

# Organochlorines in Venezuelan Raptor Eggs

Gianfranco Basili,  
Pablo Cardinale-Pizani & Robert W. Risebrough

As in most countries in Latin America and elsewhere in the Developing World, biocide use in Venezuela is largely unregulated; through advertising and publicity the international manufacturing companies have major impacts on amounts and patterns of use. Applications are frequently excessive, resulting in human mortality and sickness, as well as deleterious effects on wildlife that remain largely undocumented.

Although Venezuela had a large biocide-producing industry in the past, most biocides are now imported (Burton & Philogène 1986). Many regulations governing biocide use have been promulgated (República de Venezuela 1979). In 1984 uses of the principal organochlorine biocides, - DDT, aldrin, dieldrin, heptachlor, toxaphene and chlordane were ended by decree (República de Venezuela 1983); mirex uses were ended a year later (República de Venezuela 1985). DDT, however, is still widely used in the anti-malarial campaigns in the Amazonian regions, and other regulations are not generally enforced.

The present study was undertaken in 1989 to obtain a preliminary data set on levels of organochlorines in eggs of several species of the local raptors.

## MATERIALS AND METHODS

Raptor eggs were collected from three different areas of the Venezuelan central flatlands (Figure 1), known locally as *Los Llanos*, which lie between the Orinoco River and the Andean Coastal Highlands: (A) *Acarigua*, the vicinity of a wealthy city about 400 km southwest of Caracas. Rice, sugar-cane, and sorghum are the dominant crops, but tobacco, tomatoes, cotton, sesame and sunflower are also cultivated; (B) *Calabozo*, the vicinity of an agricultural town south of Caracas. Rice is the only crop cultivated on a large scale, with approximate yields of 3,000 kilos/hectare; (C) *Mantecal*, a cattle ranching area, with very little other agriculture. Most eggs were collected in the vicinity of *El Hato El Frío*, a ranch well-known for ecotourism and ecological research.

The species sampled were: Savanna Hawk, *Buteogallus meridionalis*, Black-shouldered Kite, *Elanus caeruleus*, Roadside Hawk, *Buteo magnirostris*, Yellow-headed Caracara, *Milvago chimachima*, and American Kestrel, *Falco sparverius*.

Because refrigeration, ice or dry ice were usually not available, eggs were hard-boiled in the field. This worked well, the principal disadvantage being the difficulty in obtaining dry-weight determinations of residue concentrations in the laboratory. Lipid weights are reported in this paper; division by 20 converts the values to approximate wet weight concentrations. Analytical methods were largely those of Risebrough *et al.* (1986).

Figure 1. Collection areas in Venezuela: A) Acarigua; B) Calabozo; C) Mantecal



## RESULTS AND DISCUSSION

The five species sampled feed primarily on insects, small reptiles, and small mammals; the residue levels are expected to be lower than in bird-eating species. The highest concentration recorded,  $12,000 \text{ g}^{-1}\text{g}$  (12 ppm) is less than a part per million on a wet-weight basis, a concentration that is generally below thresholds of harm.

The relative high amounts of the parent DDT compound, *p,p'*-DDT, and of the other principal compound in technical DDT, *o,p'*-DDT, in a Savanna Hawk egg from Calabozo indicates recent DDT use in that area. Mirex is frequently found in many samples of South American wildlife, a result of its intensive local use in the control of leaf-cutting ants (R.W. Risebrough & A.M. Springer, unpublished). The few data we present here do not suggest a problem with mirex use in Venezuela, since concentrations were generally low. Chlordane compounds (*t*-nonachlor and oxychlordane) are derived from mixtures used both in agriculture and termite control. Heptachlor epoxide derives in part from technical chlordane, and in part from heptachlor, a potent insecticide. The use of all of these compounds has been ended in North America and in many other countries, because of risks to human health. Wildlife has benefitted from these actions.

The two eggs of the Savanna Hawk from Mantecal, the cattle ranch area, contained much lower concentrations of the DDT compounds reported than the single egg from the rice-growing area of Calabozo. Concentrations of the other compounds were also lower, but differences were generally less.

PCBs were detected, also in low concentrations, in all of the samples. These data will be presented in a more comprehensive report to be published later.

A United Nations report more than a decade ago (Maltby 1980) predicted decreasing uses in Venezuela of the organochlorines in the 1980s, with or without restrictions on their use, and increasing uses of several of the organophosphate and carbamate insecticides. The 1978 use of DDT was estimated to be 730,000 kg, about 1/7 that of Mexico at that time, with a projected 50% decrease over the next decade.

We have not been able to confirm such predictions or to obtain better data. More field studies on the impacts of biocides on the environment are needed in Venezuela. Although less persistent than the organochlorines, the more toxic organophosphates and carbamates may nevertheless affect the composition and abundance of raptor populations through their effects on the food webs. We observed many uses of the highly toxic organophosphate biocide parathion, frequently a cause of accidental human deaths. The carbamate carbofuran (Furadan) is listed in the brochures we have obtained as one of the biocides imported to Venezuela. Used primarily as a soil insecticide, it is highly toxic to birds (Flickinger *et al.* 1980; Balcomb *et al.* 1984; Eisler 1985); careless use would greatly increase the mortalities of seed-eating birds and the raptors that prey on them.

**Table 1. Organochlorine biocides in the eggs of Venezuelan raptors. ng/g lipid.**

| Species                | Locality | <i>p,p'</i> -DDE | <i>p,p'</i> -DDT | <i>o,p'</i> -DDT | <i>p,p'</i> -DDD | Mirex | <i>t</i> -nonachlor | Oxychlor | HeptEpox |
|------------------------|----------|------------------|------------------|------------------|------------------|-------|---------------------|----------|----------|
| Savanna Hawk           | B        | 12,000           | 8,600            | 590              | 2,900            | 73    | 530                 | 180      | 88       |
|                        | C        | 110              | 34               | 4                | 1                | 29    | 30                  | 49       | 49       |
|                        | C        | 140              | < 1              | < 1              | < 1              | 20    | 21                  | < 5      | < 5      |
| Roadside Hawk          | A        | 2,000            | 280              | nm               | nm               | nm    | nm                  | nm       | nm       |
|                        | A        | 900              | 21               | 34               | 17               | 70    | 190                 | 1,400    | 2,800    |
| Black-shouldered Kite  | A        | 1,400            | 27               | nm               | nm               | nm    | nm                  | nm       | nm       |
|                        | A        | 1,200            | 14               | nm               | nm               | nm    | nm                  | nm       | nm       |
|                        | A        | 440              | < 1              | 13               | < 1              | 38    | 74                  | 640      | 370      |
|                        | A        | 12,000           | 74               | 140              | 160              | 40    | 630                 | 700      | 700      |
| Yellow-headed Caracara | A        | 1,400            | < 1              | < 1              | < 1              | 26    | 9                   | 54       | 27       |
|                        | A        | 1,800            | 5                | nm               | nm               | nm    | nm                  | nm       | nm       |
| American Kestrel       | A        | 1,500            | 19               | 17               | 22               | 44    | 44                  | 200      | 110      |

nm, not measured; *t*-nonachlor, *trans*-nonachlor; oxychlor, oxychlordane; hept epox, heptachlor epoxide

## ACKNOWLEDGEMENTS

Financial support was provided by Wildlife Conservation International, now NYZS The Wildlife Conservation Society; we wish to give particular thanks to Stuart Strahl for his support of the project. Professor Gonzalo Morales of the Universidad Central de Venezuela, Sr. Philip Desenne, Sr. Peter Bichier, and Allison Basili provided invaluable assistance and support in undertaking the field studies in Venezuela. Facilities of the University of California, Santa Cruz, and of the Bodega Bay Institute, Berkeley, were used in the analysis of the samples.

Gianfranco Basili  
Department of Wildlife Ecology  
1630 Linden Drive  
University of Wisconsin  
Madison, WI 53706  
U.S.A.

Pablo Cardinale-Pizani  
Environmental Engineering and Health Sciences Laboratory  
Richmond Field Station, Building 112  
University of California  
1301 S. 46th Street  
Richmond, CA 94804 U.S.A.

Robert W. Risebrough  
The Bodega Bay Institute  
2711 Piedmont Ave  
Berkeley, CA 94705  
U.S.A.