STATUS OF APHIS VERTEBRATE PESTICIDES AND DRUGS

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ABSTRACT: The Wildlife Services (WS) Program manages wildlife/human conflicts by using an integrated approach employing some vertebrate pesticides. These are used in such small quantities that private industry cannot afford to register and produce them profitably. On behalf of WS, the Animal and Plant Health Inspection Service (APHIS) maintains about 30 federal and state pesticide registrations, containing seven active ingredients, with the U.S. Environmental Protection Agency (EPA). These include: the Compound 1080 Livestock Protection Collar, DRC-1339 Concentrates (Starlicide), Gas Cartridges (carbon and sodium nitrate), the M-44 (sodium cyanide), and a number of baits and concentrates containing Strychnine Alkaloid and Zinc Phosphide. In 1988 Congress amended the Federal Insecticide, Fungicide, and Rodenticide Act, requiring reregistration of almost all older pesticides. Reregistration had an extensive impact on the WS Program. Over 400 studies, with an estimated cost of about $14 million, were requested by EPA for APHIS products. Through negotiations with EPA, repackaging of old data, and obtaining data waivers for inappropriate studies, National Wildlife Research Center (NWRC) and APHIS personnel reduced the data requirements to about 250 studies costing $3 million. In addition, the NWRC managed three Consortia that generated funds and data to maintain Starlicide, strychnine and zinc phosphide products held by APHIS, private industry, and state agencies. APHIS is now entering the final stages of reregistration. Carbon, sodium nitrate, sodium cyanide, Compound 1080, and Starlicide have been reregistered. The Reregistration Eligibility Decision (RED), with an appended product-specific data call-in notice, was received for strychnine in March 1997 and the remaining data are being generated. Reregistration of zinc phosphide is expected sometime in 1998. In addition, APHIS now maintains four products for the WS Program with the U.S. Food and Drug Administration (FDA) under Investigational New Animal Drug (INAD) permits. These include alpha-chloralose (a capturing agent), the Tranquilizer Trap Device (TTD) containing propiopromazine HCl (to sedate animals held in leghold traps and snares) and two immunocontraceptive vaccines, porcine zona pellucida (Zonacon), and gonadotrophin releasing hormone (Gonacon) for contracepting deer and other wild animals.

KEY WORDS: pesticide, drug, registration, wildlife damage management, Wildlife Services

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INTRODUCTION

Wildlife damage management is an important part of the wildlife management profession that is conducted on a national level by the U.S. Department of Agriculture (USDA)/Animal and Plant Health Inspection Service (APHIS)/Wildlife Services (WS) program. The WS program is directed by law to protect American agriculture and other resources from damage caused by wildlife; WS has personnel in most states that provide both technical assistance and direct control of damage.

Wildlife damage managers are called upon to resolve a broad range of problems caused by wildlife. Determining the volume of wildlife-caused losses to agricultural products and other resources is difficult, and definitive information is not available. However, available estimates are that wildlife-caused losses have increased from 1957 to 1987 (Conover and Decker 1991), and approach $3 billion per year (Conover et al. 1995). Wildlife sometimes cause significant damage to agricultural crops and livestock, rangelands, forests, private and public property, other wildlife and their habitats, and urban and rural structures. Wildlife can also threaten human health and safety.

Prevention of wildlife damage may involve use of a variety of pesticides, drugs, and vaccines, including anticoagulant and acute toxicants, fumigants, repellents, frightening agents, aversive conditioning agents, immobilizing agents, contraceptives, and use of herbicides to alter habitat. The Wildlife Services program registers some pesticides with the U.S. Environmental Protection Agency (EPA) and receives authorizations for drugs and vaccines from the Food and Drug Administration (FDA). This manuscript will provide an update on the status of APHIS registrations and authorizations.

REGISTRATION OF PESTICIDES IN THE UNITED STATES

In the United States, federal regulation of pesticides began with the Insecticide Act passed in 1910, which made it unlawful to sell adulterated products (Bean 1977). The primary purpose of this act was to protect purchasers of insecticides and fungicides from fraud, but the act contained no provision for registration of pesticides prior to sale (Fagerstone et al. 1990). After World War II and the concomitant development of many new pesticides, the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) was passed by the U.S. Congress and registration of pesticides was first required.

In the past 25 years, significant changes have occurred in the regulation of pesticides. FIFRA was administered by the U.S. Department of Agriculture until 1970 when increased public awareness over environmental issues, such as large-scale use of pesticides like DDT, resulted in the creation of the EPA. A major revision of pesticide regulations occurred in 1972. Prior to 1972, FIFRA regulations emphasized pesticide efficacy; after

1972, the focus of regulations shifted to reducing risks to humans and the environment. The 1972 FIFRA amendments mandated that all pesticides must be reregistered within five years and that basic toxicity data must be submitted to the EPA for each chemical. Under the process established in 1972 and refined in subsequent amendments (Fagerstone et al. 1990), Registration Standards and Data Call-Ins were issued to establish data requirements for about 200 pesticides of greatest concern to EPA. By 1987, despite submission of large quantities of data by registrants, only four chemicals had been reregistered. Public pressure to speed up the reregistration process prompted the U.S. Congress to pass the 1988 Amendments to FIFRA ("FIFRA 88"). FIFRA 88 has had a broad effect on pesticide manufacturers, registrants, and users in the U.S. and other countries.

Under FIFRA 88, all pesticides containing an active ingredient first registered before November 1984 were required to be reregistered within a nine-year period. In 1988 approximately 600 groups of related pesticide active ingredients, representing 1,150 active ingredients in 45,000 formulated products, required reevaluation. FIFRA 88 specified a five-phase Reregistration process (Fagerstone et al. 1990). Phase 1 was a listing of the active ingredients of the pesticides for which reregistration was required and was completed in October 1989. In Phase 2, registrants notified EPA of their intention to seek reregistration of their pesticides and committed to supplying data within one to four years. Phase 2 was completed in 1990. During Phase 3, registrants submitted the data to EPA and identified known adverse effects of the pesticide. The reregistration process is now in Phases 4 or 5, depending on the pesticide. During Phase 4, EPA reviews submitted data and issues Data Call-Ins for additional data. Phase 5 involves the final review of data by EPA, followed by a regulatory action (such as reregistration or cancellation).

FIFRA 88 suspended all previously required fees and established two new types of fees to fund the reregistration process. The reregistration fee is a one-time fee of between $50,000 and $150,000 split among all the registrants of each active ingredient according to their share of the market. Annual maintenance fees were also assessed for every technical and end-use registration. In 1997 this fee was set at $700 for the first registration held by a registrant and $1400 for each additional registration.

FIFRA 88 also greatly expanded data requirements. Data requirements for most vertebrate pesticides fall into several broad categories (Fagerstone et al. 1990; Ramey et al. 1994): 1) Product Chemistry studies provide a profile of the physical and chemical characteristics of the pesticide product; 2) Wildlife and Aquatic Organisms studies determine toxicity to non-target species, primarily in the laboratory but also in actual field studies; 3) Toxicology or Human Health Hazard studies assess potential hazards to humans according to duration and route of exposure to the pesticide; 4) Environmental Fate studies monitor the movement, degradation and metabolism of the pesticide in soil, water and air; 5) Residue Chemistry studies are used to determine pesticide residues in plants or animals, allowing EPA to determine allowable tolerances on food items; and 6) Product Performance studies assess the efficacy of the pesticide.

FIFRA 88 has decreased the availability of chemical registrations. Increasing data requirements and the cost of generating those data have made it uneconomical for many registrants to maintain pesticide uses except those with large volume sales. As a consequence, registration cancellations have occurred at a high rate. Since 1988, more U.S. pesticide registrations were voluntarily dropped by manufacturers than were canceled by the EPA in the last 25 years. Estimates are that of the 45,000 Federal registrations held in 1989, approximately 19,000 were canceled that year, and 8,000 more since then, because either registrants failed to support the registrations with data and fees or because EPA has taken regulatory action to cancel registrations. Of the 611 groups of active ingredients registered in 1988, all active ingredients in 212 groups have been canceled.

REGISTRATION AND REREGISTRATION STATUS OF APHIS PESTICIDES

Most vertebrate pesticides are minor use pesticides compared to insecticides, fungicides and herbicides. Because the low volume of use cannot economically justify the cost of annual maintenance fees and data generation imposed by FIFRA 88, large numbers of vertebrate pesticides of importance to agriculture, the public, and to wildlife damage managers and public health personnel have been canceled or have had their uses restricted.

Wildlife Services manages wildlife/human conflicts by using an integrated approach that employs some of these minor use vertebrate pesticides, which APHIS has reregistered itself or has developed innovative ways to help registrants generate the funding required for reregistration. APHIS maintains registrations for seven active ingredients: Compound 1080, Starlicide, carbon, sodium nitrate, sodium cyanide, strychnine alkaloid, and zinc phosphide. APHIS also maintains about 25 to 30 individual end-use products, one Experimental Use Permit, and four vertebrate drugs and vaccines. The NWRC is responsible for meeting all data requirements imposed by the EPA for maintaining APHIS products. The APHIS Data Support Team in Riverdale, Maryland is responsible for administrative liaison with the EPA.

Reregistration has had an extensive impact on the WS Program. Over 400 studies, with an estimated cost of about $14 million, were originally requested by EPA for APHIS products. Through negotiations with EPA, repackaging of old data, and obtaining data waivers for inappropriate studies, NWRC personnel reduced the data requirements to about 250 studies costing $3 million. In addition, the NWRC developed three Consortia to generate funds to maintain strychnine, zinc phosphide, and Starlicide products held by APHIS, private industry, and state agencies. These Consortia have a combined responsibility of over 90 additional vertebrate pesticide registrations.

APHIS is entering the final stages of the EPA reregistration process for WS vertebrate pesticides. Five active ingredients have been reregistered and all data requirements (except for data required for the end-use products) have been met. Two products are still in the reregistration process. The following is a summary of the status of each technical ingredient.

Gas Cartridge (Sodium Nitrate and Carbon)

The Gas Cartridge is a fumigant cartridge containing two active ingredients, carbon and sodium nitrate. The Gas Cartridge is ignited, placed into a burrow or den, and all entrances are closed to prevent the escape of gas. Ignition produces high concentrations of carbon monoxide gas, a gas recommended by the American Veterinary Medicine Association's (1993) Panel on Euthanasia because it quickly induces unconsciousness without pain. No secondary toxicity exists with use of the gas cartridge.

APHIS maintains two Gas Cartridge registrations. The Gas Cartridge is widely used to control field rodents (Fagerstone et al. 1981; Matschke and Fagerstone 1984; Dolbeer et al. 1991) where they damage rangeland and agricultural crops, or carry plague. The Large Gas Cartridge is used to control coyotes (*Canis latrans*), red fox (*Vulpes vulpes fulva*), and striped skunks (*Mephitis mephitis*) in dens (Savarie et al. 1980; Ramey 1992a, b).

EPA originally requested 110 studies costing more than $2 million for reregistration of carbon and sodium nitrate. Many of which were waived, as they were not appropriate for these chemicals. However, since 1989, 24 studies were conducted for the Gas Cartridges and their active ingredients; use instructions have also been changed to provide protection for nontarget wildlife. The reregistration process has been completed for the Gas Cartridge.

Compound 1080

Compound 1080 is an acute toxicant that formerly had wide use as a predacide and rodenticide. Most predacide uses were cancelled in 1972 because of potential nontarget hazards, and rodenticide uses were canceled in 1990 because technical registrants did not submit adequate data in support of Compound 1080 to the EPA (Fagerstone et al. 1994). Currently, APHIS maintains two U.S. registrations for Compound 1080, Compound 1080 Technical and the Livestock Protection Collar (LPC), which is used to control coyote predation on livestock. The LPC is a rubber collar filled with a dilute solution of Compound 1080 and placed around the neck of a sheep in areas where coyotes are causing livestock mortality. The toxicant is dispensed as the coyote attacks the neck of the sheep and punctures the collar (Connolly 1990). Two collars are registered, a small one for use on lambs and kid goats, and a larger one for use on sheep and goats over 50 pounds.

Although EPA originally requested 55 studies at an estimated cost of nearly $1.5 million, APHIS received waivers for many data because Compound 1080 use in a collar around the neck of a sheep does not allow exposure to nontarget wildlife or the environment. Less than one pound of 1080 is used for APHIS collars each year. The reregistration of Compound 1080 has been completed and 40 studies were submitted to the EPA.

Sodium Cyanide

APHIS maintains a single registration for sodium cyanide which is used in the M-44, a spring-loaded device containing the toxicant that is placed in areas where coyotes, foxes, or feral dogs are killing livestock, poultry, or endangered species. An attractant draws the predator to the device; when the predator pulls the M-44, it receives a lethal dose of sodium cyanide.

Sodium cyanide in the M-44 has been reregistered by the EPA. APHIS submitted 29 studies out of the 56 originally requested by the EPA; waivers were granted for many studies because of the selectivity and limited use of the M-44.

Starlicide

Starlicide or DRC 1339 is a slow-acting bird toxicant. The technical product, Starlicide, is registered by PM Resources, as is Starlicide Complete®, a pelleted product for controlling starlings (*Sturnus vulgaris*) in feedlots. APHIS maintains five Federal registrations and several state registrations for field uses of DRC-1339 for controlling: pigeons (*Columba livia*) in and around structures when they cause nuisance or disease problems; blackbirds (*Agelaius* spp.) and starlings in livestock feedlots where they consume feed and spread diseases such as histoplasmosis; blackbirds, starlings, grackles (*Quiscalus* spp.), and brown-headed cowbirds (*Molothrus ater*) in non-crop staging areas associated with roosts; gulls (*Larus* spp.) to protect colonial nesting seabirds; and ravens (*Corvus corax*) where they are killing endangered species or livestock. The use of all APHIS registrations is restricted to Certified Applicators and WS personnel trained in bird control (or persons under their direct supervision).

EPA originally requested 68 studies at a cost of over $2 million for reregistration of Starlicide and DRC-1339. Because PM Resources does not sell enough Starlicide technical to support reregistration costs, APHIS and PM Resources combined their efforts and APHIS provided much of the required data to support field uses of this product. APHIS and PM Resources have jointly submitted 44 studies costing in excess of $500,000. Starlicide has been reregistered by the EPA, although labeling for some end-use products is still being negotiated.

Strychnine

Strychnine is an acute rodenticide widely used underground to control pocket gophers (*Thomomys* spp., *Geomys* spp. and *Pappogeomys* spp.), moles (*Scalopus* spp.) and some ground squirrels (*Spermophilus* spp.) to prevent damage to forest seedlings, agricultural crops, and home landscaping. APHIS maintains four registrations for control of pocket gophers using grain baits applied either by hand or with a burrow-builder.

In 1986 and 1987, EPA issued Data Call-Ins (DCIs) requiring technical registrants to submit data on toxicology, environmental fate, and efficacy. Because none of the technical registrants could afford to produce these data, a Consortium of private, State, and Federal registrants of strychnine was formed in 1988 to generate funds. The Consortium consists of 24 members, each of which contributed $3,000 in start-up fees, and also put in place a $0.50/oz. surcharge on sales of the active ingredient. The NWRC coordinates this Consortium, and has prepared all correspondence with EPA, conducted some studies, and monitored other studies conducted by contract laboratories. In October 1988, all strychnine registrants received Notices of Intent to Suspend from the

EPA because of noncompliance with the data submission schedule. Most registrants, including APHIS, believed they had complied and the Consortium requested an Administrative Hearing, which resulted in a 1989 Strychnine Settlement Agreement specifying new data requirements and due dates. Since 1989, the Consortium has submitted over 40 studies to the EPA to meet Settlement Agreement and reregistration requirements. The EPA issued the Reregistration Eligibility Decision (RED) for strychnine in March 1997. Based on the RED, registrants were required to complete an additional two studies for the technical product and four studies for the end-use grain bait products. One of these studies has been subsequently waived and another reduced in scope. Remaining studies will be submitted in 1998 to finish the reregistration process.

Zinc Phosphide

Zinc Phosphide is an effective acute field rodenticide that has been in use for over 50 years with very few non-target hazards. For many species of field rodents such as prairie dogs (*Cynomys* spp.) and ground squirrels it is the only pesticide currently registered for use. The Zinc Phosphide Consortium was formed in 1991, consisting of 16 registrants and coordinated by the NWRC. To provide funding to generate data to reregister the zinc phosphide active ingredient, the Consortium assessed each member a $2,000 start-up fee and placed a $4.00 per pound surcharge on sales of all technical zinc phosphide. The Consortium has submitted toxicology studies to the EPA, has met environmental fate requirements with data from existing literature, and has developed residue data to maintain registered crop uses. A RED is expected to be completed by the EPA in 1998 listing any additional data requirements for the active ingredient or the end use products.

STATUS OF APHIS DRUG AND VACCINE AUTHORIZATIONS

During the past five years, APHIS has begun working with the Food and Drug Administration (FDA) to obtain authorizations for the use of drugs and vaccines in wildlife.

Alpha-chloralose

APHIS has obtained an Investigational New Animal Drug (INAD) authorization from the FDA for use of the immobilizing agent alpha-chloralose to capture nuisance pigeons and waterfowl in urban areas (Woronecki and Thomas 1995). When fed to the birds on corn or bread, the drug causes sedation and the birds can be picked up to be relocated or euthanized. The chemical is available for experimental use from WS State Directors.

Tranquilizer Trap Device

A tranquilizer trap device (TTD) containing propiopromazine HCl has also been granted an INAD by the FDA for use to sedate coyotes, wolves (*Canis lupus*), and feral dogs caught in leg-hold traps. The TTD reduces the number of escapes from traps and reduces injuries and stress to trapped animals. This product will be available to WS State Directors this spring, as soon as a training program is established.

Immunocontraceptive Vaccines

Recent advances in immunology and molecular biology have made it possible to produce and administer genetically engineered contraceptive vaccines. In 1991, the NWRC began research on immunocontraception to inhibit reproduction in overly abundant wildlife species including deer, rodents, birds, and coyotes. Immunocontraceptive vaccines control fertility by causing the production of antibodies against reproductive tract proteins (eggs or sperm) or hormones associated with reproduction. The NWRC is working on two immunocontraceptive approaches, including production of antibodies against the zona pellucida (ZP, a layer around the oocyte), and against gonadotropin-releasing hormone (GnRH).

The zona pellucida is a glycoprotein layer around the egg that functions in the process of sperm/egg recognition. A ZP vaccine causes antibodies to be produced in the female to the ZP proteins; these antibodies bind to the ZP of the female's own eggs, blocking conception by preventing sperm penetration. In December 1996, the FDA assigned an INAD that will allow the investigational field use of ZonaCon Wildlife Immunocontraceptive Vaccine (containing porcine ZP) as an immunocontraceptive for wildlife species such as deer and coyotes. As a condition of the INAD, FDA requires that free-ranging animals be tagged to indicate that they cannot be used for human food. The FDA may also require that a site-specific Environmental Assessment be developed to address effects on wildlife populations and provide opportunity for public comment.

In March 1997, FDA established a second INAD for GonaCon Wildlife Immunocontraceptive Vaccine (containing GnRH) for wildlife species such as deer, coyotes, birds, and rodents. After receiving this vaccine, animals produce antibodies to GnRH, thereby reducing the action of GnRH on the pituitary. This then shuts down secretion of the pituitary reproductive hormones FSH and LH, preventing production of reproductive hormones in both sexes, and causing temporary (one to two year) sterility. The conditions of use are similar to those imposed by the FDA on ZonaCon.

The NWRC will soon be requesting a third INAD for a cholesterol inhibitor, DiazaCon (azacosterol HCl). This is an orally ingested chemical that inhibits production of cholesterol, preventing production of reproductive hormones and causing sterility. After ingestion of DiazaCon for a few days, animals remain sterile for two to three months. The product may be promising for seasonal breeders such as Canada geese (*Branta canadensis*).

ALTERNATIVE PESTICIDE RESEARCH

Whenever possible, wildlife damage managers attempt to recommend nonlethal solutions to wildlife damage problems. Increasing use is being made of immobilizing agents, repellents, and habitat modification. Herbicides have been developed by NWRC as a solution to prevent blackbird damage to sunflowers. Each summer, millions of blackbirds congregate in cattail marshes in Minnesota and the Dakotas. From these marshes the birds fly to nearby fields to feed on sunflower seeds, causing significant damage. Wildlife managers are now using the

herbicide glyphosate (Rodeo®) to reduce cattail habitat, which in turn reduces blackbird concentrations and associated damage to sunflower fields (Linz et al. 1993). The resultant opening up of the marshes provides more waterfowl breeding habitat.

Gull populations have increased dramatically in the past few years. Roof nesting gulls cause structural damage to buildings, threaten human health, and pose hazards to aircraft at nearby airports. In urban habitats, nest disturbance will cause birds to abandon an area, however, disturbance may have to occur for three or more years before the gulls will abandon a nesting area completely. The NWRC has recently found that oiling eggs with corn oil or other oils kills the bird fetus and causes nest abandonment (Pochop et al. 1998). Corn oil is now registered for oiling both gull and Canada goose eggs.

NWRC is working with state agencies and private companies to develop and expand bird repellent products for dealing with agricultural damage. The NWRC conducted the initial evaluations and much of the efficacy research that led to registration with the EPA of methyl anthranilate (MA), a grape flavoring used in human foods such as grape pop and grape gum. MA is very aversive to birds as a trigeminal irritant that irritates the mouth as it is eaten. It is now registered by two different private companies. Current registrations include use on golf courses and parks to prevent Canada geese from feeding and fouling water supplies, use on standing water and on landfills near airports to repel birds from runway areas, and use on fruit crops (Cummings et al. 1992, 1995; Dolbeer et al. 1993).

The NWRC is currently working to restore bird repellent uses of Methiocarb (Mesurol®), one of the most effective bird repellents ever developed. Mobay Corporation previously registered Mesurol® for use on fruit and seed corn but discontinued these uses because of the low volume of use compared to the high cost of data requirements. NWRC is working with personnel from the Gowan Company, a small specialty pesticide producer, and has begun the process of obtaining EPA approval for registration of Mesurol® as an aversive conditioning agent and bird repellent on seed corn. An application for Mesurol® 75% Wettable Powder Aversive was made by APHIS in May 1997 that, when approved by the EPA, will allow use of Mesurol® in decoy eggs to deter ravens and crows from feeding on eggs of endangered and threatened species. In September 1997, Gowan submitted a Mesurol® 50% Hopper Box formulation for reducing bird damage to sprouting corn. If sufficient funds can be raised, Gowan and APHIS will attempt to bring back the registrations for soft fruits.

VERTEBRATE PESTICIDE RISKS

Most of the pesticides and drugs mentioned previously hold some potential risks to wildlife. However, risks associated with use of vertebrate pesticides are usually small, especially when compared to other pesticides. Several factors limit wildlife risks from use of vertebrate pesticides including: 1) safeguards provided by the registration process; 2) the low volume of use of these pesticides; 3) the limited area of use; 4) specificity in the action of these pesticides; and 5) the pesticides are targeted to specific animals or situations.

Registration Safeguards

The pesticide registration process lends safety to pesticide products by regulating use patterns of pesticide products, and ensuring that potential human safety and environmental health problems will be identified. In addition, for vertebrate pesticides, EPA routinely requires efficacy and nontarget hazards data not generally required for other types of pesticides.

Low Volume of Use

The low volume of use compared to insecticides, fungicides, and herbicides also provides a margin of safety for vertebrate pesticides. Total use of pesticides in the U.S. (for residential, agricultural, and other uses) averages approximately 1.2 billion pounds per year (Swanson 1990). Use in 1991 included 147 million pounds of fungicides, 495 million pounds of herbicides, and 175 million pounds of insecticides (Gianessi and Anderson 1993), about 70 percent of which was used in agriculture. National use of vertebrate pesticides in the U.S. for wildlife damage management is low, less than 1 million pounds. Annually only about 119,000 pounds of zinc phosphide active ingredient and 10,000 pounds of strychnine are used for control of field rodents, and predator and bird control products are used in even smaller amounts. The WS program uses only a small percentage of the pesticides used throughout the U.S. for wildlife damage management (ADC EIS 1994). Maximum annual rodenticide use by the WS program was less than 600 pounds, rodent fumigant use was less than 1,000 pounds, and fumigant use for coyote dens was about 1,100 lbs. Less than one pound per year of Compound 1080 was used and about 175 pounds of Starlicide. It is interesting to note that while <200 pounds of sodium cyanide are used annually as a pesticide in the M-44 for predator control, about 215 million pounds are used industrially each year in mining operations, often resulting in significant bird mortality at settling ponds and leaching heaps.

Use Sites Limited in Area

A third factor limiting vertebrate pesticide risk is their use pattern. Most are used in very limited areas, such as the Gas Cartridge (placed in burrows), and the M-44 (placed on paths frequented by predators).

Selectivity

Vertebrate pesticides also tend to be fairly selective. Rather than managing vertebrate pests on a species level, the trend in wildlife damage management is to deal selectively on a local basis with problem animals or problem situations. A good example of this is the Compound 1080 Livestock Protection Collar, which specifically targets only depredating coyotes.

FUTURE OF PESTICIDES

Use of toxicants is expected to decline in the future as alternate methods of reducing damage to crops, livestock, etc. are developed. Wildlife Services has placed

increased emphasis on development of less toxic and less environmentally disruptive pesticide alternatives, including repellents, reproductive inhibitors, and "natural" products. Those pesticides that continue to be registered will face increasing data requirements as the EPA places increased emphasis on worker protection and develops new endocrine disruption and neurotoxicity tests. Emphasis will probably increase for development of IPM programs relying on scouting to determine economic thresholds of damage and on more accurate placement of pesticides.

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