PESTICIDE RESIDUES IN ILLINOIS LOGGERHEAD SHRIKES

A Wildlife Preservation Fund Final Report
FY-1995

Prepared by:

James R. Herkert
Illinois Endangered Species Protection Board
524 South Second Street
Springfield, Illinois 62701

PESTICIDE RESIDUES IN ILLINOIS LOGGERHEAD SHRIKES

INTRODUCTION

Loggerhead shrikes are found throughout most of the United States, southern Canada, and nearly all of Mexico. In southern regions they are year-round residents, but in the north they migrate south to areas without snow during the winter months. Worldwide there are over 70 species of shrikes, but the loggerhead shrike is the only member of the family that breeds in the lower contiguous 48 states. Shrike populations appear to be declining on a global scale, with many of world's shrike species now showing signs of population declines (Yosef 1994). In the U.S., loggerhead shrike populations are significantly declining throughout the country (Sauer et al. 1996). As a result of these population declines, loggerhead shrikes are considered to be either threatened or endangered in a majority of Midwestern states (Herkert et al. 1996). The loggerhead shrike is currently listed as threatened in Illinois (Illinois Endangered Species Protection Board 1994).

In Illinois, Loggerhead Shrikes are most abundant in the southern portion of the state, occurring less frequently and more locally in the north (Bohlen 1989). Data from the North American Breeding Bird Survey (BBS) show that loggerhead shrike populations in Illinois have significantly declined over the last 30 years (Fig. 1). Reports that shrike populations in northern and central portions of Illinois were declining, however, began to appear at least as early as 1910 (e.g., Hess 1910, Eifrig 1919). The reason consistently proposed for these early shrike declines was the elimination of hedgerows (Hess 1910, Efrig 1937, Nice 1945, Mayfield 1949). In the late 1930s, Eifrig (1937) wrote what appears to be the first somewhat quantitative description of the loggerhead shrike decline in Illinois. In writing about shrike populations in the Chicago area, Eifrig wrote that "formerly a pair could be seen every two or three miles along the road, now one may drive for days without seeing one." Nevertheless despite numerous subjective references to a declining shrike population in the state no firm data were collected until the late 1950s when Ronald Labisky and subsequently Jean and Richard Graber collected quantitative data on shrike population numbers from a 36 square mile area of principally agricultural land in north-central Illinois (Graber et al. 1973). These researchers documented the decline of nesting shrikes on a 23,000 acre agricultural area from 13 pairs in 1957, to the complete elimination of nesting shrikes from the area by 1966. The shrike's decline in this region appeared to be due to the partial elimination of hedgerows and a concurrent significant decline in grassland acreage in the region (Graber et al. 1973) .

Although population declines appear to be related to habitat loss, there is some evidence that apparently suitable, but unoccupied shrike habitat occurs in the Midwest (Brooks and Temple 1990a, 1990b, Burton and Whitehead 1990, Robbins 1991). This suggests that habitat may not be entirely limiting Midwestern loggerhead shrikes. Shrike nest success both in Illinois and in other Midwestern states is generally high (Hands et al. 1989), suggesting that reproductive failure also may not responsible for recent loggerhead shrike population declines. The shrike's generally high reproductive success, combined with the presence of seemingly suitable but unoccupied habitat has prompted some researchers to suggest that recent Midwestern loggerhead shrike declines may be due to reduced survival on the wintering grounds (e.g., Brooks and Temple 1990a, 1990b, Lymn and Temple 1991, Temple 1995), although the role of other potential limiting factors such as pesticides remains unclear (Hands et al. 1989).

Pesticides have frequently been cited as having the potential to significantly influence shrike populations, despite the fact that few data on the effects of pesticides on shrikes are available. Furthermore, most of the data implicating pesticides in shrike declines to date is conjectural. For example, Blumton et al. (1990) noted that widespread declines in loggerhead shrike populations coincided with widespread use of organochlorine

pesticides, and Cadman (1985) noted that the sharpest declines in shrike populations has occurred in agricultural areas. Pesticides have been shown to delay development of hunting skills in nestling loggerhead shrikes (Busbee 1977). The loggerhead shrike's diet, consisting only of animal matter, may make it more vulnerable to pesticide ingestion than most other passerines (Kridelbaugh 1981; Stevenson and Anderson 1994) and research has confirmed that shrikes tend to be impact more by pesticide applications than other passerines (Stevenson and Anderson 1994, Collins et al. 1974.

Field work conducted between 1971-1972, reported that Illinois' loggerhead shrikes in Illinois contained detectable concentrations of pesticide residues, primarily DDE, a result which may have contributed to shrike declines by reducing fledgling and adult survival rates (Anderson and Duzan 1978). Since the early 1970s, however, one of the most problematic pesticides (DDT, a precursor of DDE) has been banned. However, many other pesticides continue to be applied widely across the landscape. For example, in 1992 over three million acres of Illinois cropland was treated with insecticides. Since Anderson and Duzan's work in 1971 and 1972, no studies have examined pesticide levels in Midwestern Loggerhead Shrikes.

The purpose of this study was to reexamined pesticide levels in Illinois Loggerhead Shrike populations. Illinois is a good location to preform such a study because Illinois shrike populations are significantly declining (Sauer et al. 1996) and because Anderson and Duzan (1978) provide baseline data against which current pesticide levels can be compared.

METHODS

Between 1995-1996, 21 eggs were removed from 12 shrike nests (one egg from three nests, and two eggs from nine nests). Nests were located in six Illinois counties (Clay, Jasper, Marion, Menard, Wayne, and Will).

Once collected, egg samples were homogenized and analyzed on a gas chromatograph (GC) equipped with electron-capture detectors (ECD) used for organochlorine and PCB analyses. Residue confirmation was done using GC/mass spectrometry. All chemical analyses were performed by Prairie Analytical Systems, Inc. (Springfield, Illinois).

Comparisons of current pesticide levels with those reported for Illinois shrikes by Anderson and Duzan (1978) were made with a t-test.

RESULTS & DISCUSSION

Detectable levels of DDE (> 0.003 ppm, Appendix I) were present in 17 of the 21 egg samples (81%) collected in 1995-1996 (Table 1). Residues of DDE varied among eggs and ranged from 0.00-4.04 ppm (Table 1). Residue pesticide levels of eggs from the same clutch were highly correlated with one another (Figure 2) indicating that nearly all of the variability in DDE levels among eggs was variability between clutches.

Detectable levels (> 0.008) of DDT were found in nine eggs (Table 1). Residual DDT levels also varied among eggs, and ranged from 0.00-0.39 ppm (Table 1). No other organochlorine compounds were detected in the 21 shrike eggs evaluated in this study. A complete list of organochlorine compounds surveyed and their detection limits are listed in Appendix 1.

The comparison of DDE residual levels in 1995-1996 with those in 1971-1972 revealed that current pesticide levels in Illinois shrike eggs are substantially lower now than they were 25 years ago (Table 2). The mean

level of residual DDE in Illinois loggerhead shrike eggs was 0.66 ppm in 1995-1996 (Table 1). In 1971-1972, the mean level of residual DDE was 3.09 ppm, representing a reduction of 78.3% between 1971-1996 (Table 2). The median level of DDE within Illinois shrike eggs also declined considerably, declining by more than 80% between 1971-1996 (Table 2).

These results demonstrate that although residual pesticides are still found in a majority of loggerhead shrike eggs in Illinois, the levels have dropped considerably over the last 25 years. Yet, despite this significant reduction in pesticide levels in shrike eggs, shrike populations have continued to decline in Illinois (although the rate has slowed somewhat since the late 1960s and early 1970s, see Figure 1) suggesting that pesticides may not be driving recent Illinois shrike declines. Current Illinois loggerhead shrike population declines, however, are highly correlated with concurrent decline in pasture acreage in the state $r = 0.845$, $P < 0.001$, 1966-1996). Thus while indirect or sub-lethal pesticide impacts can not be ruled out as a factor in recent shrike declines, decline in habitat appears to be more of a factor in Illinois shrike declines.

REFERENCES:

Anderson, W.L. and R.E. Duzan. 1978. DDE residues and eggshell thinning in loggerhead shrikes. Wilson Bulletin 90:215-220.

Blumton, A.K., J.D. Fraser, R.W. Young, S. Goodbread, S.L. Porter, and D.L. Luukkonen. 1990. Pesticide and PCB residues for loggerhead shrikes in the Shenandoah Valley, Virginia, 1985-1988. Bulletin of Environmental Contamination and Toxicology 45:697-702.

Bohlen, H. D. 1989. The birds of Illinois. Indiana University Press. Bloomington. 221pp.

Brooks, B.L. and S.A. Temple. 1990a. Dynamics of a loggerhead shrike population in Minnesota. Wilson Bulletin 102:441-450.

Brooks, B.L. and S.A. Temple. 1990b. Habitat availability and suitability for loggerhead shrikes in the upper Midwest. American Midland Naturalist 123:75-83.

Burton, K.M. and D.R. Whitehead. 1990. An investigation of population status and breeding biology of the loggerhead shrike in Indiana. Unpublished report to the Indiana Department of Natural Resources, Nongame and Endangered Wildlife Program. 13pp.

Busbee, EL 1977. The effects of dieldrin on the behavior of young loggerhead shrikes. Auk:94:28-35.

Cademan, M.D. 1985. Status report on the loggerhead shrike (Lanius ludovicianus) in Canada. Committee on the status of endangered wildlife in Canada. 95pp.

Collins, H.L., G.P. Markin, and J. Davis. 1974. Residue accumulation in selected vertebrates following a single aerial application of Mirex bait, Louisiana 1971-72. Pesticides Monitoring Journal 8:125-130.

Eifrig, C.W.G. 1919. Notes on birds of the Chicago area and its immediate vicinity. Auk 36:513-524.

Eifrig, C.W.G. 1937. The changing status of birds as regards their abundance. Illinois State Academy of Sciences Transactions 30:295-297.

Graber, R.R., J.W. Graber, E.L. Kirk. 1973. Illinois Birds: Laniidae. Illinois Natural History Survey, Biological Notes No. 83.

Hands, H., R.D. Drobney, and M.R. Ryan. 1989. Status of the loggerhead shrike in the Northcentral United States. USFWS, Twin Cities, MN.

Herkert, J.R., D.W. Sample, and R.E. Warner. Management of grassland landscapes for the conservation of migratory birds. Pp. 89-116, In *Managing Midwest Landscapes for the Conservation of Neotropical Migratory Birds*. F.R. Thompson III (ed.). U.S. Forest Service, General Technical Report, NC-187. North Central Forest Experiment Station, St. Paul, MN.

Hess, I.E. 1910. One hundred breeding birds of an Illinois ten-mile radius. Auk 27:19-32.

Illinois Endangered Species Protection Board. 1994. Checklist of endangered and threatened animals and plants of Illinois. Illinois Endangered Species Protection Board, Springfield, Illinois. 20pp.

Kridenbaugh, A. 1981. Population trend, breeding and wintering distribution of the loggerhead shrike (Lanius ludovicianus) in Missouri. Transactions of the Missouri Academy of Science 00:000-000.

Lymn, N. and S.A. Temple. 1991. Land-use changes in the Gulf Coast region: links to declines in Midwestern loggerhead shrike populations. Passenger Pigeon 53:315-325.

Mayfield, H. 1949. Nesting season. Middlewestern prairie region. Audubon Field Notes 3:237-238, 240.

Nice, M.M. 1945. Rare and endangered species of birds in northern Illinois. Audubon Bulletin 53:9-10.

Robbins, S.D. 1991. Wisconsin Birdlife. University of Wisconsin Press, Madison.

Sauer, J.R., S. Schwartz, B.G. Peterjohn, and J.E. Hines. 1996. The North American Breeding Bird Survey home page, Version 94.3. Patuxant Wildl. Res. Center, Laurel, Md.

Stevenson, H.M. and B.H. Anderson. 1994. The Birdlife of Florida. University Press of Florida. 892pp.

Temple, S.A. 1995. Where and when are shrike populations limited? Proceedings of the Western Foundation of Vertebrate Zoology 6:6-10.

Yosef, R. 1994. Evaluation of the global decline in the true shrikes (Family Laniidae). Auk 111:228-233.

TABLE 1. RESULTS OF PESTICIDE ANALYSIS OF ILLINOIS SHRIKE EGGS, 1995-1996.

Sample#	Date Collected	County	DDE (ppm)	DDT(ppm)
9501	5/02/95	Clay	0.000	0.000
9502	5/02/95	Clay	0.000	0.000
9503	5/24/95	Jasper	0.456	0.000
9504	5/24/95	Jasper	0.356	0.000
9505	5/14/95	Menard	0.217	0.000
9506	5/12/95	Will	4.043	0.063
9508	5/12/95	Will	2.967	0.062
9509	5/12/95	Will	0.124	0.015
9510	5/12/95	Will	0.159	0.011
9601	5/08/95	Marion	0.575	0.387
9602	4/25/96	Clay	0.296	0.000
9603	4/25/96	Clay	0.339	0.000
9604	5/02/96	Clay	0.000	0.000
9605	5/02/96	Clay	0.000	0.063
9606	5/06/96	Wayne	0.185	0.089
9607	5/06/96	Wayne	0.142	0.055
9608	5/06/96	Wayne	0.496	0.000
9609	5/16/96	Jasper	1.265	0.000
9610	5/16/96	Jasper	1.052	0.000
9611	5/23/96	Will	0.839	0.000
			---	---
Mean			0.675	0.037
Standard Error			0.233	0.019
Median			0.317	0.000

TABLE 2. COMPARISON OF PESTICIDE ANALYSIS RESULTS FOR LOGGERHEAD SHRIKES IN ILLINOIS 1971-1972 AND 1995-1996.

	Present Study	Anderson & Duzan (1978)	% Change	P[1]
Mean DDE (ppm)	0.67	3.09	-78.32%	<0.001
Median DDE (ppm)	0.32	1.79	-82.12%	
Range DDE (ppm)	0.00-4.04	0.48-34.14		
Mean DDT (ppm)	0.04	-		
Median DDT (ppm)	0.00	-		

[1] Results of t-test comparing the 1971-1972 and 1995-1996 means.

APPENDIX 1. COMPOUNDS SCREENED FOR IN THE ANALYSES AND DETECTION LIMITS.

Compound	Detection Limit (ppm)
Aldrin	.0027
alpha-BHC	.0020
beta-BHC	.0040
gamma-BHC	.0027
delta-BHC	.0060
Chlordane	.0094
4,4'-DDD	.0074
4,4'-DDE	.0027
4,4'-DDT	.0080
Dieldrin	.0013
Endosulfan I	.0094
Endosulfan II	.0027
Endsulfan Sulfate	.0442
Endrin	.0042
Endrin Aldehyde	.0154
Heptachlor	.0020
Heptachlor Epoxide	.0556
Methoxychlor	.1179
Toxaphene	.1608
Aroclor 1016	.0335
Aroclor 1221	.0435
Aroclor 1232	.0435
Aroclor 1242	.0435
Aroclor 1248	.0603
Aroclor 1254	.0607
Aroclor 1260	.0607
Aroclor 1262	.0607
Aroclor 1268	.0607

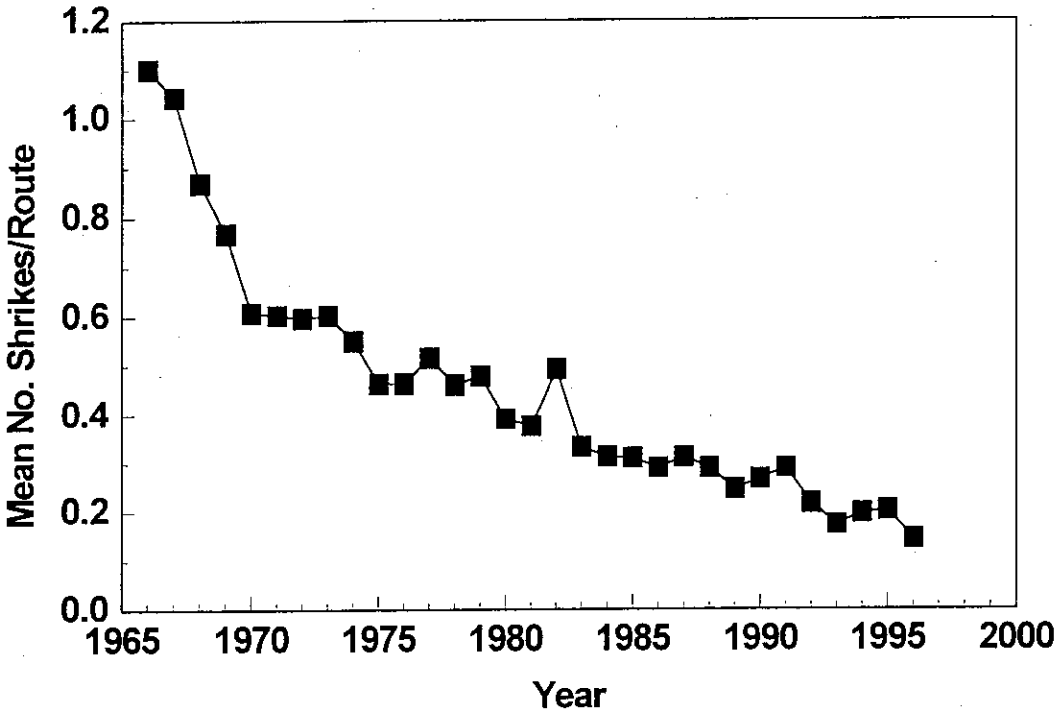

FIGURE 1. POPULATION TREND FOR THE LOGGERHEAD IN SHRIKE IN ILLINOIS BASED ON DATA FROM THE BREEDING BIRD SURVEY. DATA ARE THE MEAN NUMBER OF BIRDS DETECTED PER BBS ROUTE IN THE STATE, 1966-1996. BBS DATA WERE OBTAINED FROM SAUER ET AL. (1996).

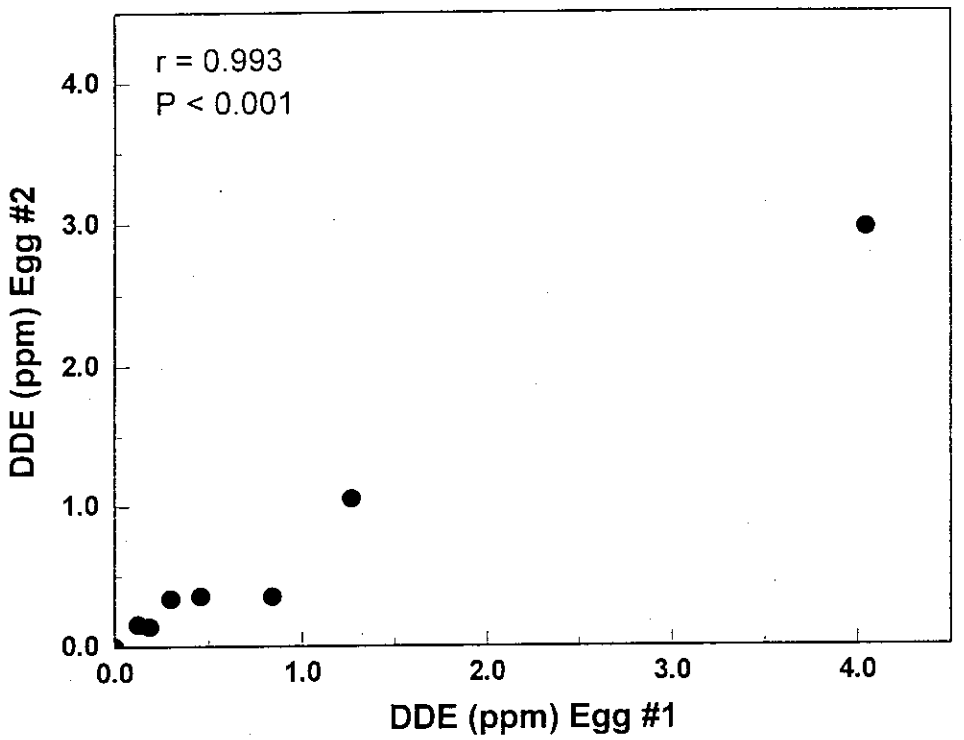

FIGURE 2. COMPARISON OF RESIDUAL DDE LEVELS IN PAIRS OF EGGS COLLECTED FROM THE SAME NEST, 1995-1996.