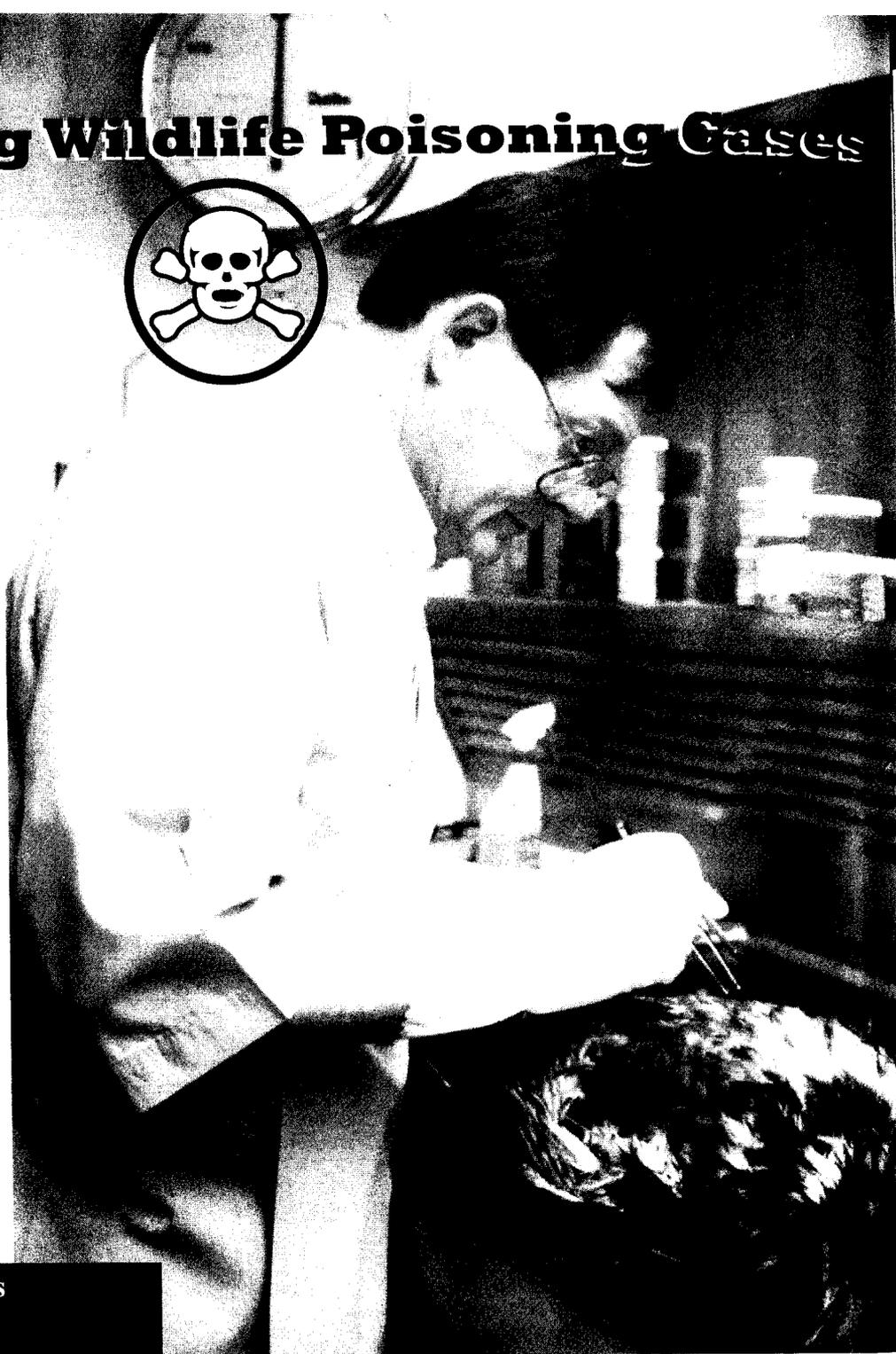


Investigating Wildlife Poisoning Cases

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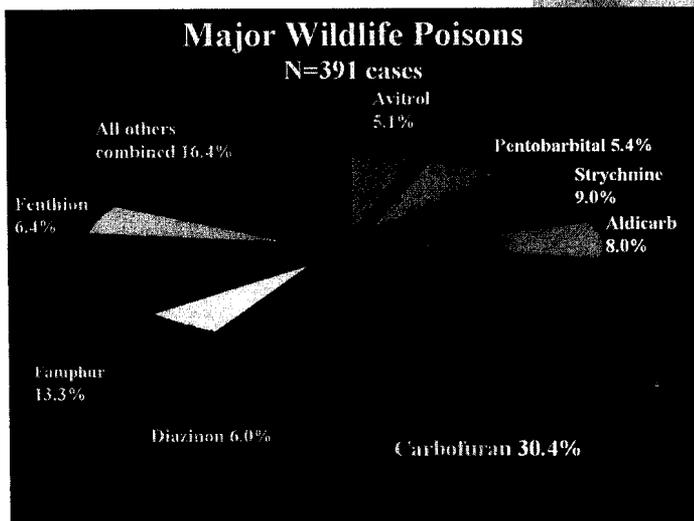


Introduction

Poisoning of wildlife is a wide spread and major investigational problem for wildlife law enforcement officers. Protected wildlife killed through pesticide misuse or environmental contamination is just as dead as if they were illegally killed with a gun. The impact on the population may, in fact, be greater because of secondary and even tertiary poisoning or impacts on breeding potential of populations lasting over a period of time. Wildlife poisoning is indiscriminate and may pose a significant hazard to endangered species, domestic animals and even human beings.

In law enforcement cases, acute and sub-acute toxicities (poisonings) are most frequently encountered. It is usually impractical to pursue individual cases which involve chronic toxicosis such as DDT, PCB, or heavy metal poisoning because of wildlife mobility. This also limits the type of poisons which must be considered in field cases. Organophosphate and carbamate pesticides are by far the most commonly encountered acute wildlife poisons followed by strychnine, avitrol, barbiturates, cyanide, compound 1080, anticoagulant rodenticides, and zinc phosphide.

Just another day at the office; Doctor Richard Stroud examines an eagle carcass.



Because of the high degree of variability in both the animals and the field conditions under which wildlife are poisoned, the pursuit of wildlife poisoning cases may require a more sophisticated level of investigation, scientific proof to support the case, interpretation of the data and presentation to the court than traditional wildlife illegal take cases. While the forensic pathologist can provide a diagnosis of cause of death due to poisoning, it is the responsibility of the investigating officer to provide the properly preserved samples and the background information through field investigations on which the diagnosis and finally the prosecution phase of the case is based.

For legal cases, a diagnosis of poisoning is based on:

- 1) an accurately documented field investigation which includes a history describing the signs or symptoms (if observed in living animals), species and numbers of animals involved, spatial, and time distribution of dead or affected animals, local agricultural chemical and pesticide use, animal control programs, sources of pollution, etc.,
- 2) complete scene investigation with properly collected, preserved evidence and documentation of evidence,
- 3) accurate analysis of specimens by qualified laboratories, and
- 4) interpretation of the laboratory results based on all the factors involved in the case.

The investigating officer is also responsible for the safety of both himself and others who may be exposed to toxic chemicals during the investigation, collection, shipping and storage of evidence. He must also be aware of Department of Transportation (DOT) regulations regarding the packaging and shipment of known poisonous substances through the mail or other commercial carriers.

Field Investigation

A good field investigational history is essential for an accurate diagnosis. It will point the laboratory investigation in the proper direction and reduce the turnaround time and cost of laboratory analysis. A request for analysis should be used to confirm a suspected poison of a specific type, not explore for options.

A field history should include observations of the number of individuals and species involved both at the suspected site and in the general area. Poisons are highly variable in the speed in which they work. For example, carbofuran may kill an eagle as it stands on the carcass of a baited sheep. On the other hand, thallium may take a couple of days to destroy the kidneys of an eagle. Therefore, thallium poisoned eagle carcasses are more likely to be found at a roost site.

The crime scene investigation may reveal critical clues such as the presence of granules on the baited carcass, abnormal smells, discolored flesh or dead insects on and below the suspect baited carcass. These are all important observations which should be recorded in the history and photographed.

Look for evidence of primary, secondary or even tertiary poisoning among the normal scavenger or predator/prey relationships. Determine if all the animals involved are in the same stage of decomposition, have full crops or stomachs, die in a particular position, have wool, hair, or other evidence of what they were feeding on in their talons or claws.

The investigative history should include an indication of the suspected poison or poisons based on previous poisoning cases in the area, active pest control operations, local availability of pesticides for agricultural applications, trace evidence found at the site, informants or other sources of information. The analytical chemist must have a clue as to what to look for because there may be only limited amount of test material available which may have to be processed in different ways depending on the suspected poison.

Collection And Preservation Of Evidence

Early evaluation of the potential for toxic exposure to the investigator as well as to the public should be recognized. If there is evidence of acute toxicosis to wildlife, steps to protect the investigator(s) from both skin and respiratory contact are essential.

Wildlife officers anticipating responding to these types of incidents should be prepared with appropriate safety equipment well before responding to any possible wildlife poisoning incident. Most organophosphate and carbamate pesticides are quickly absorbed through the skin and may cause symptoms and even death in a very short time. The handling of affected wildlife by rehabilitators or other members of the public not only increases the chances of liability to toxic exposure but destroys the chain of evidence and usually the chances for diagnosis.

Evidence in poisoning cases may include dead animal parts or whole carcasses, baits, containers, vomit or



Typical death pose of an eagle poisoned with carbofuran pesticide

feces from animals, crystals, granules or liquid mixed in soil, grain, or vegetation, etc. Such evidence should only be handled with heavy rubber gloves, forceps or other devices. Thin disposable "examination" gloves routinely carried by professional law enforcement officers do not provide the protection needed for pesticide work. If water is involved, remember that it may be contaminated with a toxic pesticide or chemical which is easily absorbed through the skin. Transportation of contaminated evidence inside a closed vehicle should be avoided, especially if the suspected material has any evidence of an odor.

Samples for laboratory analysis should be triple wrapped in heavy gauge plastic bags. Beaks, talons, claws or broken bones left unpadded or exposed may tear or puncture plastic bags. Baits or grain samples may be collected in clean or new glass or plastic containers or aluminum foil.

Each piece of evidence should be separately wrapped and clearly labeled as hazardous on the outer wrapper to warn persons handling the material of its potential toxic hazard. Do not put labels, evidence tags or other information inside the bag.

Documentation appropriate for crime scene investigations and a chain of custody should accompany the evidence. All carcasses and wet material must be frozen as soon as possible. When freezing evidence, allow adequate space for air circulation around the sample and do not overcrowd a freezer. This delays the freezing of internal organs in a whole carcass and contributes to the



decomposition and loss of pathological detail. Certain types of organic pesticide residue in decomposing samples may also be lost due to degradation of the pesticide chemical structure. The result is that pesticide residue originally responsible for the death of the animal may not be detectable. Specimens should be sent to the laboratory as soon as possible. Long term storage at normal home freezer temperatures will enhance the possibility of degradation or even total loss of some poisons.

Shipment of poisonous substances is highly controlled by Department of Transportation (DOT) regulations. The shipment of even small quantities of known concentrated toxic substances requires special packaging, documentation and shipping restrictions. Shipment of suspected poisoned carcasses is less restricted because the toxic substance is found only in small quantities (if at all) and is encased within the body. The field investigator should become familiar with the DOT regulations to protect him/her from potential fines and personal liability. Personal delivery of the samples to a qualified laboratory where possible has advantages such as more secure chain of custody, avoiding shipping problems, and better communication with the analyst doing the work.

Postmortem Examination - What To Expect In Poisoning Cases

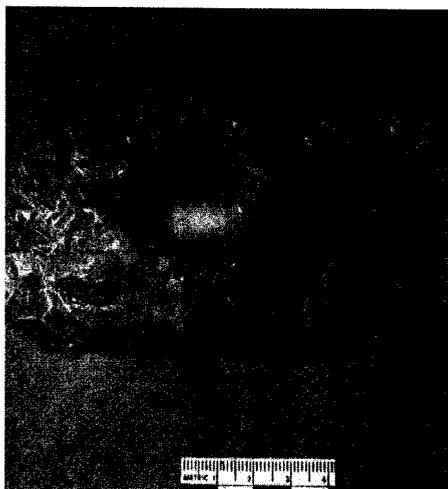
The postmortem examination of an animal carcass has the following objectives:

- 1) document the presence of gross pathological observations indicative of poisoning
- 2) eliminate naturally occurring disease, trauma or other causes of death
- 3) collect appropriate samples of tissues or stomach contents for chemical analysis to confirm the suspected diagnosis
- 4) identify the stomach contents which may be the source of the poison

The post mortem examination or necropsy (analogous to the autopsy in human medicine) is an organized, system-by-system examination of the animal carcass. The postmortem condition of the carcass is a primary factor in what can or cannot be observed either grossly or by microscopic examination of prepared tissue sections. Assays such as brain cholinesterase



Aldicarb granules on sheep carcass used as bait



Cyanide capsule in bait

determination can be done only on well-preserved tissue. The fresher the carcass and the greater the care taken in collecting and preserving the carcass, the more meaningful are the observations of the gross examination. However, carcasses in various stages of decomposition may also reveal information which can be used to confirm the cause of death and the presence of toxic substances. Evidence of poisoning has even been extracted from the dried feet and bills of decomposed or partial carcasses of birds.

During the necropsy, photographs are routinely taken to document observations and collection of samples. Particular attention is paid to the stomach or crop content which, in acute poisonings, probably represents the last meal and the source of the poison.

Rapid identification of the food items by genetic, serological and morphological characteristics will enhance the chances of finding the source of the poison by the field investigator.

The submission of appropriate

tissues for analysis by the pathologist is based on the knowledge of the most likely target organ for the suspected poison. The field history is essential in determining what tissues are submitted and which types of analytical procedures are requested of the chemist. "Shotgunning" of samples for any and all possible toxic substances is not a practical or economical approach. Various types of poisons require different extraction or analytical methodologies which consume both the limited sample and the laboratory's resources. Therefore, it is important to prioritize the analytical requests based on the field investigation and /the pathological evaluation. Minimum sample sizes required for analysis may at times be made up of pooled samples. The detection of pesticides and other poisons may be a highly complex procedure requiring various analytical approaches and instrumentation. No single laboratory can provide testing procedures for all potential poisonous substances. Few laboratories have the capability to detect the presence of compound 1080.

Poisons Used On Wildlife

Poisons most commonly encountered in wildlife poisoning cases are fast acting and acutely toxic. Slow acting poisons such as ethylene glycol (anti-freeze) or the anticoagulant rodent poisons are rarely encountered because poisoned animals and birds die slowly and are unlikely to be found due to their hiding while sick or predation while in a weakened state.

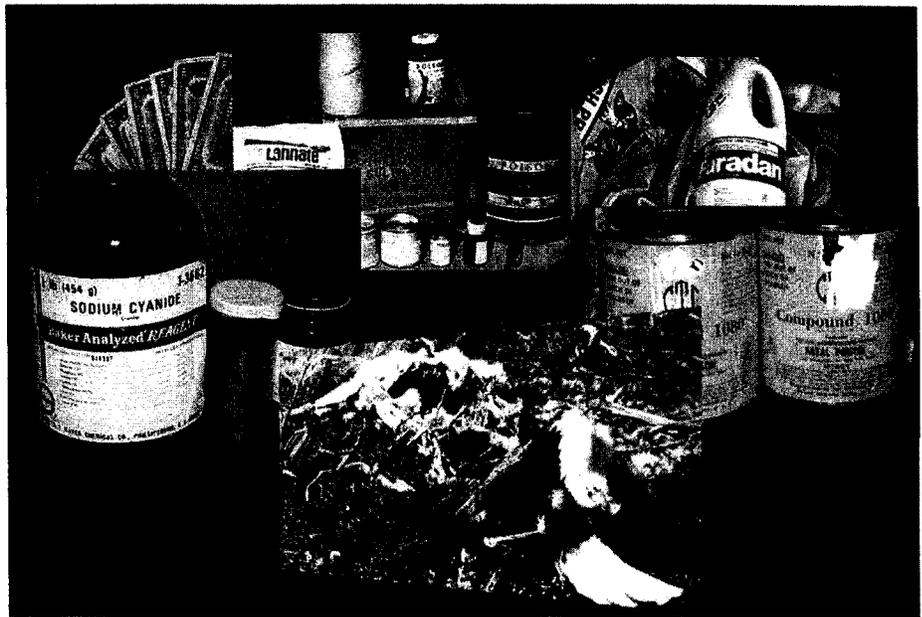
Carbamate and Organophosphate Insecticides

Carbamate and organophosphate insecticides have replaced the organochlorine pesticides in the United States and Canada because they are highly effective against various plant pests, they do not bioaccumulate, and they are quickly degraded in the environment. However, because of their high potency, they are the most commonly misused pesticides responsible for wildlife poisonings.

Both groups may kill in minutes by inhibiting the function of the cholinesterase enzyme responsible for nerve impulse transmission in the body. Very small amounts of the pesticide are needed to kill a bird or mammal. Residues within the tissues are generally not detectable. Documentation of poisoning can only be done by demon-

strating the unabsorbed chemical residue in the crop or stomach content or from the surface of the skin in cases involving dermal contact. This does not tell the analyst how much of the pesticide was actually absorbed and is present within the body. Birds are generally more susceptible to anticholinesterase pesticides than are mammals. Brain or blood cholinesterase levels, measured as enzyme activity in fresh carcasses, may be used to indicate physiological activity impacts of these two pesticide groups.

Carbofuran, aldicarb, famphur, fenthion and diazinon are common restricted use farm pesticides which are used illegally to kill unwanted wildlife. Baits or carcasses may be intentionally contaminated with these pesticides and left for predators or scavengers. However, legitimate agricultural use may also result in poisoned animals. Field investigations of suspected wildlife poisoning cases should consider the food habits of the victim animals. Considerations should include primary and secondary poisoning as the poisoned victims are consumed by other animals and therefore extend the chain and expand the "circle of death". The latter term describes the scene of the crime, higher numbers of victims at the center of the event (where the bait was placed) with a decrease in numbers of victims discovered in a circular pattern as the investigator moves further away. For example, a farmer may place grain laced with famphur, an organophosphate pesticide marketed as Warbex® for



Collage of pesticides used to poison wildlife

treatment of cattle grubs, to kill pest birds such as starlings. The starlings, disabled by the pesticide, are easy prey for hawks and eagles which become secondary victims of the illegally used pesticide.

It is not within the scope of this article to list and describe the thousands of chemical formulations of organophosphate and carbamate pesticides available on the market today used to poison wildlife. Other than famphur (marketed as Warbex®) all are restricted pesticides meaning that use by other than a licensed pesticide applicator in accordance with approved

label applications and restrictions is illegal.

However, certain formulations occur more commonly in cases submitted to the National Fish and Wildlife Forensic Laboratory. For example, Aldicarb (commonly marketed as Temik®) is a carbamate insecticide or nematocide formulated for use as a systemic agricultural pest control agent. It is the most toxic of the carbamate pesticide group. Poisoning may occur either by ingestion or dermal absorption. It is marketed only in granular form containing 10% or 15% active ingredient. The granules are coarse pepper size and are black with light centers. The granules are highly water soluble and the chemical may be rapidly degraded under wet or alkaline soil conditions, however, under dry conditions, they may retain their highly toxic character for long periods of time.

Aldicarb has been used in the western states to poison carcasses of sheep for predator control. Eagles, bears, magpies and coyotes have been found close by such poisoned carcasses. The dark granules are often grossly visible on the carcass or in the freshly ingested crop or stomach contents of the poisoned wildlife. However, moisture may dissolve the granules and impregnate the meat with the chemical. The granules, if left unburied, are picked up by small birds which mistake them for grit or food.

Carbofuran (commonly marketed as Furadan®) is a widely used agricultural pesticide for corn, alfalfa and other farm crops. It is marketed in both a liquid



strychnine impregnated seeds

Green dye stained strychnine impregnated seeds from the crop of a duck



Safety Considerations for Investigation of Wildlife Poisoning Cases

1. If dead animals are found at an industrial site or a suspected illegal toxic waste dump site, carefully leave area immediately and call for a Haz Mat team to do the collection and investigation.
2. Use heavy duty non-porous latex or rubber gloves to handle all dead birds or suspected baits to prevent contamination of your skin with pesticide residue. Most pesticides are easily absorbed through the skin. Thin disposable gloves are insufficient protection. Be aware of skin contact with contaminated water.
3. If strong abnormal chemical odor is present, use appropriate respirator when collecting samples or call Haz Mat team.
4. Double or triple bag in heavy plastic (4 mil or greater) plastic bags any carcasses collected for necropsy examination. Clearly label on outside bag as toxic.
5. If a concentrated source of suspect chemical substance is observed, take only a small sample for laboratory analysis. A cotton swab dipped in a suspect chemical and sealed in a polypropylene, plastic or glass tube is sufficient for analysis. If the evidence is undiluted chemical, less than a gram of solid material or a milliliter of liquid may be legally shipped.
6. Dept of Transportation rules (49 CFR 171 to 180) on the packaging and shipment must be followed when shipping hazardous material to a lab using a commercial common carrier. Shipment of hazardous material by US mail is forbidden.
7. Do not place evidence from a suspect pesticide poisoning case in an enclosed space such as a vehicle, office area where humans may inhale toxic fumes.
8. Properly dispose of all potentially toxic materials at the site not collected as evidence to prevent further environmental contamination or poisoning of animals.
9. Wash all exposed skin prior to eating, drinking or smoking after handling potentially poisonous material. Remove and properly dispose of gloves or other protective clothing when investigation of site is complete.

and a granular form. Carbofuran has been the most widely used pesticide found in poisoned wildlife. Carcasses of livestock, deer or coyotes have been laced or injected with carbofuran or individual baits soaked in the liquid pesticide and distributed openly on the ground. The probable distribution of the chemical poured on a carcass should be considered when taking samples for analysis.

Coumaphos and famphur are used to control parasites in domestic cattle and sheep. These organophosphate pesticides may be poured on or used as a dip with long-term residual effect. While mammals have a high tolerance, birds are affected by much lower doses. Unintentional poisoning of eagles and other scavenger species has been documented due to feeding on the carcasses of treated range cattle.

Diazinon, used on golf courses and lawns, has poisoned waterfowl when incompletely watered in according to directions. Fenthion impregnated perches have been used to control pest birds. Unfortunately, while it has been used as an effective avicide, hawks preying on the debilitated pest birds were also poisoned.

Organochlorine Insecticides

Organochlorine pesticides are no longer widely used in the United States. Pesticides such as DDT are rarely acutely toxic. Bioaccumulation resulting in chronic toxicosis and negative reproductive effects are more likely than acute poisoning. Other organochlorine pesticides such as endrin, aldrin, chlordane, lindane and dieldrin may be more acutely lethal. Nervous trembling, lack of coordination, depression and convulsive seizures are signs of poisoning. We have rarely encountered organochlorine type pesticides in intentional wildlife poisonings.

Strychnine

Strychnine is perhaps the oldest and most commonly used rodenticide in the world and in its pure form is a clear liquid. Commercially prepared baits, usually grain or pelleted grain products, are dyed green or blue and have been used to poison waterfowl. In 1978, strychnine was designated as a restricted use pesticide and taken off the general use market except for preparations containing less than 0.5% active ingredient which are available for underground use only to poison burrowing rodents such as ground squirrels.

Pigeons, doves and other seed eating birds are frequently poisoned by strychnine laced grain designated for rodent control. Strychnine is a rapidly acting neurotoxin which may result in birds falling out of the sky in convulsions after ingestion of the poison.

In mammals, the characteristic sign of strychnine poisoning is a stiff rigid stance with extended feet and opisthotonic head and neck posture (ie: the head and neck are arched dorsally). Most animals die in violent tetanic seizures which may be initiated by any form of excitement. In mammals, the lips may be curled in a "sardonic grin" and the death pose may be an almost "saw horse" appearance.

Sodium Monofluoroacetate (Compound 1080)

Sodium monofluoroacetate (1080) and fluoroacetamide (1081) were originally developed as rodenticides. Their use in coyote control programs by governmental agencies in the western states is well known. These compounds are colorless, odorless, tasteless, water soluble, highly toxic chemicals. Although highly restricted, these compounds are available on the illegal market.

Animals which die of fluoroacetate poisoning may exhibit very rapid onset of rigor mortis in which the limbs are fixed in extended positions. Vomition and repeated defecation and urination characteristically occur to expel any trace of the ingested poison bait.

Diagnosis of 1080 poisoning is extremely difficult because of the rather small amount of the poison needed to kill and the loss of stomach and intestinal content due to vomiting.

The analytical procedures for these compounds in baits, vomitus, stomach content and, occasionally (but rarely) in liver and kidney tissue are also very difficult.

Barbiturates

Barbiturates are drugs widely used by veterinarians as euthanasia solutions used to humanely destroy farm animals and some humane societies also use barbiturate solutions to dispose of unwanted pets. Animal carcasses containing lethal doses of barbiturates may be disposed of in landfills or simply left exposed in a remote area. Eagles and other meat-eating scavengers may ingest enough meat from such a carcass to become intoxicated.

Drug labels on products used for euthanasia state that animals killed may be poisonous to other animals. Proper



Dead adult flies on bait indicate presence of insecticide such as carbofuran

disposal is encouraged. Failure to properly dispose of such "attractive nuisances" which kill eagles or other scavenger type birds may constitute a violation of several statutes.

Heavy Metals

Heavy metals include arsenic, lead, mercury, thallium, selenium, copper, zinc, and others. With the exception of thallium, these generally act slowly and are not used for intentional poisoning of wildlife. They may, however, be extremely important in cases involving industrial pollution.

Unfortunately, heavy metal toxicosis

may be more difficult to trace back to its source. For example, poisoning with thallium is relatively slow giving the animal time to travel some distance from the source of the poison. Lead, mercury and arsenic tend to be cumulative and may come from multiple sources over a period of time before lethal levels finally result in the death of the animal.

Thallium is the most commonly reported heavy metal used to intentionally poison wildlife. Originally used as a rodent control formulation, it has since been replaced by other more selective rodenticides. Thallium may be absorbed

through the skin therefore extreme caution is urged in handling potentially affected animals or birds. A case of human toxicosis due to thallium has been reported in a person who came in contact with vomit from a poisoned eagle.

Making The Case

The prosecution of wildlife poisoning cases can be done under a variety of state and federal statutes. Killing migratory birds, eagles and endangered species is covered under federal statutes. The misuse of regulated pesticides may be prosecuted as separate charges under federal and/or state pesticide regulations. In addition, the oversight of pesticide misuses are state concerns usually regulated under agricultural or environmental statutes. To make a case, a good field investigation along with laboratory documentation is necessary. Every effort should be made to assure proper clean up of crime scenes to preclude any further possible wildlife or human exposure". Presenting the wildlife pesticide case to the prosecutor and finally to the judge and/or jury may require special educational efforts by the investigator and the expert witnesses on the mechanisms and routes of pesticide poisoning. ◊

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About the authors

Richard K Stroud DVM MS

Richard started his career as a marine mammal biologist working out of the NOAA Marine Mammal Laboratory in Seattle after graduating from Oregon State University in 1965. As a field biologist, working on the Pribilof Islands in Alaska and off the Pacific Coast on a pelagic sealing research vessel, he became interested in the diseases and parasites of wildlife, returning to Washington State University where he earned his Doctor of Veterinary Medicine (DVM) degree in 1972.

Upon graduation, he joined the faculty at Oregon State University, gaining hands-on pathology experience in the veterinary diagnostic laboratory, and completed a Masters in Pathology (MS) with a thesis on the causes of death in stranded marine mammals. After a year of internship in comparative pathology at the San Diego Zoological Society,

Dr. Stroud took a job with the US Fish and Wildlife Service at the National Wildlife Health Research Center in Madison, Wisconsin in 1980. As the laboratory diagnostician, he examined waterfowl and other migratory birds from the USFWS refuge system throughout the country. In 1987, he transferred to the Portland, Oregon USFWS regional office to develop and coordinate the Environmental Contaminants Program for Region 1 (CA, OR, WA, ID, NV and HI).

The first wildlife forensic laboratory in the world opened in 1989 in Ashland, Oregon and seeking to return to the "hands-on aspect of wildlife pathology", Dr. Stroud sought a transfer to the forensic lab in 1990, to become the first strictly forensic veterinary pathologist in the world. As the Veterinary Medical Examiner for the Fish and Wildlife Service, he has processed thousands of birds, mammals, reptiles and fish submitted as evidence in forensic cases over the last 15 years. After 30 years of service in the Fish

and Wildlife Service, he is looking forward to retirement and starting his own training and consulting business related to wildlife forensics. He is also currently writing a field guide on forensic investigation for wildlife veterinarians and other professionals and law enforcement personal.

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