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INVESTIGATING AND REPORTING INCIDENCE OF WILDLIFE MORTALITY FROM PESTICIDES

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A few classic examples of fish or wildlife kills by pesticides have received wide publicity. Most biologists are familiar with the Mississippi River fish kill that occurred in the spring of 1964. A majority will remember the numerous reports of fish and wildlife mortality following the attempts to eradicate fire ants with heptachlor treatments over immense acreages of the south. Almost every conservationist knows the elms and robins story.

Spectacular pesticide kills like these are big news and cause for much concern on the part of the public. They are not common however, and are becoming less frequent. We have learned from our mistakes. Progress is being made in restricting the use of the more hazardous chemicals. Many of the wide-scale pesticide applications are undertaken by the Federal Government, and these are carefully planned to prevent such problems. The States, likewise, are greatly concerned about the proper use of pesticides.

Minor pesticde kills are not uncommon, however, and, as long as toxic substances are introduced into the environment, will doubtless continue to occur. Collectively, they are probably more significant than the spectacular kills. Quite often these minor kills result from the misuse of a chemical, such as careless handling, overdosage, or improper application techniques. However, numerous wildlife kills caused by legitimate and correct applications can be documented.

Government pest control programs, though some are quite large, utilize only 5 percent of the pesticides applied in this country. Private use of the other 95 percent is largely uncontrolled. Pesticide development, production, and marketing are regulated by law. Proper use of registered chemicals, however, is virtually unenforceable.

Too often, the smaller kills caused by pesticides go uninvestigated and unreported--perhaps even unnoticed. Reports of dead animals which might have been killed by pesticide applications may not be thoroughly checked because other duties prevent it, they are considered unimportant, pesticides are not suspected, or becuase it is difficult and sometimes impossible to pin down pesticide-caused mortality. Kills may occur on private land as a result of unpublicized treatments or may occur months after the application through food chain buildup.

It is important that small pesticide kills be investigated, documented, and reported. Small, seemingly localized kills if repeated in enough scattered locations can be responsible for depressing or even removing certain susceptible wildlife species from the ecological picture. The pelican die-off in Louisiana is a good example of how wildlife mortality can go unnoticed. A great many pesticide-caused wildlife mortalities are probably not even noticed, and this makes it doubly important to check every incident that does come to our attention.

Properly investigated and reported incidents of pesticide-caused mortality can serve several vital functions. If careless or intentional misuse of chemicals is responsible, legal prosecution may be in order. Safe use of chemicals is the responsibility of the user, and he should be kept aware of the fact. Unknown hazards inherent to use of new chemicals, or new uses of old chemicals, may be detected. Suspected but unproven hazards from chemicals that are in common use might be

demonstrated. Hazardous application techniques might be discovered and modified to remove future hazards. Perhaps the most important need for such investigations is keeping the public aware that hazards do exist and that pesticides must be used with care.

Pesticides are playing an increasingly important role in our agricultural economy. The wide array of chemical tools available to the farmer enables him to produce higher quality food at a lower cost. Conservationists recognize the fact that pesticides are here to stay. It is our responsibility to help develop pesticide practices that minimize hazards to fish and wildlife. For this we need the cooperation and assistance of farmers, agricultural technicians, and pesticide dealers and manufacturers. We can and must cultivate their assistance rather than invoke their resentment.

INVESTIGATING SUSPECTED PESTICIDE KILLS

Quite frequently reports of dead songbirds or other wild animals are received by local conservation officers, police, or other city, county, or State officials. But if the possibility of pesticide poisoning is not considered, or the report is not passed along to someone who is aware of the hazards, pesticide-caused mortalities may pass unrecognized. Thus, the need for alerting lines of communication is apparent.

Obviously, every reported wildlife mortality cannot be investigated as a possible pesticide incident. Many reported incidents can quickly be attributed to other causes. If examination of the carcass reveals an injury or disease, pesticide poisoning may be the primary cause of death. Skinning the animal will usually show any injuries not readily apparent from the exterior. Stomachs will sometimes contain foods which can be associated with pesticide applications in the vicinity.

Animals which might be diseased should be handled carefully as some animal diseases can be transmitted to man. Rubber gloves should be worn when carcasses are handled or dissected. Precautions should be taken to avoid contaminating clothes, equipment, etc.

If there is no apparent clue as to the cause of death, pesticide poisoning should be considered. Search carefully for other dead or affected animals. Look especially in heavy cover, in roosting areas, near water, in brush piles or in other protective cover that dying animals may seek out. Symptoms which may be apparent in affected animals include tremors, convulsions, lack of muscular coordination, diarrhea, constriction of eye pupils, labored breathing, lung congestion, or nasal discharge.

Our southeastern States are fortunate in having the services of the Cooperative Wildlife Disease Study in Athens, Georgia, and the Cooperative Fish Parasite and Disease Study in Auburn, Alabama. Through their trained personnel and laboratory facilities, assistance is available for investigating fish and wildlife mortalities and diagnosing diseases. These services can simplify and compliment investigations of possible pesticide-caused mortalities by separating those caused by disease. Neither of the studies ordinarily investigate pesticide mortalities, but participating States could easily arrange for assistance in spotting possible victims of pesticide poisoning.

If there is reason to suspect pesticide poisoning, attempt to find the source by searching the area and talking to nearby residents. An examination of the stomach contents may give a clue (contents should be preserved by freezing). Check recent pesticide applications to crops, gardens, or other areas and try to tie in the time when the first affected animals were seen. Plot the locations of known kills and attempt to find a pattern. Do not overlook the fact that birds or some mammals could have been exposed a long distance from where they were found dead. Make every effort to identify the chemical, or chemicals, which might have been responsible for the poisoning. This can be a great help to the laboratory which analyzes the specimens. Keep complete field notes on weather, location of kills, symptoms of affected animals, etc.

COLLECTING SPECIMENS FOR LABORATORY ANALYSIS

When investigations show that pesticides may be responsible for wildlife mortality, specimens should be collected immediately. Scavengers, predators, and

pets can quickly remove dead or disabled animals. If available, living specimens that are showing poisoning symptoms are the best indicators. The freshest dead specimens should be frozen for laboratory analysis.

If symptomatic living specimens are found, birds should be taken to a poultry diagnostic laboratory, and mammals to a veternarian for diagnosis and/or post-mortem examination. If death occurs before reaching the laboratory, specimens should be refrigerated immediately, or, if it will be more than 24 hours before a post-mortem can be performed, they should be frozen for pesticide analysis. To facilitate the fastest possible delivery to a diagnostic laboratory, the locations of available labs should be known in advance by those responsible for guiding the investigations.

Dead specimens should be wrapped in aluminum foil, labeled appropriately, placed in an airtight plastic bag, and frozen promptly. If freezing facilities are not immediately available, a styrafoam cooler and dry ice can be effectively used. Wrapping samples in aluminum foil is important because chemicals used in the manufacture of plastics can interfere with analysis of pesticide residues. Prompt freezing is important because chemical changes in the body of the specimen immediately following death can interfere with accurate laboratory analysis.

If freezing space is limited, only the most important tissues for analysis (i.e., the brain, stomach, and liver) need be kept. Frozen specimens should never be allowed to thaw. If it is necessary to ship them to a laboratory for analysis, they should be packed in dry ice and sent by air express. Shipments should be made so that weekend layovers are avoided, and the lab. should be alerted to the arrival date.

LABORATORY ANALYSIS

Pesticides that are most likely to be responsible for vertebrate animal mortality may be divided by their action into two major groups:

1. The *Chlorinated hydrocarbons* are compounds that kill by modifying the electrical properties of nerve components (O'Brien, 1967). Included in this group are the most persistent pesticides, some of which remain as residues in almost every element of the environment. Examples are DDT, dieldrin, endrin, aldrin, toxaphene, heptachlor, lindane, and chlorodane.
2. The *organophosphates and carbamates* are pesticides that kill by inhibiting cholinesterase (a chemical which facilitates transmittal of nerve impulses) and thereby disrupting nervous activity vital for body functions (O'Brien, 1967). With a few exceptions, these pesticides tend to be shortlived and do not cause the residue problems associated with the persistent chemicals. Examples are parathion, malathion, fenthion, tepp, Azodrin, diazinon, carbaryl, and Zectran.

Laboratory analysis of specimens affected by either of the two groups is different. For the chlorinated hydrocarbons, residues are measured; for the organophosphates and carbamates, cholinesterase levels are measured. In either case, the brain is the tissue that can provide the best information.

Until recently, the presence of pesticide residues in animal tissues could not be interpreted positively as a cause of death. Widely different concentrations of residues could be found in the bodies or specific tissues of both dead and living animals. Virtually every animal analyzed carried some concentration of pesticide residues.

As a result of work at the Patuxent Wildlife Research Center, it is now possible to show with a degree of certainty that an animal died from exposure to a chlorinated hydrocarbon. Research has shown that death results when residue concentrations reaching the brain exceed a critical level that varies somewhat between individuals but is surprisingly constant between species. Since residues of chlorinated hydrocarbons are quite stable, dead specimens that are not badly decomposed may be analyzed.

With the organophosphates and carbamates, adverse response of an animal to the chemical is determined by measuring how much the normal level of brain cholinesterase has been depressed. In vertebrates, death usually occurs when brain cholinesterase is 95 percent inhibited (O'Brien, 1967). Normal cholinesterase levels

vary widely between species and between individuals within a species. Physical stress can also affect cholinesterase levels. As a result, normal levels must be established by analyzing brains from several unexposed animals.

Brains to be analyzed for cholinesterase must be preserved soon after death or results may not be valid. If it is certain that a cholinesterase-inhibiting pesticide is involved, only brains need be collected. To save freezer space, they can be removed before freezing, or the skull can be detached and frozen intact.

In most cases, State game and fish agencies will not require enough pesticide analyses to justify equipping a laboratory and paying a qualified chemist. There are numerous commercial laboratories capable of doing good pesticide analysis and several have experience with fish and wildlife specimens. Regional Offices of the Bureau of Sport Fisheries and Wildlife can provide advice on qualified laboratories and cost of analyses.

Some States have laboratories capable of pesticide analysis in their health or agriculture departments. Many universities also have facilities for pesticide analysis.

EXCHANGE OF INFORMATION

Equally as important as documenting effects of minor pesticide incidents is the exchange of that information. Conservationists and the general public should be made aware of the hazards of pesticides——not so their use can be stopped——but so that safer chemicals and methods of application can be encouraged. When pesticides are improperly used and wildlife losses result, prosecution under applicable fish and game codes should follow. Publicity of such investigations and prosecutions could do much to impress the need for careful use of pesticides.

The Department of Agriculture's program on safe use of pesticides is a good example of what can be done. Each pesticide accident involving humans or a major loss of livestock is investigated and reports are circulated throughout the country. Considerable effort is directed toward radio and television publicity to promote safer use of pesticides.

I am certain that some of the pesticide practices currently registered and in wide use are causing wildlife mortality that is not generally known. Perhaps isolated observations of such losses have been made, but if so, few reports have been circulated to others who might be concerned. Conservationists should all be informed in pesticide hazards so they can play a leading role in developing safe practices.

Pesticide-caused wildlife mortality may not always be readily apparent as a cause-and-effect relationship. Sometimes animals low in the food chain can survive heavy exposure to pesticides with no apparent effects, but may pass residues they are carrying to animals higher in the food chain. Animals at the top of the food chain may be the eventual victims of pesticide applications that had no immediate or readily apparent effects on fish or wildlife at the time of application. Conservationists should be alerted to cases where such delayed effects are documented.

Suspected pesticide hazards should be watched, either to document the hazard or to remove the suspicion. For example, various combinations of highly toxic and persistent chemicals are used on cotton for boll weevil control. Small-game utilization in and around cotton fields is such that some wildlife must almost certainly be affected by these treatments. Those who are responsible for screening pesticide registrations, however, have no information of this kind.

Azodrin is a relatively new insecticide which, because of its high toxicity, was considered a potential wildlife hazard. Conflicting laboratory data made its status doubtful until last fall when a large number of dead quail and other birds were found where it had been used. Additional information on this chemical is needed. Other examples of chemicals or use patterns that should be watched could be circulated to interested persons.

I am suggesting that there is a need for a communications network for the exchange of information on pesticides as they relate to fish and wildlife. I believe that such a system should tie in at least several States which have similar agricultural production and pest problems. State game and fish agencies could become centers of this communications network because most reports of wildlife mortality will be directed to them.

The California Department of Fish and Game has a specially trained pesticide investigation team which checks suspected pesticide kills of fish or wildlife. The cost of investigations and necessary chemical analyses are borne as a Federal Aid project. Most States would not require such an elaborate system.

A workable pesticide alarm system could be set up somewhat as follows. At least one person in the State game and fish department could be assigned the responsibility of pesticide coordinator. He would keep abreast of the latest information on pesticide-wildlife problems in neighboring States and the current literature. He would give necessary instructions to field personnel and make appropriate news releases to the public.

The decision as to when a reported fish or wildlife mortality should be investigated as a possible pesticide incident would be his, and he would head the investigation. He would exchange pesticide information with coordinators in neighboring States and the Regional Office of the Bureau of Sport Fisheries and Wildlife. Field personnel of the game and fish agency and other conservationists such as Audubonites, Izaak Walton Leaguers, and Wildlife Federationists could function as the grass roots of the reporting system.

The Bureau of Sport Fisheries and Wildlife can provide limited assistance for investigating significant fish or wildlife kills where pesticides are suspected. Establishment of an effective reporting system throughout the southeast could justify a cooperatively financed pesticide investigation team similar to that of the Southeastern Wildlife Disease Study or the Fish Parasite and Disease Study. This could also be an answer to the problem of obtaining fast and reliable chemical analysis.

I believe that an appropriate system for investigating pesticide kills and exchanging information of this type merits serious consideration by concerned conservation agencies. The early establishment of such a system could have a profound effect on the future of wildlife conservation in this country.

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SOME EMERGENCY DISEASE ASPECTS OF DEER MANAGEMENT IN THE SOUTHEAST

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The Southeastern Cooperative Wildlife Disease Study (SCWDS) was established July 1, 1957, at which time deer populations throughout the Southeast had commenced to expand at an unprecedented rate. This afforded considerable aesthetic pleasure for the general public, increased recreational opportunities for countless thousands of sportsmen, and significant economic returns to local communities and counties of all southeastern states. With this influx of a new, multi-million dollar, renewable natural resource, livestock producers and public health officials became

[1] This is the first regional diagnostic and research service established in the United States for the specific purpose of investigating diseases of game animals. The project is supported by the Southeastern Association of Game and Fish Commissioners and the Bureau of Sport Fisheries and Wildlife of the United States Department of the Interior. Participating states include: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia.