That first conception dates of cottontails in northern Missouri do not show normal distribution has been well established by Conaway and Wight (1962: 280) who wrote, "Conception dates for the first pregnancy of many populations, however, do not show a normal distribution around a median date but are distributed discontinuously around two or even three dates." In the present study of southeastern Missouri cottontails, conceptions for the first pregnancies were distributed around two dates: February 14 and March 14.

The significance of these observations lies in establishing the fact that the synchronous breeding which Conaway and Wight (1962) demonstrated for northern Missouri is also well defined in a population in southeastern Missouri.

In both cases it appears quite evident that once breeding has begun, it proceeds in a rhythmic pattern determined by the length of gestation.

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EFFECTS OF COTTON PESTICIDES ON WILDLIFE: A PROGRESS REPORT *

By DENZEL E. FERGUSON, JIMMIE L. TISDALE, RAMON L. CALLAHAN and GWEN A. CATCHING

Pesticide use in modern agriculture has attained proportions difficult to comprehend. Rudd and Genelly (1956) estimated that 14,088.6 tons of the major pesticides were used in California alone in 1955, and the trend has been for increased use of agricultural chemicals. An excellent review of the problems produced by modern pesticide use has been prepared by the conservation committee of the Wilson Ornithological Society (Hickey, 1961). Few areas surpass the cotton growing region of the southern United States in duration of heavy pesticide utilization and annual consumption of these chemicals.

Many reports have appeared describing effects of control measures directed at a particular insect pest where operations, though extensive in area, are relatively short-term for a given locality. For example, many types of forest insect control have involved only a single annual application of 1 lb. of DDT per acre. However, most insecticides used are applied, not in these isolated control programs, but rather in systematic crop protection campaigns. Surprisingly little study has been devoted to the long term consequences of multiple insecticide applications, repeated year after year. The present report of progress made in an initial year of study deals with the latter problem. Objectives were: (1) to examine tissues of animals from cotton fields and cotton field borders for presence of insecticide and insecticide residues; (2) to relate these findings to animal behavior, reproduction or population fluctuations.

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DESCRIPTION OF STUDY AREA

During the summer of 1962, field studies were conducted in and around cotton fields near Sidon, Leflore County, Mississippi. The area investigated received regular DDT applications from the mid-1940's to the mid-1950's, after which organic phosphate compounds and newer chlorinated hydrocarbons began to partially replace DDT. In 1961, between June 12 and September 4, one study field received 6.10 lbs./acre (4 lbs. toxaphene, 2 lbs. methyl parathion) in 12 applications, all but one of which were applied by plane. In 1962, between June 18 and September 1, 11.88 lbs./acre (.26 lbs. endrin, 3.62 lbs. methyl parathion, 8 lbs. DDT) were applied to the same field in 15 aerial applications. These data are quite typical of spraying schedules followed in that part of the Delta.

Bordering the fields are woods consisting of timber-sized, second-growth hardwoods with several species of oaks (*Quercus*), hickories (*Carya*), and gums (*Liquidambar, Nyssa*) forming the overstory. Undergrowth consists of hardwood reproduction and shrubs interspersed with relatively open grassy areas.

A nearby untreated control area includes a large field, which has been untreated for the past 15 years and in the soil bank since 1956. It is bordered by woods similar to those described for the treated fields. A variety of herbaceous growth, bramble, and scattered woody reproduction forms the only vegetative cover in the field.

METHODS

Five 1-acre plots were established on the borders of treated cotton fields, each being located half in the field and half in the wooded border. Five similar plots were established on the control area as were two others in a nearby soybean field. A 30-minute bird count was conducted on each of these plots weekly, a total of 12 such counts being made during the summer. Time of census varied from early morning to late afternoon.

In addition, weekly bird counts were taken along a measured 0.5-mile strip on the borders of treated and untreated fields. In making these counts, one observer walked in the edge of the woods and another in the field edge. Numbers and species of birds encountered were recorded in both plot and strip counts.

A total of 53 Red-winged blackbird (*Agelaius phoeniceus*) nests (26 control and 27 treated) was studied, each nest being visited daily from the time of its discovery until fledglings abandoned the nest. Untreated nests were 0.5 mile from the nearest spraying operations. Treated nests were located along a ditch which bisected a cotton field. They received direct insecticide applications since pilots did not cut-off spray nozzles as the plane crossed the ditch. The majority of treated nests were at least 0.5 mile distance from untreated lands.

Various species of birds, mammals, and occasionally other vertebrates were collected in treated and control areas and kept under refrigeration until they could be returned to the laboratory for analysis. Samples of fat were taken from the specimens and pooled, in the case of small species. Fat samples were then processed and used to prepare paper chromatograms following methods described by Mitchell (1957). These were later analyzed and spots identified with the aid of known standards.

A minimum of 20 hours per week was spent in the field conducting censuses, observing animal behavior, and collecting specimens. During these times, constant attention was devoted to searching for dead or distressed animals.

RESULTS

In Fig. 1 combined bird counts for the 5 treated plots are compared witn those of the 5 control plots and 2 from the soybean plots. Although the sample sizes are small and subject to sampling errors, certain facts seem apparent. First, the control area supported a larger breeding population and, second, nesting was completed about two weeks earlier than on the treated area. The fact that the resident populations on treated and untreated plots were about the same in late August may indicate that the aforementioned differences were not entirely attributable to a more favorable habitat on the control area. Counts made on the soybean-field plots, presumably an unfavorable bird habitat, generally resemble those for the untreated area.

Strip census data (Fig. 2) also indicate a larger breeding population on the untreated area and confirm earlier nesting and flocking for control birds (mainly icterids).

Table 1 is a summary of the treated and control blackbird nesting studies. A comparison of these data reveals surprisingly little variation and indicates that the presence of insecticide has had no apparent effects upon reproduction. In contrast, Wright (1960) found a marked reduction in reproductive success of Woodcocks *(Philohela minor)* on areas treated with only 0.5-1 lbs. DDT/acre annually for up to 5 years.

Table 1. A summary of observations derived from study of 53 Red-winged blackbird nests (*Agelaius phoeniceus*) half of which were located in a cotton field treated with 11.88 lbs. of insecticide during the summer of 1962 and half of which were in an untreated area.

	Treated	*Untreated*
Number of nests studied	27	26
Clutch size frequency		
1 egg	4	2
2 eggs	2	7
3 eggs	11	8
4 eggs	10	6
5 eggs	0	3
Total eggs produced	81	79
No. nests producing young	14	14
No. young hatched	42	40
Mean No. young in producing nests	3.0	2.9
No. nests abandoned	8	6
No. nests destroyed by predation	12	12
No. young leaving nests	19	21

In Table 2 the results of paper chromatographic analyses of 181 animals from treated fields are shown. All samples examined from untreated areas proved negative. In general, the number of positive tests increased as the summer progressed. This was expected since large flocks of mixed icterid birds moved into cotton fields after nesting was completed. Food analyses of collected birds and actual field observations revealed that these birds fed primarily on cabbage loopers (*Trichoplusia ni*) and bollworms (*Heliothis armigera*) in the fields. In so doing, they would presumably accumulate large quantities of insecticide through consumption of insects which had in turn concentrated the chemical in their tissues. Robins (*Turdus migratorius*) have been reported to accumulate lethal doses of DDT in the spring from eating earthworms treated in June and July of the previous year (Barker, 1958).

Table 2. Insecticides and insecticide metabolites found in animals collected from treated cotton fields in Leflore County, Mississippi during the summer of 1962.

Species	*Number Tested*	*Number Positive*	*DDD*	*DDE*	*Aldrin*
Cottontail (*Sylvilagus floridanus*)	3	0	..	..	..
Bobwhite (*Colinus virginianus*)	8	0	..	..	..
Mourning Dove *(Zenaidura macroura)*	20	0	..	..	..
Red-winged Blackbird (*Agelaius phoeniceus*)	68	31	9	30	5
Grackles (*Quiscalus sp.*)	76	47	3	40	21
Red-eared Turtle (*Pseudemys scripta*)—eggs	4	0	..	..	..
Bluegill *(Lepomis macrochirus)*	2	0	..	..	..
Total	181	78	12	70	26

Some animals were found to contain more than one insecticide residue. Nearby rice fields were a possible source of the aldrin which was detected in both blackbirds and grackles (*Quiscalus sp.*).

No dead vertebrates were discovered in any of the treated fields or adjacent woods in spite of the fact that many species of mammals, birds, reptiles, and amphibians were observed in these areas.

DISCUSSION AND CONCLUSIONS

No drastic effects on vertebrate populations attributable to insecticides are obvious in the foregoing account, in spite of the fact that the presence of insecticide and insecticide residues was demonstrated in tissues of birds from treated areas. No dead birds were observed during the entire summer nor were any noted behaving in a manner that suggested insecticide sickness. Yet, many birds were observed to forage and feed nestlings on insecticide contaminated food sources. This failure to observe evidence of harmful effects or mortality on an area treated with almost 12 lbs. of insecticide is in sharp contrast to published reports of catastrophic bird kills from single applications of much less insecticide. Such inconsistencies have led us to consider the possibility that some form of resistance may have been developed in bird populations of the treated areas studied here.

Evidence that DDT resistance occurs among vertebrate animals has recently been demonstrated in two species of frogs (*Acris*) and a species of fish (*Gambusia*) living in cotton growing areas of the Mississippi Delta (Boyd, Vinson, and Ferguson, 1962). Dr. L. Ellis (personal communication) reports that bird mortality in cotton growing areas of the Delta now appears markedly reduced compared to that of the mid-1950's. Does all this indicate that insecticides have, through selective mortality, produced bird populations resistant to DDT? A study of this possibility is presently being investigated in both birds and mammals.

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A SYNECOLOGICAL STUDY OF THE EFFECTS OF THE FIRE ANT ERADICATION PROGRAM IN FLORIDA

By Robert W. Murray

INTRODUCTION

In the spring of 1959 the Florida Game and Fresh Water Fish Commission entered a cooperative agreement with the Florida Agricultural Experiment Station and the Plant Industry Division * of the State Department of Agriculture to carry out a study of the effects of the imported fire ant eradication program. The Experiment Station drew up a research project entitled "A Synecological Study of the Effects of the Fire Ant Eradication Program." During the course of study the Commission was charged with the responsibility

* Formerly State Plant Board.