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Insecticide Impact on Urban and Suburban Wildlife

Homeowners tend to have two conflicting goals. On the one hand, they want to attract wildlife to their property. At the same time, they take great pains to kill bugs that may be eating their lawns and gardens. What many homeowners don't realize is that insecticides can have a serious, even fatal effect on wildlife, especially birds. Insecticides also harm beneficial insects and worms.

The damage is bound to be variable, depending on the kinds of birds and insects involved and the application rate. This variability, rather than reassuring us, calls for much more conservative use of lawn chemicals and some consideration by homeowners about whether insecticides should be used if they also want to prevent wildlife from being poisoned. We have seen how lawn chemicals in runoff impact water quality. The effect of these chemicals on local wildlife is another reason for reducing their use.

Residual amounts of insecticides that were once thought to be "safe" but have since been discontinued continue to pose a threat to local ecology. Until and unless studies show that pesticides currently in use have little effect on "desired" turf insects and the animals that feed on them, a less chemically dependent approach to landscaping is warranted.

What Chemical Insecticides Do

The insecticides examined here fall into two basic categories (Table 1). Organochlorines—such as chlordane and dieldrin—have various lethal and sublethal effects on animals. Organophosphates—such as diazinon and chlorpyrifos—inhibit the brain enzymes

Table 1: Some Chemical Insecticides

Chemical	Trade Names	In Use?	Toxicity
Organophosphates			
diazinon	Basudin, Diazol, Garden Tox, Sarolex, Spectracide	Banned on golf courses but permissible on residential turf. Pooling, spillage, overapplication occurs	Paralysis or death from depressed ChE acticity; toxic to humans
chlorpyrifos	Dursban, Lorsban, Pyrinex	Yes	Moderate toxicity
acephate	Orhtene	Yes	Contact and systemic
Organochlorines			
dieldrin	Octalox	Discontinued in US	Toxic to humans, absorbed through skin
heptachlor (component of chlordane)	Velsicol, Drinox, Heptamul	Discontinued except as subsurface termeticide	Toxic to humans, poisoning from ingestion, inhalatin, skin contact
chlordane	Toxichlor, Octachlor, Synklor, Corodane, Niran	Discontinued except as termeticide	Poisoning from ingestion, inhalation, skin contact

cholinesetrase and acetylcholinesterase. The nervous systems of all animals depend on these enzymes, therefore any animal can be affected if it receives an adequate dose. There have been more than a few cases where the amount of insecticide applied to turf was enough to kill relatively large animals such as geese (Table 2). Animals that do not eat the grass itself but forage on the ground are also vulnerable.

Effects at Ground Level

Certainly it is not desirable to kill all of the insects inhabiting the topsoil and turf. A diverse invertebrate community is necessary for soil maintenance and as the staple diet of many other animals. Chemical insecticides are often advertised as being specially targeted for certain pests—such as chinch bugs in lawns—but in reality the only specificity is in the time of application since any and all invertebrates present in the lawn at the time will be affected to some degree. The relative toxicity of these insecticides to different insects and other invertebrates has not been thoroughly studied.

Arnold and Potter (1987) attempted to find whether the number of "non-pest" insects, spiders and worms is diminished in treated turf. Counts were made of insects and spiders in treated and untreated plots of turf at different times of the year. In particular the response of herbivores and predators was compared. This comparison is prompted by the issue of whether pesticides severely reduce the population of insects and spiders that prey on pest species, thus making pest outbreaks more likely. Arnold's study found that the effect of insecticides and weed-killers on earthworms, spiders, and non-target insects is unpredictable and that in most cases the plots that experienced a decrease in the population were quickly repopulated.

Most likely, the treated plots were repopulated from neighboring untreated plots. The counts showed that the number of predators (spiders) rises and falls with the number of prey (target insects) in both treated and untreated turf but that the initial decline is much more severe in treated turf.

Toxicity to Birds

Decarie *et al*. (1992) investigated the effect of lawn and tree spraying on robins, which have small foraging territories when nesting. Nest productivity was compared in untreated lots and lots in which the lawn was sprayed with diazinon and chlorpyrifos or trees sprayed with diazinon or acephate. In the case of sprayed trees but untreated turf, birds are most likely exposed to the insecticide through the skin rather than from something they ate. Affected adult robins would be expected to be less efficient in feeding their young. The number of surviving nestlings were counted, the behavior of the parents was observed, and some adults were caught for analysis.

No symptoms of poisoning were observed 18 to 24 hours after tree spraying and adults continued to visit nests; however, necropsies showed that brain activity of birds from sprayed trees was significantly less than birds in untreated sites. There was no significant effect on nest productivity and parental behavior; however, productivity for birds in areas where *lawns* had been sprayed was negatively affected. It would seem that the birds are exposed by feeding and that the feeding habits of the robin make it susceptible to intoxication in treated lawns. For the same reason, species of birds that forage in trees might be affected if trees are sprayed.

The authors point out the many interacting variables in this study. While they conducted a controlled experiment for tree spraying, they had to rely mainly on lawn care records and resident surveys to find treated and untreated lawns. There is some uncertainty about the kind and quantity of chemicals applied to the lawns and the movement of the foraging birds.

The breeding success of birds may be impaired by insecticides—as indicated by Decarie—or individual birds may die from poisoning. In a study by Okoniewski and Novesky (1993), necropsies of dead birds from suburban areas revealed that insecticide poisoning was second to injury as the cause of death (Table 3). In all, 86 poisoned songbirds and 36 poisoned birds-of-prey were diagnosed. Some poisoned mammals were also reported. The discontinued organochlorines persist in the soil and remain a threat decades later, accounting for 17% of songbird fatalities in this study. Cholinesterase activity was depressed in birds poisoned by the organophosphate diazinon.

Linking the concentration of toxin in the poisoned bird to the actual amount of pesticide applied is difficult. Significant levels of pesticides were detected in the soil and in insects and worms from the area (Table 4). This would indicate that the birds were poisoned by ingesting toxic levels of pesticides in their diet. Whether biomagnification (increasing concentration of toxins up the food chain) is actually taking place is difficult to tell without closer analysis of the poisoned animals' diets. There was a seasonal trend in the deaths of some species - this may indicate the sensitivity of life stages or have something to do with seasonal applications of fertilizer-insecticide mixes sold as one-time, all-purpose products.

Table 2: Cases of Waterfowl Poisoned From Grazing on Diazinon-Treated Grass (Tietge, 1992)

- Grass eaten by geese on golf course was 20 ppm; 14 dead Canada geese (1978)
- Grass eaten by Brant geese on golf course contained 79 ppm diazinon (95 ml/100 m^2 application); 700 dead geese (1985)
- 10 dead geese from application of 95 ml/100 m^2 (1985)
- 2.2 kg/ha on golf course—85 dead American widgeon, some sublethally poisoned but killed by predators

Table 3: Cause of Death in Insect-Eating Birds in Suburban Yards (152 birds, >5 spp.) (Okoniewski and Novesky, 1993)

Cause of death	(%)
Trauma	26
Organochlorines	17
ChE inhibitors	8
Infectious Diseases	6
Parasites	6
Unknown	37

Insecticide Persistence and Overuse

The persistence of discontinued insecticides, such as organochlorines, poses a threat to the local ecology decades after such chemicals have been banned or restricted. The compounds studied by Okoniewski and Novesky did not pose as much a threat to birds and other wildlife than when they were first used in the 1950s. However, as generations of resistant beetles reproduced, greater amounts of the insecticides were applied—ineffectually, since the pest's resistance could be as much as 100-500 fold. Residents were applying the insecticides at up to twice the label dose and frequency (Okoniewski and Novesky, 1993). Long after these insecticides have been discontinued, residuals in the soil have toxic effects. Two lessons can be learned from this development: 1) increasing the amount of chemical insecticide applied is inefficient and ecologically costly, 2) recorded outbreaks of resistant populations of pests can identify areas that were probably overtreated and where wildlife poisoning is likely to occur.

—JMC

References

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Table 4: Organochlorine Levels in Soils and Poisoned Birds (Okoniewski and Novesky, 1993)

Chemical	Soil concentration (ppm)	Concentration in songbird diet (ppm)	Concentration in poisoned songbirds (ppm) and [std. lethal dose]	Concentration in raptors (ppm)
DDE (component of. DDT)	0.01-0.21		0.05-23.9 mean 3.30	
Heptachlor (HE)	0.01-0.15	beetles: <=15.6 (HE, OXY)	0.16-15.6, mean 3.195 [9 ppm]	9 ppm
Oxychlordane (OXY)	0.01-0.18	beetles: <=15.6 (HE, OXY)	0.11-10.0, mean 2.59 [1.1 + 3.4 HE]	1.1 plus 3.4 HE
Transnonachlor (TNCH)	0.10-1.24	chlordane cmpds (TNCH, a-, b-Chlor): earthworms: 0.2-2.7 cutworms: 0.2 maggots: 0.7-1.0	0.10-42.9, mean 3.87	
Dieldrin	0.01-3.88	earthworms: ≤ 0.3 cutworms: 0.1 beetles: ≤ 2.1 maggots: 1.2-2.0	0.03-20.5, mean 4.12 [4 ppm]	4 ppm