Journal of the Arkansas Academy of Science

Volume 45 Article 14

1991

Organochlorine Pesticide Concentrations in Various Species of Migratory Passerines in Louisiana

Ragupathy Kannan
University of Arkansas, Fayetteville

ORGANOCHLORINE PESTICIDE CONCENTRATIONS IN VARIOUS SPECIES OF MIGRATORY PASSERINES IN LOUISIANA

RAGUPATHY KANNAN
Department of Biological Sciences
University of Arkansas
Fayetteville, AR 72701

ABSTRACT

Twenty-four specimens of southbound migratory passerines comprising 13 species were collected in northeastern Louisiana during 1986, and were subjected to gas-chromatography analyses for organochlorine pesticide compounds. Eleven of the specimens analyzed (46%) were positive for pesticides. The compounds detected were in trace amounts ranging from 1.37 to 200.14 ppb. The data indicated a further decline in pesticide burdens in birds since the ban on DDT. It also supported the hypothesis that a post-mortem breakdown of DDT to DDE may occur in avian tissues. It is hypothesized that northbound migrants may have higher pesticide burdens than fall migrants considering the continued usage of pesticides in their wintering grounds south of the United States border.

INTRODUCTION

Monitoring of pesticide levels in wildlife has intensified since the 1950's when man started the indiscriminate use of chlorinated hydrocarbons to curb populations of insect pests. Most of the investigations were carried out on raptorial species or waterfowl (Blur, 1984; Cade *et al.*, 1968; Cain, 1981). Little research has been conducted on the possible contamination of the myriads of small insectivorous, granivorous or frugivorous bird species. A single major study was conducted between 1964 and 1973 on wild North American passerine birds to study environmental organochlorine pesticide pollutants (Johnston, 1975).

The present study had two objectives: 1. To increase the knowledge of the pesticide exposure problem faced by migratory passerines along their international routes, and 2. To check the current status of avian organochlorine pesticide residues following more than a decade after the ban was imposed on their use in the United States.

MATERIALS AND METHODS

The tissues of 13 species of passerine birds, the White-eyed Vireo *(Vireo girseus)*, Red-eyed Vireo *(Vireo olivaceus)*, Yellow-throated Vireo *(Vireo flavifrons)*, Philadelphia Vireo *(Vireo philadelphicus)*, Warbling Vireo *(Vireo gilvus)*, Prothonotary Warbler *(Protonotaria citrea)*, Common Yellow-throat *(Geothlypis trichas)*, Black and White Warbler *(Mniotilta varia)*, Nashville Warbler *(Vermivora ruficapilla)*, Magnolia Warbler *(Dendroica magnolia)*, Tennessee Warbler *(Vermivora peregrina)*, Worm-eating Warbler *(Helmitheros vermivorus)*, and Indigo Bunting *(Passerina cyanea)* were analyzed in the study. The specimens were collected in Ouachita Parish, Louisiana. All of the specimens analyzed were obtained during fall of 1986 when the birds were on their southbound autumn passage. The birds were accidental tower kills by collision against television towers during migratory flight. The specimens were stored in a freezer where they remained for at least 15 months prior to the analyses.

The extraction and analyses of pesticide residues were done following the methods adopted by White (1976). The instrument used for analyses was a Hewlett Packard Model 5880A gas-chromatograph equipped with a Hewlett Packard Model 7672A automatic sampler and a Nickel 63 electron capture detector. Operating parameters followed were those of White (1976). One microliter of the sample was used in each injection. The samples were identified and quantified using a non-polar 3% SE-30 column. Identifications were verified using a polar 3% OV-17 column. The columns were 6 feet long and 2 mm in diameter.

Organochlorine compounds were identified by comparing the retention times obtained with the sample extract with those obtained with standard pesticide standard solutions. Pesticide standards were obtained from the Pesticide Monitoring Laboratory, Bay Saint Louis, Mississippi. Standard "A" contained the following pesticides: heptachlor, heptachlor epoxide, chlordane, dieldrin, endrin, o, p'-DDT, and p,p'-DDT in known concentrations. Standard "B" contained: aldrin, o,p'-DDE, p,p'-DDE, and p,p'-TDE in known concentrations.

RESULTS AND DISCUSSION

Eleven of the 24 bird samples analysed (46%) were found to contain pesticide residues (Table 1). Nine of the 13 species collected were positive for pesticides. Four compounds were detected viz. p,p'-DDE, o,p'-DDE, dieldrin and heptachlor epoxide. p,p'-DDE was the most predominant residue showing up in 38% of the samples. Dieldrin followed next in the order of predominance (16%) followed by o,p'-DDE (8%) and heptachlor epoxide (4%). White (1976) had also detected a predominance of DDE in his analyses of duck liver tissues. Heath (1969) and Dindal and Peterle (1968) reported DDE was the major residue in their analyses of bird tissues. Studies of migratory song birds by Johnston (1975) also revealed more DDE residues than any other compound. DDT, the metabolic predecessor of DDE, was not detected during the present study. A possible explanation for the absence of DDT and predominance of DDE in the samples could be that most of the bird specimens were collected and stored in a freezer for at least 15 months before the analyses

Table 1. Organochlorine pesticide concentrations detected in eleven passerine birds collected in northeastern Louisiana during fall 1986.

Bird Species	Pesticide (ppb)			
	o,p'-DDE	p,p'-DDE	Dieldrin	Heptachlor epoxide
White-eyed Vireo	nd	1.37	nd	nd
Prothonotary Warbler	nd	77.62	nd	nd
Yellow-throated Vireo	nd	nd	12.48	nd
Yellow-throated Vireo	nd	77.48	37.91	nd
Yellow-throated Vireo	nd	200.14	nd	nd
Common Yellow-throat	nd	55.40	nd	nd
Black & White Warbler	nd	72.51	69.39	nd
Nashville Warbler	nd	108.34	nd	nd
Warbling Vireo	26.21	29.91	16.58	13.79
Worm eating Warbler	nd	45.86	nd	nd
Indigo Bunting	5.25	nd	nd	nd

were done. French and Jeffries (1969) found that in the anaerobic conditions existing after death, p,p'-DDT was broken down to p,p'-DDE in avian tissues. Later, White (1976) supported these findings in his studies on pesticide levels of duck livers, when he noted that most of the livers analyzed after 60 days in storage contained no DDT residues. The present study thus increases the evidence of the post-mortem breakdown of DDT to DDE.

All the bird samples analyzed were tower kills collected during fall migration, when the birds were on the southbound post-breeding movement. Two previous studies indicate that autumnal samples of migratory birds killed at television towers and ceilometers nearly always contained a high proportion of immature or birds-of-the-year individuals (Stoddard, 1962; Stoddard and Norris, 1967). In light of these findings, it seems more reasonable to assume that the birds in the present study had been contaminated in their summer range in North America.

Organochlorine pesticide residues were detected in trace amounts ranging from 1.37 to 200.14 ppb (Table 1). The highest concentration was found in a Yellow-throated Vireo. All four compounds were detected in a Warbling Vireo, which had a combined pesticide burden of 86.51 ppb. The mean DDE level detected was 60.34 ppb, well below the acceptable level of 4,000 ppb. The low concentrations are attributable to the decline in the usage of organochlorine pesticides in the U.S. over the past two decades. Johnson (1975) reported a progressive decline in DDT residues in migratory song birds between 1964 and 1973 and correlated it with the decreased use of DDT in the U.S. during the same period. In his studies, the mean annual concentration decreased from 17.80 ppm in 1964 to 2.06 ppm (2,060 ppb) in 1973. The data collected in the present study clearly indicated that a further decline in residue levels has occurred since 1973.

Even though the residue levels are negligible, the fact that they are present indicates that there are still areas across North America which have remnants of the pesticides used years ago. The levels in these areas could be very low and declining in the passage of time, but the risks of biological magnification along food chains cannot be ruled out. Migratory song birds form part of a subterminal trophic level wherein pesticide residues could play important roles in population dynamics. The organisms of trophic levels immediately above are prone to the effects of biological magnification. Similar concern had been expressed earlier by Cade *et al.* (1968) and Johnston (1975).

In the 1960's and 1970's Johnston (1975), in his studies on migratory song birds, found more pesticide residues in southbound autumn migrants than in northbound spring migrants. This was expected because at that time spraying was heavy in the U.S. In recent years, however, the use of these pesticides has ceased in the U.S. The more agriculture dependent, developing nations of Central and South America, the wintering range of many of our song birds, persist in the application of organochlorine pesticides. Some studies have suggested that birds wintering south of the U.S. border are exposed to higher levels of organochlorine pesticides than nonmigrant forms (Fleming *et al.*, 1983). Based on these facts, it is hypothesized that the trend could be reversed in recent years: northbound migrants carrying heavier burdens in their tissues than southbound ones. A similar case was reported in the Old World by Persson (1972) who detected a much higher DDT content in spring than in autumn for Whitethroats *(Sylvia communi)* migrating northward across North Africa and Europe to their late summer range in Sweden where DDThas been banned since 1970. The inability to obtain spring specimens for the present study has made it impossible to verify this possibility, but leaves this interesting aspect open for future study.

LITERATURE CITED

BLUR, L.J. 1984. Effects of heptachlor and lindane treated seed on Canada geese. J. Wildl. Management 48:1097-1111.

CADE, T.J., C.M. WHITE, and J.R. HAUGH. 1968. Peregrines and pesticides in Alaska. Condor 70:170-178.

CAIN, B.W. 1981. Nationwide residues of organochlorine compounds in wings of adult mallards and blackducks. Pest. Monit. J. 15:128-134.

DINDAL, D.L. and T.J. PETERLE. 1968. Wing and body tissue relationships of DDT and metabolite residues in mallards and lesser scaup ducks. Bull. Environ. Contam. Toxicol. 3:37-48.

FLEMING, W.J., D.R. CLARK, JR., and C.J. HENNY. 1983. Organochlorine pesticides and PCBs: A continuing problem for the 1980's. Trans. 48th N. Amer. Wildl. & Nat. Res. Conf. 48:186-199.

FRENCH, M.C. and D.J. JEFFRIES. 1969. Degradation and disappearance of ortho, para isomer of technical DDT in living and dead avian tissues. Science. 165:914-916.

HEATH, R. 1969. Nationwide residues of organochlorine pesticides in wings of mallards and blackducks. Pest. Monit. J. 3:115-123.

JOHNSTON, D. 1975. Organochlorine pesticide residues in small migratory songbirds 1964-1973. Pest. Monit. J. 9:79-88.

PERSSON, B. 1972. DDT content of whitethroats lower after summer stay in Sweden. Ambio. 1:34-35.

STODDARD, H.L., SR. 1962. Bird casualties at a Leon County Florida tv tower, 1955-61. Bull. No. 1, Tall Timbers Res. Stn. 1-94.

STODDARD H.L., SR. and R.A. NORRIS. 1967. Bird casualties at Leon County, Florida tv tower; an eleven-year study. Bull. No. 8, Tall Timbers Res. Stn. 1-104.

WHITE, D.H. 1976. Residues of DDT and DDE in livers of waterfowl in northeastern Louisiana 1970-71. Pest. Monit. J. 10:2-3.