



A two-summer study of the effects on bird populations of chlordane bait and aldrin spray as used for grasshopper control  
by Robert L Eng

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management  
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**Abstract:**

A two-summer study of the effects on bird populations of chlordane baiting and aldrin spraying as used for grasshopper control was carried out in eastern Montana. Two 40-acre plots (treated and control) were censused daily for a period before and after application of one or the other of the insecticides. All birds observed daily on each plot were recorded by species and those displaying territorial traits were recorded as such. From these census data, a comparison was made of the population index and the number of resident pairs on the treated plot, before and after treatment, with similar data from the control plot. Nests located on both plots were kept under observation, A comparison was made of the nesting success on the two plots. Data of a more general nature were gathered from larger areas which were subjected to chlordane baiting or aldrin spraying in routine grasshopper control operations.

In 1950, chlordane bait was applied at the usual rate employed for grasshopper control to one square mile surrounding and including the treated plot. Following baiting, the population index showed a decrease (8.4%) on the treated, and an increase (3.1%) on the control plot; the number of resident pairs indicated similar increases on both plots (18.9% treated, 12.5% control); and there was no apparent effect on the development of nestlings on the baited plot. The western meadowlark was the most abundant bird and the most common resident on both plots. Following baiting, the population indices for this species indicated similar increases on both plots (9.1% treated, 3.0% control), while its number of resident pairs remained the same on the baited and increased (21.4%) on the control plot. No dead or sick birds were located on any of the baited areas.

In 1991, aldrin spray was applied at the usual rate employed for grasshopper control to 400 acres surrounding and including the treated plot. Following spraying, the population indices indicated similar decreases for both plots (9.9% treated, 6.3% control); the number of resident pairs showed a decrease (9.3%) on the treated and an increase (9.3%) on the control plot; and the nestling redwings exhibited a higher mortality rate (90%) on the treated than on the control plot (7.7%). Mortality for the other nesters was similar for both plots. The population indices for the western meadowlark, following spraying, indicated increases for both plots (20.8% treated, 11.4% control) while its number of resident pairs decreased (7.1%) on the treated and increased (16.7%) on the control plot. No dead or sick adult birds were observed on the sprayed areas.

No positive evidence of bird mortality due directly to the toxicity of the insecticides was obtained. Some adverse effects on the bird populations were indicated which were evidently associated with the reduction in grasshopper numbers brought about by the insecticides. These effects appeared to be in direct proportion to the efficiency of the grasshopper kill.

A TWO-SUMMER STUDY OF THE EFFECTS ON BIRD POPULATIONS  
OF CHLORDANE BAIT AND ALDRIN SPRAY AS USED FOR GRASSHOPPER CONTROL

by

ROBERT L. ENG

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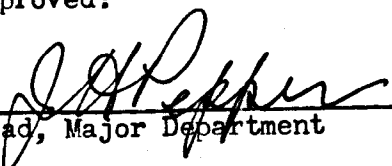
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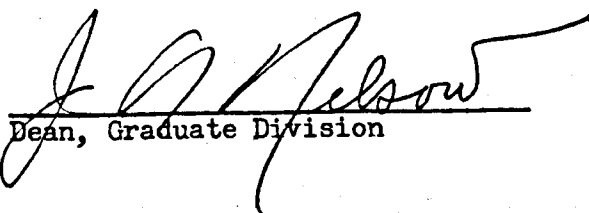
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ABSTRACT

A two-summer study of the effects on bird populations of chlordane baiting and aldrin spraying as used for grasshopper control was carried out in eastern Montana. Two 40-acre plots (treated and control) were censused daily for a period before and after application of one or the other of the insecticides. All birds observed daily on each plot were recorded by species and those displaying territorial traits were recorded as such. From these census data, a comparison was made of the population index and the number of resident pairs on the treated plot, before and after treatment, with similar data from the control plot. Nests located on both plots were kept under observation. A comparison was made of the nesting success on the two plots. Data of a more general nature were gathered from larger areas which were subjected to chlordane baiting or aldrin spraying in routine grasshopper control operations.

In 1950, chlordane bait was applied at the usual rate employed for grasshopper control to one square mile surrounding and including the treated plot. Following baiting, the population index showed a decrease (8.4%) on the treated, and an increase (3.1%) on the control plot; the number of resident pairs indicated similar increases on both plots (18.9% treated, 12.5% control); and there was no apparent effect on the development of nestlings on the baited plot. The western meadowlark was the most abundant bird and the most common resident on both plots. Following baiting, the population indices for this species indicated similar increases on both plots (9.1% treated, 3.0% control), while its number of resident pairs remained the same on the baited and increased (21.4%) on the control plot. No dead or sick birds were located on any of the baited areas.

In 1951, aldrin spray was applied at the usual rate employed for grasshopper control to 400 acres surrounding and including the treated plot. Following spraying, the population indices indicated similar decreases for both plots (9.5% treated, 6.3% control); the number of resident pairs showed a decrease (9.3%) on the treated and an increase (5.3%) on the control plot; and the nestling redwings exhibited a higher mortality rate (50%) on the treated than on the control plot (7.7%). Mortality for the other nesters was similar for both plots. The population indices for the western meadowlark, following spraying, indicated increases for both plots (20.8% treated, 11.4% control) while its number of resident pairs decreased (7.1%) on the treated and increased (16.7%) on the control plot. No dead or sick adult birds were observed on the sprayed areas.

No positive evidence of bird mortality due directly to the toxicity of the insecticides was obtained. Some adverse effects on the bird populations were indicated which were evidently associated with the reduction in grasshopper numbers brought about by the insecticides. These effects appeared to be in direct proportion to the efficiency of the grasshopper kill.

## INTRODUCTION

During the past three years, the insecticides chlordane, toxaphene, and aldrin have been extensively used for the control of grasshoppers in certain western states (Annual Control Reports of the Division of Grasshopper Control, 1949, 1950, and 1951). This widespread useage has aroused considerable concern as to the effects on wildlife populations. Post (1951) determined through laboratory experiments the minimum lethal dose of chlordane and toxaphene for three species of game birds. He also made extensive field observations in Wyoming following the use of these insecticides for grasshopper control. Jackson (unpublished thesis) fed chlordane and toxaphene treated food to penned pheasants. Linduska and Springer (1950) determined by feeding tests the comparative toxicity of chlordane and toxaphene for bobwhite quail. The present paper summarizes the results of a two-summer study in Montana of the effects of chlordane and aldrin on bird populations, under field conditions, following their application for grasshopper control.

For help during the study, the writer extends his sincere appreciation to the following: Dr. Don C. Quimby, Montana State College, who directed the study and assisted with the manuscript; the Montana Fish and Game Department for financial support and assistance and advice of their staff, especially W. K. Thompson, W. H. Bergeson, and F. L. Hartkorn; the U. S. Bureau of Entomology for treating the experimental plot with chlordane bait and use of a vehicle; and the Montana State Entomologists Office for treating the experimental plot with aldrin and for financial assistance.

## METHODS

An effort to determine the effects was made by comparing the population index, number of resident pairs, and development of nestling birds on a treated plot, before and after application of the insecticides, with similar data from an untreated plot. Further data of a more general nature were gathered by observations on larger treated areas.

Two square 40-acre study plots, 2 1/3 miles apart, were selected in Powder River County, Montana, 17 miles southeast of Ashland. Otter Creek Valley, where the plots were located, is bordered on both sides by Custer National Forest. Plot I was used as a control plot, Plot II as a treated plot.

Each plot was cover-mapped. With the exception of 3.5 acres of cultivated land on Plot II, the study plots were on winter and spring cattle ranges. For the most part, the areas are grassland. The most common grass is bluestem, Agropyron smithii, although Japanese chess, Bromus japonicus, downy chess, Bromus tectorum, and others are locally dominant. Big sage, Artemesia tridentata Nutt., is found in varying degrees of abundance throughout the areas. Otter Creek, a small, sluggish stream, meanders through both plots. Along the course of the stream are scattered clumps of boxelder, Acer negundo, and less frequently small groups of cottonwood, Populus sargentii. The dominant shrubs found along the stream are snowberry, Symphoricarpos sp., and rose, Rosa sp..

Following the method of George and Stickel (1949), the central 25.6 acres of each plot was staked into 16 equal squares, forming transect lines through the area every 264 feet.

One square mile, including Plot II approximately in the center, was treated by airplane with chlordane bait at the usual rate of ten pounds per acre on June 22, 1950 under the direction of personnel from the U. S. Bureau of Entomology and Plant Quarantine. The bait was the same as that used in routine grasshopper control work, consisting of one-half pound of chlordane in one-half gallon of kerosene mixed with 100 pounds of dry bran. On June 20, 1951, 400 acres, surrounding and including Plot II, were treated by airplane with aldrin spray at the usual rate of two ounces per gallon of fuel oil to the acre under the direction of personnel from the Montana State Entomologists Office.

Both plots were censused daily before and after insecticidal treatment of Plot II, 13 and 12 days for Plots I and II respectively before chlordane baiting in 1950, and 17 for each following baiting. In 1951, when Plot II was sprayed with aldrin, the number of censuses was the same except Plot II received the extra pre-treatment census. The censuses began at 5:30 and 9:30 A. M. Each required about 1 1/2 hours. The early census was alternated between the plots. The transect lines were walked slowly, and all birds observed within approximately 132 feet on either side were recorded by species number on an outline map. A new map was used each day. Birds displaying territorial traits were designated by symbols. Species numbers, recorded on cross-transects, were encircled to indicate the possibility of duplication. Following the field work, the daily census sheets were grouped into pre- and post-treatment census periods for each plot (only Plot II treated). Then, an index of the daily population was derived by determining the average number of birds seen

per day during the census period. Censuses conducted during adverse conditions (weather or agricultural activity) were considered inadequate for computing daily population indices. The number of resident pairs for each plot during a census period was determined by examination of the daily census sheets. Those birds showing territorial behavior, such as singing or defense activity, in the same general area five times or more (5 to 13 pre-treatment, 5 to 17 post-treatment) during the census period were considered as resident pairs. Exceptions were made in cases where nests were located. Familiarity with the census plots greatly facilitated these determinations. Williams (1936) used a similar method.

Both plots were systematically searched for nests. Those located were plotted by number on a map. Nests adjacent to Plot II, but well within the area to be treated, were also included. The progress of nesting activities for each nest was recorded from observations taken at three to five day intervals during the period prior to treatment of Plot II. Following application of the insecticide, the nests containing nestlings were observed daily until each nest had terminated. Young were considered successfully reared when they reached the fledgling stage. Nestlings not found on the treated area until after insecticidal treatment were compared with young of known age to determine their stage of development at the time Plot II was treated.

While censusing Plot II, following its treatment with chlordane or aldrin, a constant vigil was kept for sick and dead birds. An additional 24 and 38.5 man hours were spent searching the entire treated area following chlordane baiting and aldrin spraying respectively.

To supplement the data from the study plots, observations were made on a 55 thousand acre area of rangeland in Rosebud and Powder River Counties which was baited with chlordane, and on 95 acres of crop and grassland in Sheridan County which were sprayed with aldrin. Both applications were made at the same rates as applied to Plot II. A total of 85.5 man hours was spent driving and walking 123 and 36 miles respectively, over the chlordane baited area from July 10 to 24, 1950. Twenty-eight man hours were spent walking over the aldrin sprayed area from July 27 to August 5, 1950. A route of 2 1/2 miles was covered daily beginning three days after spraying. While covering the areas, the principal species observed were recorded. Particular emphasis was placed on attempting to locate dead and/or sick birds.

RESULTS

Chlordane

Grasshopper populations on the experimentally baited plot (Plot II) showed a decrease following baiting from 30 to 10 per square yard on the higher areas, and from 60 to 35 on the lower more heavily vegetated areas (population estimates made by C. R. Pratt of the U. S. Bureau of Entomology and Plant Quarantine).

The average number of birds observed per day on Plots I (control plot) and II (baited plot) during the pre- and post-baiting census periods is shown by species in Table I. The average number on the baited plot was 68.16 during the pre-baiting, and 62.41 during the post-baiting census period, a decrease of 5.75 birds or 8.4 percent. Totals from the control plot over the same periods were 77.84 and 80.64, an increase of 2.8 birds or 3.1 percent. These data suggest that the chlordane bait may have affected the population on the baited plot because its average daily population index decreased following baiting, whereas that of the control plot increased slightly. The inclusion of certain species seen only occasionally on the plots may distort the true picture since there is the possibility of their being there "as strays" during the census periods. Considering only the most abundant bird, the western meadowlark, the trend for both plots is somewhat the same, showing an increase for both following baiting of Plot II (Table I).

Table II shows the number of resident pairs of birds on Plots I and II, before and after chlordane baiting of Plot II. The totals of

TABLE I - AVERAGE NUMBER OF BIRDS OBSERVED / DAY ON PLOTS I AND II, BEFORE AND AFTER CHLORDANE BAITING, 1950. ONLY PLOT II BAITED.

	PLOT I Control Plot			PLOT II Baited Plot		
	June 9-21	June 23- July 9	% Change	June 10-21 (Pre- baiting)	June 23 to July 9 (Post- baiting)	% Change
Sparrow Hawk	.38	.41	+ 7.9			
Sharptail Grouse	.69	.24	- 65.2	.08		-100.0
European Partridge	.15		-100.0			
Ring-necked Pheasant	.15		-100.0	1.50	.59	- 60.7
Killdeer	.15		-100.0	1.25	.29	- 76.8
W. Mourning Dove	.46		-100.0	.35	.41	+ 17.1
Black-billed Cuckoo		.41			.53	
Red-shafted Flicker	.62	1.12	+ 80.6	1.50	2.24	+ 49.3
Eastern Kingbird	4.46	5.06	+ 13.4	2.83	2.88	+ 1.8
Arkansas Kingbird	1.00	2.24	+124.0	2.75	.65	- 76.4
Say's Phoebe	.15		-100.0			
W. Wood Pewee	.31		-100.0			
Maggie				.17		-100.0
W. House Wren	2.54	3.00	+ 18.1	1.17	2.53	+116.2
Brown Thrasher	.62	1.06	+ 71.0	.08	.06	- 25.0
Robin				1.00	.24	- 76.0
Yellow Warbler	4.77	3.64	- 23.7	5.67	4.53	- 20.1
Yellowthroat	3.38	2.47	- 26.9	2.58	4.06	+ 57.4
Long-tailed Chat	1.23	.29	- 76.4	2.67	.88	- 67.0
W. Meadowlark	28.15	29.00	+ 3.0	16.00	17.47	+ 9.1
Redwing	10.62	14.29	+ 34.6	8.67	11.12	+ 28.2
Bullock's Oriole	6.46	7.41	+ 14.7	4.83	3.29	- 18.8
Bronzed Grackle	5.38	5.94	+ 10.4	2.92	.47	- 83.9
Cowbird				.42		-100.0
Western Tanager	.08	.06	- 25.0			
Black-headed Grosbeak	1.54	1.35	- 12.3	.50	.70	+ 40.0
Lazuli Bunting	.69	.47	- 31.8	2.25	1.88	- 16.4
Goldfinch				.08		-100.0
Lark Bunting	.46	.18	- 60.9	3.25	1.12	- 65.5
Vesper Sparrow				.75		-100.0
W. Lark Sparrow	2.69	2.00	- 25.6	4.92	6.47	+ 51.8
W. Chipping Sparrow	.69		-100.0			
TOTAL	77.84	80.64	+ 3.1	68.16	62.41	- 8.4

TABLE II - RESIDENT PAIRS OF BIRDS ON PLOTS I AND II, BEFORE AND AFTER CHLORDANE BAITING, 1950. ONLY PLOT II BAITED.

	PLOT I Control Plot			PLOT II Baited Plot		
	June 9-21	June 23- July 9	% Change	June 10-21 (Pre- baiting)	June 23 to July 9 (Post- baiting)	% Change
Sparrow Hawk	1	1	0.0			
Killdeer				1	1	0.0
Black-billed Cuckoo					2	
Red-shafted Flicker				1	1	0.0
Eastern Kingbird	1	3	+200.0	1	1	0.0
Arkansas Kingbird	1	1	0.0	1	1	0.0
House Wren	2	2	0.0	1	2	+100.0
Brown Thrasher	1	1	0.0			
Yellow Warbler	2	4	+100.0	2	4	+100.0
Yellowthroat	2	2	0.0	2	3	+ 50.0
Longtailed Chat				1	1	0.0
Meadowlark	14	17	+ 21.4	13	13	0.0
Redwing	6	5	- 16.6	3	4	+ 33.3
Bullock's Oriole	2	3	+ 50.0	2	2	0.0
Bronzed Grackle	3	2	- 33.3	1		-100.0
Black-headed Grosbeak	2	2	0.0	1	2	+100.0
Lazuli Bunting	1	1	0.0	1	2	+100.0
Lark Bunting				1	1	0.0
Vesper Sparrow				1		-100.0
Lark Sparrow	1	1	0.0	4	4	0.0
Chipping Sparrow	1		-100.0			
<b>TOTAL</b>	<b>40</b>	<b>45</b>	<b>+ 12.5</b>	<b>37</b>	<b>44</b>	<b>+ 18.9</b>

resident pairs on the baited plot during the pre- and post-baiting census periods were 37 and 44 pairs respectively, showing an increase following baiting of 7 pairs or 18.9 percent. These totals for the control plot during the same census periods were 40 and 45 pairs, showing an increase of 5 pairs or 12.5 percent. The figures for the two plots show the same general trend suggesting that chlordane bait had no appreciable effect on the number of resident pairs on Plot II. Considering only the western meadowlark, the most common resident, there is evidence of some effect. The baited plot showed no increase in resident pairs whereas the resident pairs on the control plot increased 21.4 percent. For a discussion of the possible cause of this effect, see effects of aldrin on resident pairs in a later section.

Data from Plots I and II summarizing the fate of nestling birds, which hatched before or soon after baiting of Plot II, are found in Table III. The majority of the nests located on the control plot were those of the western meadowlark and appeared to be approximately ten days more advanced than those available for comparison on the baited plot. The numbers appearing in the "Number of Days Observed" column for the control plot in Table III are counted from a date ten days earlier than those on the baited plot, but are included to show the amount of natural mortality present during this stage of development. There was a 6.2 percent mortality of nestlings for the baited plot and 12.1 percent for the control plot. No particular significance can be attached to their difference, suggesting that the chlordane bait had no effect on the development of nestlings. These data seem especially

TABLE III - FATE OF NESTLING BIRDS HATCHED BEFORE OR SOON AFTER CHLORDANE BAITING ON PLOT II, 1950. EARLIER FIGURES FOR PLOT I (CHECK PLOT) INCLUDED FOR COMPARISON.\*

PLOT II - BAITED PLOT

Species	No. Young Hatched	No. Days Observed In Nest Following Baiting	Number Successfully Reared	% Mortality	Remarks
Red-shafted Flicker	?	7 days	5	-	
W. Meadowlark	5	13 days	5	0	
Redwing	3	11 days	2	33.3	1 found dead below nest.
Lark Bunting	3	3 days	3	0	
Lark Sparrow	5	5 days	5	0	
TOTAL	16		15	6.2	

PLOT I - CONTROL PLOT

W. Meadowlark	5	8 days	5	0	
W. Meadowlark	5	12 days	1 <sub>1</sub>	20.0	1 unaccounted for.
W. Meadowlark	5	12 days	5	0	
W. Meadowlark	1 <sub>1</sub>	8 days	1 <sub>1</sub>	0	
W. Meadowlark	1 <sub>1</sub>	12 days	1 <sub>1</sub>	0	
Redwing	1	1 day	0	100.0	1 unaccounted for.
Bullocks Oriole	1 <sub>1</sub>	5 days	1 <sub>1</sub>	0	
Bronzed Grackle	5	11 days	3	10.0	1 found dead in nest. 1 unaccounted for.
TOTAL	33		29	12.1	

\* Nests on Plot I were approximately ten days earlier than on Plot II.

significant because some of the nesting birds (western meadowlark, red-wing, lark sparrow) on the baited area were seen feeding grasshoppers to their young. It seems probable that many of these grasshoppers were those that had consumed chlordane bait. Jackson (unpublished thesis) fed penned pheasants food which had been treated with the maximum calculated amount of chlordane which would normally be encountered under field conditions. He found neither mortality nor loss in body weight in his experimental birds over a period of four weeks.

No dead or sick birds were observed on either the experimental baited plot or the larger baited area in Rosebud and Powder River Counties. It is probable that affected birds could have been overlooked. However, it seems logical to assume that some evidence of deleterious effects would have been noticed if there had been a high degree of affliction because many normally appearing birds were seen. Birds present on the experimental plot are listed in Table I. The western meadowlark and sharp-tailed grouse were the birds most commonly seen on the larger baited area, young of both being observed closely. One flock of adult sharp-tailed grouse, ranging from seven to ten birds was observed regularly. Young of upland plovers, vesper sparrows, redheaded and Lewis's woodpeckers and nighthawks were observed close at hand. These observations do not conform with Post's (1951) findings. He reported finding many dead and affected birds on chlordane baited areas. The two sets of data are not entirely comparable since he points out that from 5 to 35 pounds of chlordane bait per acre were applied during the control program. The

extent of application on the exact areas where the affected birds were located was evidently not known.

#### Aldrin

Before application of aldrin spray to Plot II, the grasshopper population ranged from 5 to 65 per square yard. Following the spraying, a steady decline was noted for four days, until a population of less than one per square yard was present. These figures were obtained through quantitative measurements of the population by N. L. Anderson of the Montana State Entomologists Office.

The average number of birds observed per day on Plots I (control plot) and II (sprayed plot) during the pre- and post-spraying census periods is given by species in Table IV. Four censuses were considered invalid for use in computing daily averages on the two plots due to adverse censusing conditions. The sprayed area had a daily average of 92.38 for the pre-spraying, and 83.64 for the post-spraying census period, a decrease of 8.74 birds or 9.5 percent. Daily averages for the control plot during the same periods were 86.0 and 80.56 respectively, a decrease of 5.44 birds or 6.3 percent. The western meadowlark shows similar trends on both areas following the spraying of Plot II (Table IV). These data do not indicate any great differences in the changes in the population indices of the two plots following spraying of Plot II.

The resident pairs of birds present on Plots I and II, during the census periods before and after the spraying of Plot II are summarized in Table V. A total of 43 pairs was present on the sprayed plot during

TABLE IV - AVERAGE NUMBER OF BIRDS OBSERVED / DAY ON PLOTS I AND II, BEFORE AND AFTER ALDRIN SPRAYING, 1951. ONLY PLOT II SPRAYED.

	PLOT I Control Plot			PLOT II Sprayed Plot		
	June 8-19	June 21- July 7	% Change	June 7-19 (Pre- spraying)	June 21- July 7 (Post- spraying)	% Change
Mallard				.77	.57	- 26.0
Sparrow Hawk	1.00	2.25	+125.0			
Sharptail Grouse		1.62				
Sage Hen		.50				
Ring-necked Pheasant	.25	.06	- 76.0	.38	1.43	+276.3
Killdeer		.06		.85		-100.0
W. Mourning Dove	.25	.19	- 24.0	1.08	1.07	- 0.9
Black-billed Cuckoo	.58	.69	+ 19.0	.23	.93	+304.3
Red-shafted Flicker	1.00	1.12	+ 12.0	1.62	1.14	- 29.6
Hairy Woodpecker				.08		-100.0
Eastern Kingbird	3.08	2.62	- 14.9	6.92	7.28	+ 5.2
Arkansas Kingbird	2.83	1.94	- 31.4	.92	.14	- 84.8
Magpie	.17		-100.0	6.00	3.00	- 50.0
W. House Wren	1.42	1.25	- 12.0	1.38	2.21	+ 60.1
Brown Thrasher	.17	.06	- 64.7	.08	1.00	+1150.0
Robin	.25	.12	- 52.0	1.08	.14	- 77.8
Cedar Waxwing				.15		-100.0
Yellow Warbler	3.42	1.25	- 34.2	3.77	3.28	- 13.0
Yellowthroat	1.33	.81	- 39.1	3.62	2.64	- 27.1
W. Meadowlark	36.17	40.31	+ 11.4	15.31	18.50	+ 20.8
Redwing	16.92	14.62	- 13.6	20.85	20.14	- 3.4
Bullock's Oriole	5.58	5.19	- 7.0	6.08	3.78	- 37.8
Bronzed Grackle	6.83	4.81	- 29.6	9.23	5.57	- 39.6
Cowbird				.08		-100.0
Black-headed Grosbeak	.25	.38	+ 52.0	.23	.36	+ 56.5
Lazuli Bunting	.17	.19	+ 11.7	1.08	2.00	+ 85.2
Goldfinch	.08		-100.0	.31	.64	+106.4
Arctic Towhee	.08	.06	- 25.0	1.15	.86	- 25.2
Lark Bunting	2.58	.06	- 97.7	1.23	1.00	- 18.7
W. Lark Sparrow	1.58	.38	- 75.9	7.92	5.93	- 25.1
<b>TOTAL</b>	<b>86.00</b>	<b>80.56</b>	<b>- 6.3</b>	<b>92.38</b>	<b>83.64</b>	<b>- 9.5</b>

TABLE V - RESIDENT PAIRS OF BIRDS ON PLOTS I AND II, BEFORE AND AFTER ALDRIN SPRAYING, 1951. ONLY PLOT II SPRAYED.

	PLOT I Control Plot			PLOT II Sprayed Plot		
	June 8-19	June 21- July 7	% Change	June 7-19 (Pre- spraying)	June 21- July 7 (Post- spraying)	% Change
Sparrow Hawk	1	1	0.0			
Killdeer				1		-100.0
Black-billed Cuckoo		1			1	
Red-shafted Flicker	1	1	0.0	1	1	0.0
Eastern Kingbird	1	1	0.0	3	3	0.0
Arkansas Kingbird	1	1	0.0			
Magpie				2		-100.0
House Wren	1	1	0.0	2	2	0.0
Brown Thrasher					1	
Robin				1		-100.0
Yellow Warbler	3	2	- 33.3	2	1	- 50.0
Yellowthroat	2	2	0.0	2	3	+ 50.0
Meadowlark	18	21	+ 16.7	14	13	- 7.1
Redwing	4	5	+ 25.0	6	6	0.0
Bullock's Oriole	3	3	0.0	2	2	0.0
Bronzed Grackle	2	1	- 50.0	2	1	- 50.0
Lazuli Bunting				1	1	0.0
Arctic Towhee				1	1	0.0
Lark Sparrow	1		-100.0	3	3	0.0
TOTAL	38	40	+ 5.3	43	39	- 9.3

the pre-spraying and 39 during the post-spraying census period, showing a decrease of 4 pairs or 9.3 percent. Totals on the control plot for the same periods were 38 and 40 pairs respectively, an increase of 2 pairs or 5.3 percent. The pair of killdeers and both pairs of magpies present on Plot II during the pre-spraying and not during the post-spraying census period were known to have successfully reared young and moved off the plot during the pre-spraying census period. On Plot I, the pair of lark sparrows abandoned the nest and moved off the plot before the post-spraying census period. Omitting these pairs from the plots, the percentage change for Plots I and II were + 8.1 and - 2.5 percent respectively. Based on the numbers of each species resident on the plots, the most striking difference in the change of resident pairs between the two plots following the spraying of Plot II concerns the western meadowlark (Table V). Field observations gave some clues as to the probable cause. Most of the young of the first broods of this species were leaving the nests at the time of spraying (observations indicated that this species raised two broods). "Second nestings" were begun several days after the grasshopper kill was complete. It is possible that the sprayed area was not as attractive for nesting due to the scarcity of grasshoppers as compared to nearby areas. It is well known that meadowlarks feed heavily on grasshoppers at this season. These data suggest that the resident bird population on the treated area was affected by the aldrin.

The fate of nestling birds on Plots I and II, which hatched before or soon after the spraying of Plot II, is summarized in Table VI. A greater mortality of nestling birds occurred on the sprayed plot (27.5%)

TABLE VI - FATE OF NESTLING BIRDS HATCHED BEFORE OR SOON AFTER ALDRIN SPRAYING ON PLOT II, 1951. SIMILAR FIGURES FOR PLOT I (CHECK PLOT) INCLUDED FOR COMPARISON.

PLOT II - SPRAYED PLOT

Species	Number Young Hatched	No. Days Observed In Nest Following Baiting	Number Successfully Reared	% Mortality	Remarks
Yellow Warbler	1	6 days	1	0	
Yellow Warbler	1	1 days	1	0	
W. Meadowlark	7	7 days	6	11.3	1 unaccounted for.
Redwing	1	2 days	2	50.0	1 found dead below nest. 1 unaccounted for.
Redwing	5	8 days	0	100.0	2 found dead in nest. 3 unaccounted for.
Redwing	3	6 days	0	100.0	2 found dead in nest. 1 unaccounted for.
Redwing	1	5 days	1	0	
Redwing	1	7 days	1	0	
Bullock's Oriole	?	11 days	1	-	
Lark Sparrow	5	1 days	5	0	
TOTAL	40		29	27.5	

PLOT I - CONTROL PLOT

Yellow Warbler	5	1 days	1	20.0	1 unaccounted for.
W. Meadowlark	6	7 days	5	16.6	1 unaccounted for.
Redwing	5	6 days	5	0	
Redwing	5	10 days	1	20.0	1 found dead below nest.
Redwing	3	6 days	3	0	
Bullock's Oriole	5	10 days	1	20.0	1 unaccounted for.
TOTAL	29		25	13.7	

than on the control plot (13.7%). Nestling redwings supplied the greatest amount of data because their hatching date coincided closely with the spraying date of Plot II. There was a higher degree of mortality in nestlings of this species than in those of the other species. Considering the redwing alone, a 50 percent loss of nestlings was recorded from the sprayed plot while only a 7.7 percent loss was recorded for the control plot. The fate of two nests on the sprayed area was especially striking. All of the young (3 and 5) were found dead in their nests or missing within eight days after spraying (Table VI). The young from the two nests had hatched one and two days before the spraying. These nests were located 200 feet apart, near a large flat which before the spraying had had the heaviest grasshopper populations. Adult redwings from the area where the nests were located had been observed feeding regularly on this flat before and for a short time after the spraying. The amount of feeding on this flat was observed to be greatly reduced by eight days after spraying. The young found dead in these nests were examined for food content. The digestive tract of each was empty with the exception of one which contained parts of a beetle in the gizzard. This might lead one to suspect that the young died of starvation. (Unfortunately, the young were not analyzed for the presence of aldrin.) The cause(s) of these complete nesting failures is, of course, unknown, but the fact that the development of these nests was so completely different from others observed during the two summers suggests some relationship to the spraying operation and its subsequent effects. These nestling data point to the

conclusion that the aldrin spray adversely affected the development of nestlings.

No dead or sick adult birds were observed on either the experimentally sprayed plot or on the sprayed area in Sheridan County. In addition to the birds listed in Table IV for study Plot II, sage hens were observed on the experimentally sprayed area. A few small flocks of two or three were seen and the activities of a single flock of nine adults were closely watched for approximately one-half hour on three consecutive days beginning with the fifth day after spraying. The pheasants observed on the experimentally sprayed area during the post-spraying census period consisted of single males and three individual hens with broods which were seen on different occasions. During the time spent on the sprayed area in Sheridan County, an average of 35 birds was observed daily. The species present, listed in order of their numerical importance, were the savannah sparrow, chestnut-collared longspur, sharp-tailed grouse, redwing, western meadowlark, vesper sparrow, and horned lark. The sharp-tailed grouse observed composed a flock ranging in numbers from 8 to 12 and were seen regularly in the same area.

## DISCUSSION AND CONCLUSIONS

No positive evidence of bird mortality which could be attributed directly to the toxicity of either chlordane or aldrin was obtained. It is true that some mortality in redwing nestlings was evidently associated with the aldrin spray, but there was evidence suggesting a lack of food as being a contributing factor. Assuming for convenience that these nestlings were killed directly by the effects of the insecticide, the fact still remains that when all available data are considered, the effects due to toxicity of the insecticides were of little importance.

On the other hand, there was evidence to indicate that the bird populations on the treated plot were adversely affected by the reduction of grasshopper numbers brought about by the insecticides. The magnitude of this effect seemed to be in proportion to the efficiency of the insecticide in reducing the grasshopper population. Aldrin spray effected a near 100% reduction in grasshopper numbers, whereas chlordane bait reduced the population by only about 50%. The number of resident pairs and the development of nestlings seem to be more valuable criteria for evaluating the effects of the insecticides on the bird populations than daily population indices, because of the somewhat unstable character of the latter. Following the application of aldrin to Plot II, there was apparently a reduction in the total number of resident pairs. This reduction was more marked for the western meadowlark, the most common resident, making it more amenable to quantitative measurements. When chlordane bait was used, there was apparently no reduction in total residents, but the western meadowlarks exhibited the same trend as when aldrin spray was used. As

was previously stated, there was evidence of adverse effects of the aldrin spray on the development of certain nestlings whereas no such data were available following chlordane baiting. The data lead to the conclusion that a reduction of the grasshopper population by as much as 50 percent (chlordane) was sufficient to make the area less desirable for resident pairs but not to affect the development of nestlings. A near 100 percent reduction of the grasshopper population (aldrin) made the area even less desirable for resident pairs and also appeared to adversely affect development of certain nestlings.

SUMMARY

1. A study of the effects of chlordane baiting and aldrin spraying for grasshopper control on bird populations was conducted during the summers of 1950 and 1951.
2. Two square, 40-acre study plots (treated and control) were selected on rangeland near Custer National Forest in southeastern Montana.
3. An effort to determine the effects was made by comparing population index, number of resident pairs, and development of nestling birds on the treated plot, before and after application of the insecticide, with similar data from the control plot. Data of a more general nature were gathered by observations on larger treated areas.
4. In 1950, chlordane bait was applied at the usual rate of ten pounds per acre to one square mile surrounding and including one study plot.
  - a. The population index on the baited plot before and after baiting was 68.16 and 62.41 respectively, a decrease of 8.4 percent. Figures from the control plot over the same periods were 77.84 and 80.64, an increase of 3.1 percent.
  - b. The resident pairs on the baited plot, before and after baiting, numbered 37 and 44 respectively, an increase of 18.9 percent. Totals for the control plot, over the same periods, were 40 and 45 pairs, an increase of 12.5 percent. The most abundant bird on both plots, the western meadowlark, showed an increase on the control and remained somewhat stable on the treated plot following baiting.

- c. Development of nestling birds on the baited plot following baiting appeared similar to that of nestling birds of equal age on the control plot.
  - d. Considerable searching on the baited plot and on additional baited areas revealed no sick or dead birds.
5. In 1951, aldrin spray was applied at the usual rate of two ounces of aldrin in one gallon of fuel oil per acre to 400 acres, surrounding and including one study plot.
- a. The sprayed plot had a population index of 92.38 before and 83.64 after spraying, a decrease of 9.5 percent. Figures for the control plot for the same periods were 86.00 and 80.56, a decrease of 6.3 percent.
  - b. Resident pairs on the sprayed plot totaled 43 pairs before spraying and 39 after, a decrease of 9.3 percent. Totals for the control plot over the same periods were 38 and 40, an increase of 5.3 percent. The western meadowlark exhibited an increase on the control and a decrease on the sprayed plot following spraying.
  - c. Nestling redwings exhibited a higher mortality rate (50%) on the sprayed than on the control plot (7.7%). Mortality rates of nestlings of other species on the sprayed plot were similar to those on the control plot.
  - d. No sick or dead adult birds were observed on the experimentally sprayed plot or on other sprayed areas.
6. No positive evidence of bird mortality due directly to the toxicity of the insecticides was obtained. Some adverse effects on the bird

populations were noted. These effects were apparently associated with reduction in grasshopper numbers, appearing to be in direct proportion to the extent of the grasshopper kill.

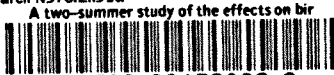
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