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Source: Journal of Wildlife Diseases, 23(1) : 165-168

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-23.1.165

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horns of the uterus, indicating a previous pregnancy in which two cubs were born (Erickson et al., 1964, Mich. State Univ. Agr. Exp. Sta. Res. Bull. 4: 22–44).

It is possible that the two yearling bears with mange in the summer of 1984 were the offspring of the sow euthanized in 1985. All three bears were shot or captured within 1 km of one another. The yearling bears, which would have been born in January 1983, may have been represented by the two old, faded placental scars in the sow.

There were two plausible theories for sarcoptic mange in bears being rarely observed. One is that bears, which are normally solitary animals, have very little direct contact with other bears or with species such as red fox and coyotes that frequently have mange infestations. This theory assumes the possibility of interspecies transmission (Fain, 1978, Int. J. Dermatol. 17: 20–30) and may not be valid.

The second theory is that bears may have an innate or acquired resistance to infection by the mites. The sow and her presumed offspring may have had an immune deficient trait which made them more susceptible to sarcoptic mange. Sarcoptic mange with scaly, crusted, hyperkeratotic lesions such as these bears had, has been termed Norwegian scabies, which in man is generally found in immune depressed individuals (Calnan, 1950, Br. J. Dermatol. 62: 71–78; Fain, 1978, Int. J. Dermatol. 17: 20–30). A case of Norwegian scabies in a dog was postulated by Anderson (1981, J. Am. An. Hosp. Assoc. 17: 101–104) to be related to immune competence. No immunological testing was done to support the theory that immunosuppression was responsible for the sarcoptic mite infestation of these bears.

The authors thank T. Havard for submitting the sow and one of the yearlings to the RLWDL. We also thank Dr. R. R. Gerrish of the NVSL for confirmation of our identification of the mites, and J. M. Wickham for typing the manuscript.

Journal of Wildlife Diseases, 23(1), 1987, pp. 165–168

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The large numbers of ducks in winter at playa (naturally landlocked) lakes of the Texas Panhandle are dominated by mallards (*Anas platyrhynchos*), northern pintails (*A. acuta*), American wigeon (*A. americana*), and green-winged teal (*A. crecca*). The annual mortality of ducks that occurs at playa lakes in winter is generally attributed to disease (Jensen and Williams, 1964, *In* Waterfowl Tomorrow, Linduska (ed.), U.S. Fish and Wildlife Service, Washington, pp. 333–341; Bolen and Guthery, 1982, Trans. N. Am. Wildl. Nat. Resour. Conf. 47: 528–541) and is particularly heavy in Castro and Parmer counties in the southwestern corner of the Panhandle. Avian cholera has been epizootic in this area in winter since February 1944 when the first die-off from chol-

Received for publication 15 July 1985.

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era in wild ducks in the United States was discovered in Castro County (Quortrup et al., 1946, J. Am. Vet. Med. Assoc. 827: 94–103). Because Castro and Parmer counties are intensively cultivated throughout the year with crops that receive annual treatments of insecticides, this study was conducted in 1981–1983 to determine if, in addition to losses from avian cholera, mortality may be associated also with pesticide contamination of ducks and habitat at playa lakes.

The study area was in Castro, Parmer, and Swisher counties of the Texas Panhandle and Curry County, eastern New Mexico. We chose 13 basins for the study which had sufficient water (playa lakes) for duck resting areas. Most of the water in the basins was supplied by runoff from irrigated agricultural fields. Seven of the 13 playa lakes received drainage from cattle feedlots in addition to agricultural drainage. Six received strictly agricultural drainage.

Some corn fields in Castro County were planted with heptachlor-treated seed. No other organochlorine (OC) treatments to crops were known to occur. No crops planted around the basins were treated with organophosphates in winter during the study. No basins were used for petroleum waste disposal sumps.

Twenty-four sediment samples were taken at 12 playa lakes (six feedlot-agricultural lakes and six strictly agriculture lakes) for OC residue analyses. Two samples of the top 6.5 cm of sediment were collected in wide mouth jars at the northwest and southeast sides of each lake during low water levels, closed, and refrigerated until analyses were conducted.

Remains of 1,291 ducks (American wigeon [35%], mallards [30%], northern pintails [24%], green-winged teal [11%]) and 11 American crows (*Corvus brachyrhynchos*) were counted at playa lakes in Castro and Parmer counties in January 1981 and 1982. No dead birds of other species were observed. Forty-eight adult ducks (northern pintails, mallards, American wigeon, green-winged teal) were shot for OC residue analyses of carcasses; 31 at feedlot-agricultural lakes, 17 at strictly agricultural lakes in September and November 1981, and January 1982 and 1983. These ducks were not examined for disease agents. In January and February 1982, we collected 23 adult ducks found dead (the same species) and sent them to the National Wildlife Health Laboratory (NWHL), Madison, Wisconsin for necropsy. These were not analyzed for OC residues.

Seventy-eight percent of ducks found dead and 73% shot for OC residues were in good to excellent body condition based on visual amounts of subcutaneous fat. The gastrointestinal tracts contained corn in 47% of teal, pintails, and mallards shot and 32% found dead. One wigeon (8%) contained corn. Only two ducks contained sorghum.

Brains were analyzed for OC residues of seven ducks that contained above 1 ppm heptachlor epoxide (HE) in carcasses. All residue analyses were conducted at the Patuxent Wildlife Research Center for p,p'-DDE, DDD, and DDT, dieldrin, HE, chlordane isomers, endrin, toxaphene, and PCB's by electron-capture gas-liquid chromatography. Analytical procedures were described in detail for brains and carcasses by Cromartie et al. (1975, Pestic. Monit. J. 9: 11–14) and for sediments by Nash and Harris (1972, J. Assoc. Off. Anal. Chem. 55: 532–536). Residues in 10% of samples were confirmed by mass spectrometry. The lower limit of reportable residues was 0.1 ppm for pesticides and 0.5 ppm for PCB's.

Only 13% of lake sediment samples contained detectable (low) OC residues; all were chlordane isomers (0.05–0.22 ppm) and all were from two feedlot-agricultural lakes in the same drainage system in Parmer County. No OC residues

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TABLE 1. Organochlorine residues (geometric mean) in 48 ducks shot at 13 playa lakes in three counties of the southwestern corner of the Texas Panhandle and one county in eastern New Mexico in September–January 1981–1983.

Species and location (n)	Sex	n	Tissue	Mean ppm wet weight (no. with detectable concentrations) (range)		
				DDE	HE	OXY
Green-winged teal[a]						
Feedlot and agricultural lakes (3)	M	5	Carcass	— (2) (ND[b]–0.23)	1.41 (4) (ND–9.3)	0.15 (4) (ND–0.38)
		3[c]	Brain	(0)	1.06 (3) (0.65–1.7)	(0)
	F	1	Carcass	(0)	3.3	0.11
		1[c]	Brain	(0)	2.0	(0)
Agricultural lakes (2)	M	4	Carcass	0.17 (3) (ND–0.5)	— (1) (ND–0.21)	(0)
Northern pintail						
Feedlot and agricultural lakes (4)	M	8	Carcass	0.12 (6) (ND–0.33)	0.31 (5) (ND–5.0)	(0)
		2[c]	Brain	(0)	— (2) (1.1, 1.7)	(0)
	F	3	Carcass	— (1) (ND–1.2)	— (2) (ND–1.5)	(0)
		1[c]	Brain	(0)	(0)	(0)
Agricultural lakes (2)	M	3	Carcass	0.22 (3) (0.09–0.7)	— (1) (ND–0.13)	(0)
	F	1	Carcass	0.2	(0)	(0)
Mallard						
Feedlot and agricultural lakes (4)	M	6	Carcass	— (2) (ND–0.38)	(0)	(0)
	F	2	Carcass	— (1) (ND, 0.23)	— (1) (ND, 0.8)	(0)
Agricultural lakes (4)	M	4	Carcass	— (1) (ND–0.16)	(0)	(0)
	F	2	Carcass	— (1) (ND–0.43)	(0)	(0)
American wigeon						
Feedlot and agricultural lakes (3)	M	5	Carcass	(0)	(0)	(0)
	F	1	Carcass	(0)	(0)	(0)
Agricultural lakes (2)	M	3	Carcass	(0)	(0)	(0)

[a] One carcass from Castro County contained 0.21 ppm *trans*-nonachlor.
[b] ND = None detected at 0.1 ppm.
[c] Brains from ducks also analyzed for carcass residues.

were detected in carcasses of 46% of ducks shot. Forty-four percent contained low residues of DDE (0.09–1.2 ppm, Table 1). White and Krynitsky (1986, Arch. Environ. Contam. Toxicol. 15: 149–157) found low residues of DDE (not detected—0.4 ppm) in carcasses of 20 mallards collected in Castro County in winter 1982–1983. Thirty-one percent of ducks in the present study contained HE (0.13–9.3 ppm). Of those with HE residues, 94% were pintails and teal. Low concentrations of oxychlordane (OXY, 0.11–0.38 ppm) were found in teal (10% of total ducks). No OXY residues were found in pintails. Ducks with the highest HE residues in carcasses (teal

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and pintails, 1.5–9.3 ppm) contained low HE residues in brains (not detected—2 ppm). Only one mallard contained HE residue (0.8 ppm in carcass). No OC residues were found in wigeon.

HE and OXY residues in animals can be derived from exposure to heptachlor or chlordane contaminants (Tashiro and Matsumura, 1977, J. Agric. Food Chem. 25: 872–880; Stickel et al., 1979, *In* Toxicology and Occupational Medicine, Elsevier/North Holland Inc., New York, pp. 387–396). The residues of only HE in brains of teal and pintails from Castro County, and much more HE than OXY in carcasses of teal imply exposure to heptachlor contamination. No residues of OXY were found in brains of birds fed heptachlor by Stickel et al. (1979, op. cit.), but OXY occurred in brains of birds fed chlordane. In birds suspected of dying from chlordane poisoning, HE residues were similar to OXY residues in carcasses (Blus et al., 1983, J. Wildl. Manage. 47: 196–198). HE residues in brains of teal and pintails were low and did not approach the lethal hazard of 8 ppm for birds (Stickel et al., 1979, op cit.).

Pintails and teal from feedlot-agricultural lakes in Castro County had higher HE residues in carcasses than from both kinds of lakes in other areas. But, low OC residues were found only in sediment from two lakes in Parmer County. Pintails and teal comprise 50–75% of ducks feeding in corn fields in Castro County (Baldassarre and Bolen, 1984, J. Wildl. Manage. 48: 63–71). Therefore, any exposure of teal and pintails to HE would have been in harvested corn fields.

Avian cholera was diagnosed in 61% of ducks sent to the NWHL for necropsy; American wigeon (100%), northern pintails (83%), mallards (43%), and green-winged teal (33%). Three may have contained sublethal doses of elevated lead (3.0–5.3 ppm in liver) residues. Three may have died from lead (8.2–27.9 ppm in liver) poisoning. Cause of death could not be determined in six ducks.

Green-winged teal and northern pintails contained the highest OC residues (HE), but were among the lowest in mortality. American wigeon comprise only 13–22% of the population on Muleshoe and Buffalo Lake National Wildlife Refuges (Soutiere et al., 1972, J. Wildl. Manage. 36: 752–758) north and south of the study area, but comprised the largest die-off (35% of total dead birds). Avian cholera was positive in all wigeon diagnosed, but no OC residues were detected in wigeon. Therefore, it is unlikely that contaminants contributed to the annual winter duck mortality at playa lakes in the Panhandle. The mortality was probably caused largely by avian cholera.

We thank R. K. Stroud of the National Wildlife Health Laboratory for disease diagnoses of ducks found dead, E. G. Bolen of Texas Tech University for support of the study in Castro County and review of the manuscript, and G. A. Baldassarre and R. J. Whyte of Texas Tech University for help in field work. We thank personnel of Patuxent Wildlife Research Center: C. A. Mitchell for analyzing food and fat content of ducks and T. W. Custer, C. J. Henny, and J. C. Franson for reviewing the manuscript.

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