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Elizabeth Kovacs

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By Elizabeth Kovacs

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It is common practice to use store-bought rodenticides or simply call an exterminator when one is faced with an unexpected rat, mouse, or bug infestation in or near the home. Rodenticide use is also commonplace on farms to protect livestock and crops. However, these practices may pose a more significant risk than the rodents and pests themselves. These rodenticides and insecticides are poisons. They attract and poison animals other than the target species and can harm wildlife and pets when they consume the poisoned animal. This is referred to as secondary poisoning. Secondary poisoning is a serious threat to ecosystems, because the poisons advance through the levels of a food chain all the way to the top. Hawks, owls, and snakes are rodents' natural predators, with rodents comprising the vast majority of their diets. In addition to remaining in the food web through predator consumption, the poisoned rodents that are not consumed eventually die and decompose, entering the soil. This fertilizes the plants that may eventually be eaten by deer and other animals.

Rodents are not limited to mice and rats, but also include voles, squirrels, chipmunks, porcupines, and beavers (National Pesticide Information Center). Rodents can be divided into two groups: field rodents and commensal rodents. Commensal rodents are household rodents such as mice and rats, while field rodents include those that do not typically enter the home such as voles and squirrels (Meerburg et al. 2004). While all of these rodents are natural parts of an ecosystem, they can reproduce rapidly in unwanted environments such as residential dwellings. In residential spaces, natural predators such as owls and snakes are not present to intervene in population control. This poses a problem because residential dwellings and farms are two areas where rodent control is often needed, but control does not happen naturally through predation.

The mechanism of action for many common rodenticides is their anticoagulant property, the same property that makes them so deadly when other wildlife and pets are exposed to them (Sanchez-Barbudo et al. 2012). These are known as second generation rodenticides. The two most commonly used second generation rodenticides known for their effect on wildlife and ecosystems are difenacoum and brodifacoum. Brodifacoum accounts for the majority of deaths in secondary poisonings by rodenticides and is understood to be the deadliest anticoagulant rodenticide. There are alternative rodenticides that are effective in rodent control, but they are typically not used as widely as the more lethal second-generation anticoagulant rodenticides (Stone 1999).

In an experiment, mice that were fed food containing small amounts of brodifacoum and difenacoum died within 2-11 days on average. Once these mice were fed to barn owls, 67% of the owls who had consumed brodifacoum died as well. The amount of time that mice can stay alive after being fed a lethal dose of rodenticide influences the frequency of secondary poisoning due to these rodenticides. The longer the mice stay alive after being poisoned, the more likely they are to venture outside a residence in search of food or water as their condition deteriorates. This increases the likelihood of the rodents being consumed by a predator and causing secondary poisoning. Because rodenticides are killing alarming numbers of predators through secondary poisoning, fewer owls, snakes, and hawks will be present in ecosystems that need rodent control the most. This has the potential to become a continuing cycle with devastating ecological impacts (Newton et al. 1990).

Species of raptors which include owls, bald eagles, golden eagles, falcons, buzzards, and hawks, seem to be a group that are vastly affected by secondary poisoning due to brodifacoum. As birds of prey, this is largely due to their diets, which include many rodent species. Many of these animals are endangered, and continued poisoning poses an extra threat to species that are already struggling to grow to maturation and produce healthy offspring. In the United States alone, 44% of dead birds, mammals, and reptiles were found to be non-target victims of anticoagulant rodenticide poisoning (Nakayama et al. 2019). In New York, rodenticides were found in 49% of dead raptors of all species, and 81% of horned owls (Williams 2013). Some studies have indicated that as much as 11% of the great horned owl population is at a serious risk for death as a direct result of anticoagulant rodenticide poisoning (Thomas et al. 2011). These studies indicate how widespread secondary poisoning has become in ecosystems, and without intervention these numbers are bound to increase.

While birds of prey seem to be the demographic most largely affected by rodenticide secondary poisoning, there are other animals that are affected as well. In some studies, otters have tested positive for anticoagulant rodenticides. It is likely that these otters were exposed to stream riparian zones where small rodents with anticoagulant rodenticide poisoning had died and decomposed. This leaves behind traces of the poison in the soil and plant roots. Otters are omnivores, but are typically only carnivorous for marine animals, so poisoning through the decomposition and absorption of rodent tissue in riparian zones is a probable route of contamination (Lamarchand et al. 2010). Advancing even higher along the food chain, bobcats in California are rapidly succumbing to disease, and studies have indicated that anticoagulant rodenticides are a contributing factor. One study indicated that as much as 92% of bobcats were exposed to anticoagulant rodenticides in the food chain throughout their lives. This study also indicated that the rodenticides could be transferred from parent to offspring and remain in the food web and ecosystems for years. While the mortality rate due to secondary poisoning of anticoagulant rodenticides is lower in larger animals like bobcats, the long-term effects of increasing tissue concentration are unknown (Serieys et al. 2015).

Secondary poisoning by anticoagulant rodenticides can result in agonizing deaths for many animals. When the pathways of anticoagulant rodenticides were studied, it was found that deaths were prolonged over multiple days and included symptoms that would be especially painful for animals. While hemorrhage is the cause of death, animals can suffer from lethargy, difficulty breathing, and pain and discomfort in the days leading up to death (Rattner et al. 2014). In humans, anticoagulant rodenticides can present as symptoms of leukemia, sepsis, the plague, and leptospirosis. Although most cases of anticoagulant rodenticide contamination in humans are non-lethal, the excruciating symptoms and physical manifestations indicate how uncomfortable these slow deaths must be for smaller animals (Palmer et al. 1998). It should also be noted that while many humans are prescribed anticoagulants such as warfarin to thin blood and prevent blood clots, these are typically first-generation anticoagulants and require high doses to result in toxicity. They are only prescribed to patients who have a medical need for these anticoagulants (Khan; Shell).

In order to protect wildlife, pets, and ecosystems from rodenticides in the future, a more sustainable and ethical form of pest management is necessary. Three necessary elements of rodent management should be used: the prevention of infestations, monitoring the appearance and population density of rodents, and rodent control measures. Populations and infestations should be controlled using effective management before using measures such as anticoagulant rodenticides to remedy larger and residential infestations (Meerburg et al. 2004). For smaller residential rodent infestations, catch and release traps are an ethical alternative to poisons. While glue traps are often suggested for smaller rodents like mice, they are not a truly ethical alternative. The mice who become stuck in glue traps typically struggle and rip their fur and skin off in an attempt to break free. Sometimes the mice do not die at all, but in most cases, they struggle up until their death. There are some rodenticides that are considered safer and have little or no instance of secondary poisoning. These are called first generation rodenticides. These rodenticides include chlorophacinone, diphacinone, diphacinone sodium salt, warfarin, and warfarin sodium salt. When chemical pest management is absolutely necessary, these chemicals are favorable alternatives to second generation rodenticides (Williams 2013).

Information about the harmful effects of rodenticides should be more readily available to consumers who may not understand the subsequent environmental issues and long-term effects on ecosystems. Large, chain stores such as Lowe's and Home Depot sell anticoagulant rodenticides and physical traps (most of which also include some form of rodenticide), but typically do not sell catch and release traps or other forms of rodent control without harmful rodenticide. Consumers should be educated and have choices as to how to ethically and sustainably deal with these issues when they arise in their home, including consumers like farmers who may choose to use rodenticides on a large scale. These chemicals pose an even greater risk to endangered species, and if their use continues, species that are already vulnerable will inevitably suffer the consequences. In order to maintain balance in ecosystems and promote natural rodent control through predators in the food web, we must find ways to eliminate secondary poisoning by anticoagulant rodenticides.

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