Pesticide Mortality of Young White-Faced Ibis in Texas

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From May through July 1970, following a generally successful nesting season, many 2- to 4-week-old white-faced ibis (Plegadis chihi) were observed dead or dying at three large nesting colonies on the Texas Gulf Coast (on the mainland at Willie Slough and on islands in Matagorda Bay and Lavaca Bay). We observed the conditions at Matagorda Bay in May and Willie Slough and Lavaca Bay in June. Four dead young and three that were dying in violent convulsions were collected in July at the Lavaca Bay colony and analyzed for organochlorine and mercury residues. This report summarizes the results of these analyses and presents evidence that the observed mortality of young ibis was caused by pesticides.

Mortality of Young Ibis in 1970

Three visits were made to each of the three colonies between early May and mid July 1970. At the time the mortality of young occurred at the colonies, adults numbered 500 at Willie Slough, 1,400 at Matagorda Bay and 1,000 at Lavaca Bay. There was little mortality of adults at the colonies, but, after unsuccessful attempts to rear young, numbers of adults dropped sharply at each colony.

On May 22 at Matagorda Bay we observed a few hundred sick and dead young in about 150 ibis nests, 75 percent of the nests on the island. On June 11 we found that the first nesting attempt at Willie Slough was almost a complete failure. A few hundred desiccated remains of young were at nest sites, and few live young were observed at the colony. Mortality of young at Lavaca Bay, first observed on June 18, appeared to be even greater that that of the other colonies. By July 19 there were several hundred casualties, and most of the few live young at the colony appeared to be sick.

Young ibis that were sick showed muscular weakness, jerkiness in gait, fluffed feathers, and drooping wings. Those that were dying showed loss of muscular coordination or immobility, violent body tremors, opisthotonos (neck arched far over back), and finally terminal wing-beat convulsions. These are typical symptoms of dieldrin poisoning (TUCKER and CRABTREE 1970). We therefore suspected lethal exposure of young to aldrin and

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dieldrin contaminated food from rice fields where ibis from these three colonies feed extensively. On July 19 four dead young and three that were alive but in terminal convulsions were collected from the Lavaca Bay colony and shipped frozen to the Denver Wildlife Research Center for pesticide residue analysis.

Ibis at the Lavaca Bay Nesting Colony

This colony is located on about a 35-acre spoil island of the Matagorda Ship Channel in the middle of Lavaca Bay. Rice is the principal crop of the area and is grown to the north and directly to the south of the bay. Rice fields are planted with seed treated with aldrin at 4 oz/100 lb seed/acre and with Ceresan L (a fungicide containing methylmercury 2,3-dihydroxypropyl mercaptide and methylmercury acetate) at 1.2 oz/100 lb seed/acre. In June 1970 the central part of Lavaca Bay adjacent to the Point Comfort Alcoa Aluminum Manufacturing Plant was designated a mercury-polluted area by the Division of Marine Resources, Texas Department of Health; the colony lies partly within this area.

White-faced ibis arrive at the nesting colony in early May and are among the most abundant of 12 species of birds, mostly fish-eaters, that nest on the island. They build their nests on the ground soon after they arrive and lay an average of 3 eggs that hatch in June and early July. Young ibis fledge when they are about 5 weeks old and are still fed by the parents at this time (BELKNAP 1957). During the nesting and young-rearing period, adult ibis at the Lavaca Bay colony obtain food for themselves and their young almost exclusively in flooded rice fields about 3 miles south of the island. They make numerous flights to these fields daily and return with food that they regurgitate and feed to their young.

Two samples of regurgitated food collected in July 1970 at the Lavaca Bay colony contained mostly insects. BELKNAP (1957) found that white-faced ibis in Louisiana preferred rice fields for feeding in the summer and that crayfish and insects were their most important food items, although snails, small bivalves, earthworms, small fish, and frogs were also commonly taken. FLICKINGER and KING (ms.), who investigated pesticide contamination in three rice-field study areas on the Texas coast, found that insects made up most of the stomach contents of three white-faced ibis collected in July. All invertebrates that they collected from April through August contained aldrin or dieldrin. Crayfish (Procambarus clarki and Cambarus diogenes) and snails (Physa sp. and Lymnaea sp.), the most abundant large invertebrates in the rice fields, had average aldrin-dieldrin residues of 9.5 ppm (13 samples, range 0.1-21 ppm). Much lower levels of aldrin or dieldrin in the diet of young birds can cause mortality. DEWITT (1956) showed that day-old quail (Colinus virginianus) exposed to a chronic diet of 5 ppm aldrin all died within 4 weeks. Residues found by FLICKINGER and KING (ms.) in other invertebrates, including aquatic and terrestrial insects (Carabidae, Corixidae and

Notonectidae), ranged from less than 0.1 ppm in earthworms (Lumbricus sp.) to 5.4 ppm in clam shrimp (Eulimnadia sp.) (10 samples). Residues of DDT and its metabolites in these invertebrates were 0.8 ppm or less.

Chemical Analyses

Methods. Brains were removed from all seven birds for organochlorine analysis, and kidneys were removed from the four dead birds for mercury analysis. The remaining carcasses, minus skin, feet, wings, and beaks, were ground, and a 15 g. aliquot of each was taken for organochlorine analysis.

Samples for organochlorine analysis were desiccated with sodium sulfate, ground, and Soxhlet-extracted for 6 hours with 1:9 diethyl ether-petroleum ether. The solvent was evaporated and replaced with n-hexane, and the sample was cleaned up by elution through a florisil column with 3:1 n-hexane-benzene. The concentration of the sample was adjusted to 1 g./ml., and the sample was analyzed by electron-capture gas chromatography (Tracor model MT-220), with two columns for confirmation. This method is quantitative for many organochlorine residues (including dieldrin and DDE) at levels as low as 0.01 ppm.

Mercury residues were determined by methods described by OKUNO et al. (1972) in which the extracted mercury was amalgamated on a silver wire, volatilized, and measured by an atomic absorption spectrophotometer (Jarrell-Ash).

Results. The results of the pesticide residue analyses are summarized in Table 1.

TABLE 1

Pesticide residues (ppm) in young white-faced ibis, Lavaca Bay, Texas, July 1970.

Bird No.	Condition when Collected	Brain		Body Remainder		Kidney
		Dieldrin	DDE	Dieldrin	DDE	Mercury
1	Dying	8.0	0.2	6.7	0.2	--
2	Dying	6.3	0.3	4.5	0.3	--
3	Dying	5.8	0.5	3.3	0.3	--
4	Dead	4.8	0.7	1.7	0.2	0.98
5	Dead	4.6	0.5	2.7	0.2	2.00
6	Dead	0.5	0.2	0.3	0.2	1.60
7	Dead	0.4	0.1	1.1	0.4	1.75

Dieldrin and DDE were the only organochlorine residues detected at more than trace levels in the seven birds. DDE residues were relatively low, amounting to 0.7 ppm or less in both brain and

body remainders. Dieldrin residues were also low in two of the birds collected dead but were considerably higher in the remaining five birds (4.6-8.0 ppm in brain, 1.7-6.7 ppm in body remainders). Brain residues this great suggest severe dieldrin poisoning. STICKEL et al. (1969) concluded from laboratory tests with Japanese quail (Coturnix coturnix) that death was associated with brain residues of dieldrin as small as 4 or 5 ppm. They found that all but 3 of 26 birds--meadowlarks (Sturnella magna), robins (Turdus migratorius), starlings (Sturnus vulgaris) and woodcocks (Philohela minor)--collected dead from dieldrin-treated areas in Tennessee and Pennsylvania contained brain residues of 5 ppm or more.

All four birds analyzed for mercury had moderate residues in the kidneys (0.98-2.00 ppm). No criteria are available to correlate kidney residues of mercury with disability or death, but the levels found in these birds indicate more than negligible exposure to mercury.

Conclusions

The combination of the symptoms observed in sick and dying birds and the high brain residues in the three birds collected dying, as well as in two of the four collected dead, implicate dieldrin as at least one of the causes of mortality of young ibis at the Lavaca Bay colony. Mercury residues in the kidneys of all four dead young, including those with low brain residues of dieldrin, suggest that birds were exposed to mercury in rice fields and that mercury may also have contributed to the mortality. Since adult ibis normally feed their young on invertebrates collected in rice fields treated with aldrin and Ceresan L, the use of these rice pesticides appears to be a serious hazard to this species, and probably to other wild birds with similar habits.

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Literature Cited

BELKNAP, H. W.: M.S. Thesis, Louisiana State Univ., p. 64 (1957).
DEWITT, J. B.: J. Agr. Food Chem. 4, 864 (1956).
FLICKINGER, E. L., and K. A. KING: J. Wildl. Mgmt. (Submitted to editor).
OKUNO, I., R. A. WILSON, and R. E. WHITE: J.A.O.A.C. 55, 96 (1972).
STICKEL, W. H., L. F. STICKEL, and J. W. SPANN: Chem. Fallout. Proc. 1st Rochester Conf. on Toxicology. p. 174 (1969).
TUCKER, R. K., and D. G. CRABTREE: U.S. Bureau of Sport Fisheries and Wildlife, Resource Pub. 84, 47 (1970).