

AVIAN MORTALITY FROM DDT IN CALIFORNIAN RICE FIELDS

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Wildlife in the rice fields of the Sacramento and San Joaquin valleys of California is a valuable recreational and esthetic resource. In the valleys, plantings of rice have been increasing for several years, and in 1954 the total cultivated was approximately 350,000 acres. The constant water supply and abundance of food in rice fields allow the existence of dense bird populations. Of particular interest to the sportsman is the excellent hunting which results from concentrations of waterfowl and pheasants on these lands. Although application of chemicals to control noxious invertebrates is necessary to insure economically satisfactory production, conservationists feel that consideration must be given to possible undesirable effects on wildlife of such control measures. To serve the interests of both agriculturalists and conservationists we need to examine factors which disturb desirable recreational and esthetic values on these lands.

Recognition of the multiplicity of values of managed lands necessitates continuing examination of use of chemical controls in agricultural practice. Serious disturbances from such chemicals may result from carelessness or from lack of appreciation of the high toxicity of the newer control chemicals. A case in point is the sowing of DDT-coated seed rice. The chemical is applied to control tadpole shrimps and scavenger beetles which may damage seedling rice. With the intent of reducing operating costs, growers have combined the sowing and chemical control phases of rice culture. Reduction of costs is, of course, always desirable but it is also desirable to investigate the possibility of unfavorable ecological effects resulting from this method of applying chemicals.

Field reports on avian mortality in rice fields, at best, have been insufficiently documented. Some have been little more than "impressions." However, reports of bird loss in rice fields due to DDT have now been recorded from Glenn, Yolo, Sutter, San Joaquin, and Merced counties. Presumably, conditions of exposure are the same in the other rice-growing counties. From the field reports alone, it is difficult to conclude that no effect of the treated seed on birds exists.

We have investigated reports in San Joaquin and in Merced counties. The first of these concerned a pheasant in a delta rice field that was observed to exhibit the characteristic tremors of DDT poisoning. Several verbal accounts confirmed the reports of pheasant loss in this area. A rice grower near Merced, who was also an ardent conservationist, had originally reported significant bird losses on his own farmlands. He had found dead pheasants, ducks and blackbirds and had reported that "some" pheasants when approached appeared reluctant to run or fly and showed signs of incoordination.

On our first survey of the Merced field on May 5, 1953, we found ten dead Mallards (*Anas platyrhynchos*), one dead Ring-necked Pheasant (*Phasianus colchicus*) and one dead blackbird. The pheasant had died a short time previously and was in the same area where one was seen behaving strangely the preceding day. At autopsy, all birds showed empty crops and gizzards with the exception of the pheasant, in which there was rice in both crop and gizzard. The second trip to the same ranch on May 15, 1953, yielded four dead male Mallards. Crops and gizzards of all showed traces only of vegetable matter. One bird had extensive subcutaneous hemorrhage and none showed obvious injury.

The consensus of field reports is that a detectable mortality of birds occurs regularly during the sowing period (April to June). As a test of the likelihood of mortality in the field, it seemed desirable to determine experimentally the effect of DDT-treated rice on caged pheasants and ducks. The results of feeding experiments with six male Pin-

tails (*Anas acuta*) and twelve pheasants of both sexes are indicated in table 1. Rice treated at the rate of one and one-half pounds of DDT (three pounds of a 50 per cent wettable powder) per 100 pounds was offered *ad libitum* to experimental birds. This value is equivalent to 15,000 parts per million DDT in the diet. In other studies, values as low as 400 parts per million in the diet have caused death. All birds were caged in outdoor pens at the University of California in Davis. Normal feeding was resumed after 11 days with the remaining test pheasants and after 15 days with remaining ducks.

Results of Feeding DDT-Treated Seed Rice to Ring-necked Pheasants and Pintail Ducks

Number and sex	Weight in grams			Time in days			Remarks
	At dosing	Terminal	Change	Interval between weights	Dosing to 1st observed symptom	Dosing to death	
Pheasants							
562 ♀	938	891	-47	19	....	(survived)	no symptoms
563 ♀	901	865	-36	19	....	(survived)	no symptoms
567 ♀	869	836	-33	19	4	(survived)	slight incoordination
573 ♀	836	762	-74	19	....	(survived)	no symptoms
586 ♀	801	740	-61	19	6	(survived)	slight tremors
981 ♀	943	830	-113	13	4	5	severe tremors
574 ♂	1176	1036	-140	13	4	5	severe tremors
577 ♂	1287	1110	-177	13	3	5	severe tremors
528 ♂	1115	1057	-58	19	....	(survived)	no symptoms
719 ♂	1208	1001	-207	18	....	10.	no symptoms
720 ♂	1234	1125	-109	19	....	(survived)	no symptoms
721 ♂	1213	1028	-185	12	3	4	severe tremors
Ducks							
102 ♂	995	953	-42	35	....	(survived)	no symptoms
108 ♂	797	599	-198	30	13	13	visceral hemorrhage
114 ♂	1045	862	-183	35	....	(survived)	no symptoms
141 ♂	882	669	-213	32	13	15	mild tremors
147 ♂	946	702	-244	32	14	15	severe tremors
197 ♂	831	678	-153	35	....	(survived)	weakened

Pheasants did not begin to resist the diet until symptoms were well advanced. Ducks, however, appeared reluctant to eat the treated grain after two or three days of exposure. All birds registered losses in weight (see table). Histological preparations of the liver of two birds (nos. 574 and 721) revealed slight fatty degenerative changes characteristic of chlorinated hydrocarbon intoxication. Most specimens at autopsy showed some visceral hemorrhaging and one (no. 577) had numerous small subcutaneous hemorrhages. This subcutaneous congestion was similar to that found in a wild Mallard.

The pattern of mortality clearly shows that male pheasants are more susceptible to the chemical than are females. Greater sensitivity of male pheasants to DDT has also been noted in our other studies.

Although results from pen experiments may not be applied directly to field conditions, the combination of field reports and controlled experimentation in this instance makes it clear that DDT-treated grain is or can be lethal to grain-eating birds. This mortality may be entirely eliminated by applying chemical and seed separately. There is some indication that application of chemical after germination yields more effective pest control. In recognition of this, many growers have already begun to apply DDT a week or two after sowing.

Acknowledgment.—This study was supported by the Federal Aid in Wildlife Restoration Act, Project California W45-R.

University of California, Davis, California, November 24, 1954.