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Lack of Widespread Organochlorine Pesticide Contamination in South American Resident Passerines

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Recent studies have documented the existence of organochlorine (OC) pesticides and metabolites—notably p,p'-DDE, dieldrin and heptachlor epoxide—in the ng/g range in many species of Neotropical migrant passerines that breed in the Nearctic region and winter in the Neotropics (e.g., Kannan 1991; Harper et al. 1996; Klemens et al. 2000; Bartuszevige et al. 2002). This is despite the banning and/or restricted use of OC pesticides in the United States and Canada in the 1970s and the observed decline in DDT residues in migratory songbirds seen in the 1970s (Johnston 1974). Apparently, these relatively short-lived birds are still being exposed to these compounds.

The contamination observed in migrant non-passerines (e.g., raptors and piscivorous birds) since restrictions were placed on DDT resulted in the hypothesis that migratory birds encounter and accumulate organochlorine pesticides during their time spent (migrating and/or wintering) in Latin America (see Mora 1997 for a literature compilation). High levels of p,p'-DDE, dieldrin and heptachlor epoxide have been documented in tree bark samples from South America (Simonich and Hites 1995). However, determining the site of acquisition of OC pesticides in migratory birds is difficult as exposure could also occur on their breeding grounds. One way to determine the site of pesticide acquisition is to document the OC pesticide levels in resident (non-migratory or locally migratory) Neotropical birds throughout the wintering areas used by migratory birds. The purpose of this study was to document organochlorine pesticide and metabolite levels in Neotropical resident songbirds from South America. To date, no studies have focused on OC contamination in this group of birds.

MATERIALS AND METHODS

After securing all necessary permits, year-round resident Neotropical passerines were collected in mist nets or by shotgun at three widely separated sites in South America (Table 1). The majority of birds were collected by mist net and euthanized by thoracic compression. Specimens were maintained at ambient temperature until transport to the preparation facility and

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prepared as museum skin specimens usually within 12 hr of collection. Carcasses (torso, proximal limbs, brain, subcutaneous fat) were frozen in liquid nitrogen at the time of preparation and maintained therein until eventual storage in a -80 °C freezer. Eleven birds (representing ten species from seven families) were collected during January 1996 from two remnant forested areas of northeastern Argentina (27°21'S, 55°24'W; 25°51'S, 54°10'W). The first site was a woodlot in close proximity to agricultural and forest plantation lands, while the second was in a forested area in a small national park. Sixty-seven birds (representing 29 species and 11 families) were collected during June-August 1996 from three sites in a remote, pristine forested area of east-central Peru (7°9'S, 75°44'W; 7°8'S, 75°41'W; 7°5'S, 75°39'W). Finally, 57 birds (representing 40 species from 11 families) were collected during July-August 1997 from three sites in Guyana. One site was in a remnant, forested area near Georgetown (6°25'N, 57°37'W), which was in close proximity to agricultural lands. Two other sites were in primary forest interior in the Iwokrama Reserve (4°17'N, 58°31'W; 4°45'N, 59°1'W). In all, a total of 135 birds (representing 78 species from 15 families) were used in this study.

In the laboratory the carcass was thawed, the digestive tract was removed and the intestines were rinsed with deionized water to remove any fecal material. The remaining carcass and cleaned intestines were homogenized with anhydrous sodium sulfate using a hand blender. The homogenate was transferred to a soxhlet thimble and extracted with 200 mL of hexane for 18-24 hr. The extract was concentrated to under 5 mL and then transferred to a chromatography column containing Florisil® (18-22 g, 60-100 mesh, activated at 130°C for 16 hr) and sodium sulfate (1-2 cm). The column, which had been washed with hexane (~40 mL), was eluted with 200 mL portions of 3% diethyl ether in hexane, 15% diethyl ether in hexane, and 50% diethyl ether in hexane. The elutions were collected, concentrated to about 5 mL using a rotary evaporator and rediluted to 10 mL in a volumetric flask (Frick et al. 1998). Each fraction was analyzed with a Hewlett Packard (HP) 6890 gas chromatograph equipped with electron capture detectors (see Frick et al. 1998 for specific details).

Carcasses were analyzed for 16 different OC compounds that have been used in the analysis of other organisms. These compounds (with % recoveries for a spiked sample in parentheses) included: aldrin (114), alpha-BHC (110), beta-BHC (100), gamma-BHC (109), p,p'-DDD (112), p,p'-DDE (111), p,p'-DDT (110), dieldrin (98), endosulfan I (108), endosulfan II (106), endosulfan sulfate (38), endrin (4), endrin aldehyde (84), heptachlor (110), heptachlor epoxide (112), and methoxychlor (113). Level of detection of all chemicals was 1.4-14 ng/g extract except for heptachlor (2.8-28 ng/g), aldrin (4.2-42 ng/g), endosulfan I (4.2-42 ng/g) and endosulfan sulfate (14-140 ng/g). OC pesticide levels in duplicate samples were within five percent of each other.

RESULTS AND DISCUSSION

With only four exceptions, no detectable levels of any of the 16 different OC compounds were found in the Neotropical resident birds analyzed. Birds with contaminants included one individual from Argentina [*Basileuterus leucoblepharus* (Family Parulidae): 1.9 ng/g p,p'-DDD, 6.3 ng/g dieldrin] and three individuals from Guyana [*Molothrus bonariensis* (Family Icteridae): 2.6 ng/g p,p'-DDE; two *Progne chalybea* (Family Hirundinidae): 3.6 ng/g p,p'-DDE and 7.9 ng/g p,p'-DDE].

This represents four of 135 individuals (3.0%) that were contaminated. Previous studies of Neotropical migrant passerines have documented that insectivorous birds had higher levels of OC contamination than non-insectivores (Klemens et al. 2000; Bartuszevige et al. 2002). Two of the contaminated species from this study were exclusively insectivorous (*Basileuterus* and *Progne*), while *Molothrus* was a granivore/insectivore. The majority of the uncontaminated species were insectivores. All contaminated individuals were collected near agricultural sites.

The low frequency of OC contamination of Neotropical resident birds from South America may be due to the fact that fewer individuals (N=19) were collected from sites near agricultural land (two of eight sites). However, our results suggest that widespread contamination of avifauna with OC pesticides in South America has not occurred. Our findings also suggest that contaminated Neotropical migratory birds that winter in South America are acquiring contaminants either on their North American breeding grounds, which are known to be contaminated (Simonich and Hites 1995), or along their migratory pathway. Documentation of OC contamination along their migratory pathway through Mexico and Central America is incomplete, but a few studies suggest that these contaminants should be present (Standley and Sweeney 1995; Castillo et al. 2000). Klemens et al. (2002) found similar compounds in the ng/g range in Costa Rican resident birds. The Simonich and Hites (1995) study suggests that contaminants should be entering South American birds, a result that we did not find. Future contaminant studies of Neotropical resident birds should increase the number of birds sampled near agricultural sites.

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Table 1. Avian species analyzed for OC compounds in relation to the collection site.

Argentina								
Family Emberizidae	N	Site[1]	Family Pipridae	N	Site	Family Turdidae:	N	Site
Zonotrichia capensis	1	F	*Schiffornis virescens*	1	F	*Turdus albicollis*	1	F
Family Parulidae:			Family Thraupidae:			Family Tyrannidae		
Basileuterus leucoblepharus	1	A	*Tachyphonus coronatus*	1	F	*Myiodynastes maculatus*	1	F
Geothlypis aequinoctialis	1	F	*Trichothraupis melanops*	1	A	Family Vireonidae:		
			Pyrrhocoma ruficeps	1	A	*Vireo olivaceus*	2	F

Peru								
Family Cardinalidae:	N	Site	Family Pipridae:	N	Site	Family Thraupidae:	N	Site
Cyanocompsa cyanoides	3	F	*Machaeropterus regulus*	2	F	*Habia rubica*	3	F
Family Conopophagidae:			*Pipra erythrocephala*	3	F	*Tangara schrankii*	1	F
Conopophaga peruviana	1	F	*Pipra fasciicauda*	4	F	Family Troglodytidae:		
Family Dendrocolaptidae:			Family Thamnophilidae:			*Microcerculus marginatus*	2	F
Deconychura longicauda	1	F	*Hylophylax naevia*	3	F	Family Turdidae:		
Dendrocincla fuliginosa	1	F	*Hylophylax poecilinota*	4	F	*Platycichla leucops*	2	F
Dendrocincla merula	5	F	*Myrmeciza hyperythra*	1	F	*Turdus albicollis*	2	F
Glyphorynchus spirurus	5	F	*Myrmoborus myotherinus*	5	F	Family Tyrannidae:		
Xiphorhynchus spixii	1	F	*Myrmotherula erythrura*	1	F	*Mionectes oleagineus*	5	F
Family Furnariidae:			*Myrmotherula hauxwelli*	1	F	*Terenotriccus erythrurus*	3	F
Ancistrops strigilatus	1	F	*Phlegopsis nigromaculata*	2	F	Family Vireonidae:		
Automolus infuscatus	1	F	*Thamnomanes ardesiacus*	1	F	*Hylophilus ochraceiceps*	2	F
Sclerurus caudacutus	1	F						

Table 1. (continued) Avian species analyzed for OC compounds in relation to the collection site.

Guyana

Family Furnariidae:	N	Site	Family Thamnophilidae:	N	Site	Family Troglodytidae:	N	Site
Automolus infuscatus	1	F	*Gymnopithys rufigula*	2	F	*Cyphorhinus aradus*	1	F
Sclerurus mexicanus	2	F	*Hylophylax poecilinota*	3	F	*Henicorhina leucosticta*	1	F
Family Hirundinidae:			*Hypocnemis cantator*	2	F	Family Turdidae:		
Progne chalybea	2	A	*Myrmeciza ferruginea*	1	F	*Turdus albicollis*	2	F
Family Icteridae:			*Myrmotherula gutturalis*	1	F	Family Tyrannidae:		
Molothrus bonariensis	3	A	*Pithys albifrons*	1	F	*Fluvicola pica*	1	A
Family Parulidae:			*Sakesphorus canadensis*	2	A	*Mionectes macconnelli*	1	F
Phaeothlypis rivularis	1	F	*Thamnomanes ardesiacus*	1	F	*Myiarchus tyrannulus*	2	A
Family Pipridae:			*Thamnomanes caesius*	1	F	*Myiobius barbatus*	1	F
Corapipo gutturalis	1	F	*Thamnophilus murinus*	2	F	*Myiozetetes cayanensis*	1	A
Dixiphia pipra	2	F	Family Thraupidae:			*Pachyramphus marginatus*	1	F
Schiffornis turdinus	1	F	*Caryothraustes canadensis*	1	F	*Platyrinchus saturatus*	1	F
			Conirostrum bicolor	1	A	*Ramphotrigon ruficauda*	1	F
			Cyanerpes caeruleus	3	F	*Rhynchocyclus olivaceus*	1	F
			Tachyphonus cristatus	1	F	*Sublegatus modestus*	1	A
			Tangara gyrola	1	F	*Tolmomyias assimilis*	1	F
			Tangara mexicana	3	A	Family Vireonidae:		
						Hylophilus ochraceiceps	1	F
						Hylophilus pectoralis	1	A

[1]A = Forest in close proximity to agricultural land; F = Forest distant from agricultural land

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