second test was similar to the first with the following exceptions: (1) There were 10 each of treatment and check quail, (2) baby chick and bird scratch was used instead of game bird ration and the feed pans were not removed from the cages throughout the test period, and (3) cricket feedings were made four times daily during which 5 crickets were counted into a cup inside each cake. If the 5 crickets were eaten, five more were added until they were no longer consumed. This procedure was followed for 14 days. Observations were continued throughout the test and for 12 days thereafter.

The treatment quail consumed 265 crickets during the 2 week test for an average of 18.90 crickets per quail per day as compared with a total of 275 crickets or an average of 19.65 crickets per quail per day for the check quail. Observations were continued for 12 days after the test feeding.

Test III, Crickets. Male coturnix quail (*Coturnix coturnix joponica*), 2 weeks of age, were used in the third test. As in the first test, the feed trays were removed in the afternoon and the feedings were made the following morning. Ten treatment and 10 check quail were offered 5 crickets per quail per day for 17 days. During the test the treatment quail consumed an average of 82 crickets each or 4.8 crickets per quail per day as compared with a total of 77 crickets or 4.5 crickets per quail per day for the check quail. Observations continued through the test period and for 28 days thereafter.

Test IV, Crickets. The fourth test was planned to see what effect feeding quail as a group might have on the consumption of crickets. Five juvenile bobwhite quail were put into each of two cages and were given baby chick, bird scratch, and water. One cage was used as a treatment cage and the other a check. The treatment and check quail were fed kepone poisoned and freezer-killed crickets, respectively, for 15 days. The crickets were fed at such a rate

that the quail competed for each cricket. When fed from the top of the cage the quail would jump 15 or more inches to take the crickets.

During one feeding the 5 check quail ate 131 crickets in about 15 minutes. Treatment quail ate 1,445 kepone-killed crickets for an average of 19.2 crickets per quail per day. The check quail consumed 1,409 crickets for an average of 20.9 crickets per bird per day. The inconsistency in the averages per quail per day resulted from the death of 2 check quail on the 13th day of the test.

Under the conditions of the experiment, neither coturnix nor bobwhites were visibly affected by the ingestion of poisoned crickets. Results of the chemical analysis indicated that the average kepone-killed cricket contained 10 to 12 micrograms of kepone. Secondary poisoning from these crickets would require ingestion of several pounds of crickets per bird. Even before completing the cricket feeding tests, it seemed appropriate to reexamine the possibilities of direct poisoning by quail feeding on the peanut butter bait.

Direct Feeding of Peanut Butter Bait to Quail

Test I, Bait. Bait was prepared using an acetone solution of kepone added to peanut butter. Two groups of juvenile coturnix quail, 6 weeks of age, were placed in separate pens and provided with feed and water. One group of 25 was offered peanut butter bait, the other group of 22 plain peanut butter. When the bait was put in the cages both groups were seen to peck at the bait but only in the check pen did the quail appear to be eating the bait. On the following morning a substantial amount of peanut butter had been eaten by the check quail, and only a slight amount of the bait had been eaten by the treatment quail. This observation led to the discovery that acetone fumes were detectable in the kepone-peanut butter bait container, and posed the possibility that the fumes could be acting as a repellent. Further observations revealed that the kepone-peanut butter bait was consumed at a rapid rate after it had aired for 2 or 3 days.

Subsequent kepone baits were prepared by dissolving the kepone in peanut oil and then mixing it with the peanut butter, as was done in the field tests. Quail readily consumed this peanut butter bait throughout the remainder of the test. With both bait mixtures, the test was continued a total of 21 days. Observations were continued throughout the test and for 8 days thereafter.

During the 21 day test, the treatment quail consumed 919.48 grams of kepone bait as compared to 589.75 grams for the check quail. On a quail-day basis, the average amount of kepone bait eaten by treatment quail was 1.54 grams per quail per day.

Slight tremors, characterized by small vibrations of the tail feathers were detected on the sixth day of the test. Pronounced tremors involving the entire body were observed on the eighth day. The plumage appeared ragged, especially on the head and neck, and the wings were not held up in the normal position on the back but allowed to drop to the sides. In addition, normal posture was not maintained in the leg joint formed by the tarsometatarsus and tibia. This gave the quail a crouching, weak-legged appearance. These symptoms were strikingly similar to those observed in the Camden field test. Of the 25 test quail, 13 survived. Two appeared little affected, while the others had tremors and other symptoms to some extent.

It was also apparent that kepone affected the mobility and flight capabilities of the quail. On the last day of the observation period, two treatment quail that appeared to have recovered except for slight tremors were taken from the pen and released to compare their flying abilities to those of check quail. They were able to fly about 20 or 30 feet. Other birds with more pronounced tremors dropped to the ground and were unable to fly or run when released. Check quail flew several hundred feet and were lost in tall Johnson grass.

Test II, Bait. The second test was planned to more closely simulate field conditions. A 9 x 10½ foot modification of the pen described by Hart and Mitchell (1947) was erected over an area of dense grasses. Eight 2 month old bobwhite quail were banded and placed inside the pen with clean water and were offered 12 cubic centimeters of baby chick and bird scratch per quail per day. Two hundred and twenty-nine grams of kepone-peanut butter was placed in the pen. Half of it was scattered on the ground at 1-foot intervals and the remainder was put in a container. The test was continued 24 days during which

6 quail died. One of the 2 remaining quail had severe tremors and the other had slight tremors. Night observations during this test revealed that roosting was interfered with because of continuous fluffing of the plumage and readjustment of position.

Test III, Bait. Cages described by Nestler and Bailey (1941) were used for the third test. Six 4-week old bobwhite quail were used as treatment quail and five were used as check quail. Both groups were provided with baby chick and bird scratch and water. Measured amounts of bait were placed in the test cage.

Minute tremors of the tail feathers were detected 26 hours after the bait was made available, and 100 per cent mortality occurred on the morning of the eighth day. During the test the treatment quail consumed 57.9 grams of the bait for an average of 1.7 grams per quail-day as compared to 171.5 grams or 4.9 grams per quail-day for the check quail. The check quail appeared to have remained normal through the test.

Test IV, Bait. Test four was a repeat of the above experiment, except that there were 14 treatment quail and 11 check quail, and game bird ration was added to the diet giving them a choice of peanut butter, game bird ration, and baby chick and bird scratch. Slight tremors were detectable in two treatment quail on the second day and in all of them on the third day. One hundred per cent mortality had occurred by the 12th day. The treatment quail consumed a total of 358.8 grams of the bait as compared to a total of 291.4 grams for the check quail. On a quail day basis, the treatment quail consumed 3.04 grams, while the check quail consumed 2.2 grams. Check quail remained healthy during the test.

In the four tests described, quail were fed kepone peanut butter baits in addition to varied diets of game bird ration and baby chick and bird scratch. Mortality occurred in 26 of the 28 bobwhite quail subjected to the poison bait, and in 13 of the 25 coturnix quail exposed to the bait. Symptoms characteristic of kepone poisoning were noted in all of the treatment quail.

DISCUSSIONS AND CONCLUSIONS

When the Camden field test was undertaken, no serious effects of the kepone bait were anticipated. Oral reports of laboratory tests being made at that time by Smith indicated that quail simply would not eat enough of the bait to cause mortality. When details of these tests became available later, it was apparent that some important difference existed between the methods of preparing and presenting the bait in the laboratory and in the field. Smith (1961) had prepared his bait by dissolving the kepone in acetone and adding this solution to the peanut butter, whereas no acetone was used in the field test. Also, he did not try to simulate field conditions, but offered fresh bait as the only food each day. Even with these methods he induced toxic symptoms in 2 of 10 tested with peanut butter. Also, he used adult birds for the tests, whereas the field test was conducted in August when juveniles normally make up most of the population. In the tests herein reported, the senior author found that the baits prepared with acetone, when fresh, apparently acted as a repellent to quail, and they would not eat much of the bait until the acetone had evaporated. On the other hand, when bait was prepared with oil, as it was in the field test, quail took the bait readily and heavy mortality resulted. It was also noted that bobwhites consumed the bait readily as a group but less so as individuals. Since it was not possible to induce apparent toxic symptoms in quail by feeding kepone-poisoned crickets for periods up to 2 weeks, and since quail fed readily on bait prepared as it was for the field test, the logical conclusion seems to be that the mortality that occurred in the field was most likely caused by ingestion of the bait and not to ingestion of poisoned insects.

The foregoing does not rule out the possibility of secondary poisoning in other species of birds. During the cricket feeding tests, a blue jay ate several kepone killed crickets. On the following day a blue jay with slight tremors ate several more poisoned crickets. Later the same day a blue jay with severe tremors and affected flight, flew into an open cage and was dead the next morning. This may or may not have been the same bird. It seems likely that it was, and this incident might well justify similar tests on a variety of species.

SUMMARY

In 1960, a field test was made of a bait designed to control the imported fire ant. The bait consisted of 0.125 per cent of kepone in peanut butter applied at the rate of 3.5 grams of kepone in 6 pounds of peanut bait per acre. Heavy mortality of quail occurred following treatment. Tremors and other symptoms of poisoning implicated kepone as the cause of death, but the mode of entry, whether through the bait or through poisoned insects was unclear. Subsequent laboratory tests indicated that quail very likely could not be killed by feeding poisoned insects, but were readily killed by exposure to the bait when it was prepared as it was for the field test.

REFERENCES CITED

George, John L. 1958. The program to eradicate the imported fire ant. The Conservation Foundation. New York. 39 p. Proc.

Hart, Dennis and T. R. Mitchell. 1947. Quail and pheasant propogation. Wildl. Mgmt. Inst. Washington. 71 pp.

Hays, Sidney B. and F. S. Arant. 1960. Insecticidal baits for the control of the imported fire ant. Jour. Econ. Entomology 53 (2) : 188-191.

Nestler, R. B. and W. W. Bailey. 1941. Bobwhite quail propogation. Conservation Bull. 10, U. S. D. I., Fish and Wildlife Service. 50 pp.

Smith, John C. 1961. The relative effects of kepone baits on the imported fire ant, bobwhite quail and dairy cows. Unpub. Master's Thesis. Auburn University, Auburn, Alabama.

CHANGING CONCEPTS AND NEEDS IN WILDLIFE MANAGEMENT

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This paper is an attempt to review, in a general way, some of the achievements of the business we call "wildlife management", and some of our failures to achieve its purposes and needs. Since the subject of this discussion encompasses large and ramifying problems and possibilities, and is related to a vast interplay of forces which are not directly subject to our control, we can in such a discussion, only touch on some of the highlights. Much more will remain to be said.

In a little more than a half century we have seen tremendous changes in our surrounding world. Within that time our population has more than doubled, vast acreages of land and water have been altered from their original condition, and we have developed the tools and techniques to change the total environment of men and animals radically and permanently. The majority of our people have become urbanized and transient. Each day we move mountains, cut down whole forests, drain more marshes and wetlands, and engineer vast alterations in the world about us; and we have developed the means and techniques to effect even greater changes in the future to the extent that we may live in a man made world. From an agrarian "horse and buggy" way of life, we have emerged into a high speed, mechanized and specialized society. Like travelers speeding along a highway, we have lost sight of many of our goals and objectives, while concentrating on the dangers of momentary and sudden oblivion. To avoid losing our way, it is essential that we stop occasionally to determine our position and re-establish our destination. Without reappraisal, we tend to become lost in a maze of single objectives, each of which leads to a dead end or a blind alley.

In making such a reappraisal, we need to determine, first, just what we are after; whether we simply want to produce more game, fish or fowl, or whether we want to fuse all the single objectives we have, as a people, into that fundamental goal directed at preservation of an adequate en-