Preliminary Study of Pesticide Levels in the Eggs of Iowa Pheasants, Blue Wing Teal and Coots

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Pesticides are widely used in Iowa and have been applied in steadily increasing annual rates by the agricultural industry for more than twenty years. Figures stating actual pounds used of each compound are not available, but through general knowledge of the insect problems occurring in this region, we are certain that generous applications of DDT, aldrin and heptachlor have been made to combat corn borers and corn rootworms. The use of DDT in Iowa agriculture has declined and in recent years has been very small.

Because of the possible adverse effects on the reproduction of fish and wildlife by persistent pesticides the State Hygienic Laboratory and the State Conservation Commission undertook a cooperative study of the residual levels of these chemicals in the eggs of some fish from Iowa waters and a variety of birds.

These persistent pesticides are principally the chlorinated hydrocarbon insecticides which have been widely used such as DDT and its metabolities, dieldrin and heptachlor epoxide which are the epoxides of aldrin and heptachlor.

The following article contains the results of the analyses of some pheasant, blue wing teal and coot eggs. The data on fish eggs will be published in a separate article.

While it is generally agreed that there is not usually widespread adult mortality in fish and wildlife due to pesticide poisoning, the effect that accumulation of pesticides in these species has on reproduction is not well understood. There have been reports of lowered reproductive rates in species of birds whose egg shells have become thinner due to exposure of the birds to relatively large amounts of pesticides.

In order to gain an insight into the potential problem in Iowa, eggs from the above mentioned species of birds were collected by the State Conservation Commission during May 1969.

Pheasant eggs were collected from numerous nests in several counties and coot and blue wing teal eggs were collected from nests in the Ventura marsh in Cerro Gordo County.

Bulletin of Environmental Contamination & Toxicology,
Vol. 5, No. 5, 1970, published by Springer-Verlag New York Inc.

Methods of Analysis

All of the analyses of the bird eggs were done by the Mills, Onley and Gaither[1] method. This method and three others were recently compared for the determination of chlorinated pesticide residues in eggs by Wessel[2]. The conclusion reached was that all of the methods gave comparable results and the Mills, Onley and Gaither method can be applied to the determination of chlorinated pesticide residues in eggs. One egg was selected from each nest and analyzed by the above procedure.

The final determinations were made on a F & M Model 400 gas chromatograph equipped with an electron capture detector. Glass columns 4' x 1/8" I.D. were used in the instrument. Both a non-polar OV-1 column and a polar mixed QF-1:DC200 column were used to confirm the identities of the various peaks and to quantitate them.

Results and Conclusions

In evaluating the levels of pesticides in the tissues of any animal, the diet of the species under study needs to be considered.

Pheasants are essentially seed and insect-eating birds and in Iowa live near agricultural areas where large amounts of a variety of pesticides are generally used. This is reflected in the data in Table I which shows a great variability in the analysis from egg to egg. The DDT residues in the eggs tested are relatively low as might be expected since DDT has not been extensively used in Iowa agriculture for some years.

Dieldrin and heptachlor epoxide show up in significant but highly variable amounts, probably resulting from some birds getting their food from fields which have been treated with aldrin or heptachlor while other birds are not in such close proximity to treated fields. No explanation is apparent for the high concentration of lindane found in one egg (Table I).

The sum of the DDT product residues in the coot and blue wing teal eggs, shown in Table II, are roughly ten times greater than in the pheasant eggs. This is not surprising since these birds feed on shallow-water organisms such as plants, insects and mollusca which tend to concentrate and magnify the trace amounts of DDT residues present in the aquatic environment.

With one exception each, dieldrin and heptachlor epoxide are generally more uniformly distributed and at lower levels in the waterfowl eggs. Undoubtedly, the eggs of fish-eating water birds which are further up the food chain would contain larger amounts of DDT, dieldrin and heptachlor epoxide residues. See the excellent review of pesticides in the environment by Stickel on this subject[3].

TABLE I
Pesticides in Pheasant Eggs
Concentration in Parts Per Billion

Egg	County	DDT	DDE	Dieldrin	Heptachlor Epoxide	Lindane
1	Union	9	14	1,400		
2	Union	5	8	18	16	
3	Union	42	26	180	26	3,100
4	Lucas	5	9	330	120	
5	Poweshiek	7	8	32	220	
6	Poweshiek	9	9	9	29	
7	Story	26	20	100	25	
8	Story	22	18	63	19	

TABLE II
Pesticides in Water Bird Eggs
Concentration in Parts Per Billion

Egg	DDT	DDE	DDD	opDDT	Dieldrin	Heptachlor Epoxide
Coot						
1	40	84	3	4	74	10
2	33	77	3	2	65	7
3	190	450	180	61	83	9
4	50	100	5	3	62	10
5	20	39	-	3	42	--
6	24	120	4	4	37	7
Blue Wing Teal						
1	57	044	18	7	680	31
2	115	360	19	8	12	7
3	49	120	14	6	8	79
4	32	120	8	8	70	21
5	26	77	10	8	42	15
6	36	110	16	9	64	11

Reduction of some bird populations resulting from an enzyme induced breakdown of specific sex hormones attributed to the uptake of certain insecticides of the chlorinated hydrocarbon group has become a matter of solemn concern to the wildlife profession. Verified reports of decreased eggshell thickness for eagles, peregrine falcons, ospreys and sparrow hawks, with subsequent reproductive failures and a precipitous decline in their populations, have prompted us to investigate the role of pesticides in Iowa wildlife of importance to sportsmen. Our initial pesticides studies were directed toward a determination of the occurrence of and concentrations of pesticides found in the natural waters of the state and in those portions of fish and game species commonly consumed by humans for food. Episodes such as the failure of Great Lakes coho salmon to spawn successfully and reproductive crashes for those raptors cited above have led us to investigate pesticides in the eggs of several species of fish, waterfowl and pheasants.

Except for the ringneck pheasant Phasianus colchicus, we do not now have sufficient data to make a legitimate assessment of the effect pesticides may or may not have upon fish and game populations. In the case of pheasants, however, we do have annual observations dating back to 1954 that we hold significant and worthy of record. The data involves surveys of the reproductive success of pheasants carried on in August of each year. These statewide surveys provide two pieces of data pertinent to the pesticide problem - (1) the percentage of hens with broods, and (2) the average number of young in each brood. Table III lists these annual surveys for the past sixteen years.

TABLE III

Indices to Reproductive Success of Iowa Ringneck Pheasants
Phasianus colchicus as Obtained
From Late Summer Roadside Surveys

Year	% Hens with Broods	No. Broods Observed	Avg. No. Young Per Brood
1954	64	1,732	3.7
1955	77	2,314	5.2
1956	71	2,165	4.2
1957	74	2,183	4.4
1958	72	2,878	4.5
1959	64	2,407	3.5
1960	72	2,037	4.1
1961	63	1,655	3.8
1962	69	1,050	5.0
1963	69	1,493	5.2
1964	71	1,488	5.4
1965	65	1,143	4.7
1966	66	1,338	3.5
1967	58	1,113	3.5
1968	64	1,181	4.5
1969	68	1,034	5.0

Our studies revealed the presence of several insecticides in measurable levels in the eggs of the ringneck pheasants. However, the data in Table III does not show any trend toward barren hens or continuous reduction in brood size. In every case population highs and lows have been attributed by conservation commission biologists to favorable or unfavorable climatic conditions occurring at the time of nesting. While the increasing use of pesticides in Iowa agriculture has led to the presence of small but measurable amounts of insecticide residues in the eggs of some wild birds, in the case of the ringneck pheasant we are not able to show that this has had any discernible affect on reproductive success.

REFERENCES

1. P A Mills, J H Onley and R A Gaither, J Assoc Offic Agri Chem, 46, 186 (1963)

2. J R Wessel, J Assoc Offic Anal Chem, 52, 172 (1969)

3. L F Stickel, Bureau of Sport Fisheries and Wildlife, Special Scientific Report - Wildlife No. 119