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Organochlorine Pesticides and Reduction of Eggshell Thickness in a Black Vulture *Coragyps atratus* Population of the Tuxtla Valley, Chiapas, Mexico

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INTRODUCTION

Mexico is a major agricultural country, and pesticide use has been both extensive and intensive, particularly after the Green Revolution. The manufacture of pesticidal chemicals has become a major domestic industry, with imported pesticides accounting for less than 20% of total use (FERTIMEX 1981). Mexico has remained a major producer of DDT, with an annual capacity of about 5,000 tons (FERTIMEX 1981). Restrictions on DDT use were implemented in the 1970s, and currently there is official approval only for use on cotton plantations in the State of Chiapas (SAHR 1983). Nevertheless, widespread use of DDT has apparently continued; moreover, many other organochlorines whose uses have ended or have been restricted elsewhere continue to have widespread applications (FERTIMEX 1981; Inigo & Risebrough, this volume). In addition to uses in agriculture, large amounts are used for the control of the vectors of tropical diseases (Bodegas *et al.* 1980).

In spite of this intensive use of organochlorine pesticides, only one study has so far been undertaken of the effects on birds of prey in the Neotropics; Kiff *et al.* (1980) reported significant reductions in eggshell thickness indices of eggs of the Aplomado Falcon (*Falco femoralis*) and of the Bat Falcon (*F. rufigularis*) preserved in museum collections and that had been obtained in eastern Mexico between 1954 and 1967. Mean reductions were 25% and 18%, respectively, suggesting that the local populations of these species were likely to have depreseed reproduction; the changes in thickness index were furthermore correlated with concentrations of the DDT compound DDE in the lipids of the eggshell membranes.

Very little information is available about the biology and population status of most neotropical birds of prey (Kennedy 1986). Information on the use of pesticides in the tropics and about potential effects on resident and migratory raptors is fragmentary (Maltby 1980; Risebrough & Springer 1983; Burton & Philogene 1986; Inigo & Risebrough, this volume).

In this paper we report on the organochlorine pesticides detected in fragments of three eggs and in a whole egg of the Black Vulture (*Coragyps atratus*) and on the shell thicknesses of these eggs. This species was selected for this study in view of its widespread distribution in the country and its close relation with human garbage dumps. It and other species of New World vultures are sensitive to the shell-thinning effects of DDE (Wilbur 1978; Kiff *et al.* 1979, 1983).

STUDY AREA AND METHODS

The study area was the Tuxtla Valley in the central plateau of the State of Chiapas in southern Mexico. The valley includes the city of Tuxtla, surrounding farm lands, and cattle ranches.

Egg fragments and one whole egg were collected from nests in 1985. Shell thicknesses of these and of 12 pre-DDT eggs collected in Mexico and now preserved in the Museum of the Western Foundation of Vertebrate Zoology in Los Angeles were measured with a model 35 PS Federal bench comparator thickness gauge.

Following the method of Peakall (1974), lipid-soluble residues were extracted with hexane from the shell membranes of the egg fragments with the aid of ultrasonic vibration.

Extracts were analysed without clean-up for organochlorine residues by gas-liquid chromatography using a Ni63 electron capture detector. The identification and quantification of the residues were accomplished by comparing the chromatograms of the extracts with those of authentic standards of known concentrations; identifications were confirmed through the uses of two columns of different polarity.

RESULTS

The analyses showed that the DDT and hexachlorocyclohexane (HCH)compounds were the principal contaminants accumulated by this group of Black Vultures (Table 1). Assuming that the lipid content of whole eggs is 5% (Kiff *et al.* 1983), highest concentrations of p,p'-DDE and of the alpha isomer of HCH were in the order of 1 ppm wet weight, or 20 ppm lipid weight. Traces of the chlordane compounds, including heptachlor epoxide, and of HCB (hexachlorobenzene) were also detected.

TABLE 1. Organochlorine contaminants in membranes of three egg fragments and one whole egg of Black Vultures in Chiapas. Parts per million of the lipid weight.

Contaminant	Egg Fragments			Whole Egg
	1	2	3	4
alpha-HCH	19	19	-*	+**
beta-HCH	5.5	3.1	1.4	+
gamma-HCH	1.2	2.6	1.1	+
HCB	+	+	-	+
Heptachlor epoxide	0.18	+	-	+
p,p'-DDE	20	3.4	5.3	13
p,p'-DDD	1.6	0.62	0.97	+
p,p'-DDT	1.4	0.36	0.68	+
alpha-chlordane	0.26	-	-	+
gamma-chlordane	+	-	-	-
oxychlordane	+	-	-	-
lipid weight (g)	0.026	0.014	0.009	0.522

* not detected at the analytical sensitivity employed
** detected but not quantified

Mean thickness of the pre-DDT eggs was 0.439 mm. Shell thickness of egg – 1 was 0.450 mm, 2.5% higher than the estimated pre-DDT mean. Shells of eggs 2, 3 & 4 were 5.9, 11, and 5.2% thinner than the estimated pre-DDT mean. A lack of correlation with DDE levels is attributed to the small sample size and to the generally low levels of DDE recorded in the eggs.

DISCUSSION

The DDE levels we found were substantially lower than a mean concentration of 5.6 ppm wet weight recorded in Black Vulture eggs from Texas over the period 1948-1970 by Kiff *et al.* (1983). The mean thickness index in the Texas samples was 17% lower than the estimated pre-DDT index, and a significant negative correlation between thickness index and DDE levels was recorded.

Populations of Black Vultures are declining throughout Mexico (Phillips & Alvarez del Toro, pers. comm.). Without additional studies it is not possible to link this decline with environmental contaminants.

Mora (1984) found lower levels of DDE in wintering ducks in north-western Mexico than in southern California; similarly, Henny and Blus (1986) found lower DDE levels in Black-crowned Night Herons (*Nycticorax nycticorax*) wintering in eastern Mexico than in birds wintering in the south-western United States. Although this area of the United States continues to have exceptionally high levels of DDE contamination (White & Krynitsky 1986), continuing DDT use in Mexico has not necessarily resulted in the accumulation of high levels of DDE in local food webs.

In view of the continuing use of DDT and of other organochlorines in Mexico, continuing studies of environmental levels of these compounds will be necessary to determine their potential effects upon the fauna.

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REFERENCES

BODEGAS, P. R., F. BELTRAN, R. FLORES & M. E. DE COSS 1980. El impacto ecologico de los pesticidas en el tropico humedo mexicano y la implantacion de programas de control integrado de plagas. Boletin de Informacion 9 Centro de Investigaciones Ecologicas del Sureste. CIES-CEA-CONACyt. Tapachula, Chiapas, Mexico.

BURTON, D. K. & B. J. R. PHILOGENE 1986. An overview of pesticide usage in Latin America. Canadian Wildlife Service Latin American Program; Report on Contract OST85-00181 Canadian Wildlife Service, Ottawa.

FERTILIZANTES MEXICANOS S. A. (FERTIMEX) 1981. Development Plan of the Fertimex Company for the Production, Formulation, and Sales of Insecticides (in Spanish). Salamanca, Guanajuato, Mexico. 232 pp. (Vol I); 254 pp. (Vol II).

HENNY, C. J. & L. J. BLUS 1986. Biotelemetry locates wintering grounds of DDE-contaminated black-crowned night herons. *Wildl. Soc. Bull.* 14:236-241.

INIGO ELIAS, E. E. & R. W. RISEBROUGH. Patterns of current pesticide use in Mexico. This volume.

KENNEDY, R. 1986. Raptors in the tropics - the next 50 years. Pages 17-25 *in* S. E. Senner, C. M. White & J. R. Parrish (eds.). *Raptor Conservation in the Next 50 Years.* Raptor Research Report No. 5.

KIFF, L. F., D. B. PEAKALL & D. P. HECTOR 1980. Eggshell thinning and organochlorine residues in the Bat and Aplomado Falcons in Mexico. *Proc. Intern. Ornithol. Congr.* 17:949-952.

KIFF, L. F., D. B. PEAKALL, M. L. MORRISON & S. R. WILBUR 1983. Eggshell thickness and DDE residue levels in vulture eggs. Pages 440-458 *in* S. R. Wilbur & J. A. Jackson (eds.) *Vulture Biology and Management.* Berkeley, Univ. of Calif. Press.

KIFF, L. F., D. B. PEAKALL & S. R. WILBUR 1979. Recent changes in California Condor eggshells. *Condor* 81:166-172.

MALTBY, C. 1980. Report on the use of pesticides in Latin America. United Nations Industrial Development Organization. UNIDO/IOD 353 (19 May 1980). 139 pp.

MORA, M. A. 1984. Seasonal and geographical variation of organochlorines in waterfowl from California and Mexico. Thesis for the Degree of Master of Science, University of California, Davis. 46 pp.

PEAKALL, D. B.. 1974. DDE: its presence in Peregrine eggs in 1948. *Science* 1983:673-674.

RISEBROUGH, R. W. & A. M. SPRINGER 1983. Pesticide use patterns in Latin America of potential significance to wildlife: A preliminary survey and working document. The Bodega Bay Institute, Berkeley. 32 pp.

SECRETARIA DE AGRICULTURA Y RECURSOS HIDRAULICOS (SARH) 1983. *Manual de plaguicidas autorizados para 1983.* Direccion General de Sanidad Vegetal. Mexico, D. F. 243 pp.

WHITE, D. H., & A. J. KRYNITSKY 1986. Wildlife in some areas of New Mexico and Texas accumulate elevated DDE residues, 1983. *Arch. Environ. Contam. Toxicol.* 15:149-157.

WILBUR, S. R. 1978. Turkey vulture eggshell thinning in California, Florida, and Texas. *Wilson Bull.* 90:642-643.

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