The Impact of Anticoagulant Rodenticides on Fishers (*Pekania pennanti*)

Introduction

Anticoagulant rodenticide (AR) poisoning of non-target wildlife is a significant conservation concern. Studies conducted across the country as well as in Canada have demonstrated that fishers, among other predators, are highly impacted by ARs and that these toxins pose a threat to predator populations (2, 7, 8, 12, 13). As the scale of the environmental consequences of rodenticides becomes more recognized, states are beginning to restrict the use of these toxins to protect wildlife.

The Fisher

The fisher (*Pekania pennanti*) is a carnivorous forest-dwelling mammal native to North America. It is a member of the Mustelid (weasel) family and is closely related to the American marten, an endangered species in Vermont (5). Fishers, themselves, are endangered in parts of the western US. They are protected to varying degrees in Washington, Oregon, and California.

Fishers live in coniferous and mixed hardwood forests. They prefer old-growth boreal forests where downed trees and underbrush provide locations for dens and concentrations of prey. Dense woods with overhead cover protect them in winter from deep snow that hinders their mobility. Fishers are territorial, wary of humans, and generally solitary except during the spring mating season. Although top predators, they are dietary generalists and will eat whatever food is available to them including, small- to medium-sized mammals, birds, fruits, nuts, berries, reptiles, and amphibians. Fishers are one of the few animals that prey on porcupines. Despite their name, they rarely eat fish (5, 15).

Unfortunately, fisher populations appear to be declining in New England and the reasons are likely complex and the result of habitat loss and fragmentation, trapping, and the use of rodenticides. Trapping of fisher can negatively impact both fisher and protected American marten populations because these species overlap in habitat, food sources, and behavior. Because fishers are elusive,

solitary, prefer dense forested habitat, and nest hidden in the cavities of large trees, it is challenging to effectively measure their populations.

Fishers have few predators besides humans who have trapped them for their fur since the 18th century, almost driving them to extinction. They were common in Vermont prior to the middle of the 20th century when numbers sharply declined due to long trapping seasons and loss of habitat from excessive logging and farming (15). The porcupine population flourished in the fisher's absence and, because of its appetite for bark, existing forests and efforts to reforest were threatened. Consequently, trapping season on fishers was closed in 1929, and from 1958 through 1967 fishers were reintroduced into Vermont from Maine. The fisher population gradually recovered with more successful efforts at reforestation and increased habitat. By 1974, reintroduction was considered a success. Historically, fishers have been characterized as vicious and savage predators with no positive attributes other than their prized pelt. Only recently have they garnered the appreciation they deserve as a keystone and indicator species (13). Because fishers, as well as martens, are extremely sensitive to human-caused environmental disturbances, they should be considered indicators of ecosystem function in the forests they inhabit. Therefore, declining populations should be seen as a cause for alarm.

Anticoagulant Rodenticides

Anticoagulant rodenticides (ARs) are commonly used to kill rodents in urban, rural, agricultural, industrial, and suburban locations. These toxins work by preventing blood from clotting and causing fatal internal hemorrhaging.

ARs are classified as either first generation (FGARs) or second generation (SGARs) compounds based on the specific toxins involved (2, 7, 12, 13, 14). FGARs, developed before 1970, are less potent than SGARs and require frequent bait feedings by rodents to build up to the lethal dose. SGARs, introduced in the 1970s to address resistance to FGARs by target animals, possess greater toxicity and a longer half-life. Consequently, the toxins remain in the tissues of affected animals longer. Although a single dose of SGAR will prove fatal, all ARs can take from four to nine days to kill the target animal. During this time the target rodent may continue to ingest poisoned bait and will become increasingly more toxic to any

predator that may consume them. Poisoned rodents tend to act intoxicated as they gradually deteriorate, become lethargic, and spend more time than normal out in the open, exposed to potential predators (2, 12, 13).

SGARs poison wildlife in two ways: 1) primary poisoning when a targeted animal eats the bait and dies several days later, or 2) secondary poisoning when a predator or scavenger eats prey that has eaten poisoned bait. Anticoagulants bioaccumulate, or build up over time, in animals that consume large quantities of rodents that have ingested these poisons. Secondary poisoning has been documented in birds of prey like eagles, hawks, and owls, as well as mammals like foxes, fishers, bobcats, and coyotes (4, 9).

In addition to direct mortality, sublethal exposure to SGARs can be equally devastating to wildlife (3, 4, 8, 13). These lesser exposures result in compromised immune and circulatory systems and abnormal clotting mechanisms. Thus, what might otherwise be a minor wound can result in a fatality in an animal made much more vulnerable to hemorrhaging. Life threatening tick infestations were found to be higher in fishers with sublethal levels of AR toxicity (7). Neonatal transfer of toxins between nursing mothers with sublethal exposures and kits has also been documented, as have miscarriages and still births. This collection of disturbing data serves to emphasize SGARs devastation and their potential to decimate fisher populations.

The Impact of ARs on Fisher populations

The effects of ARs on fishers was first studied in California to document presumed threats to isolated populations. A correlation was found between high amounts of ARs being used, particularly by marijuana farms, and fisher population decline (7, 8). Like most subsequent studies, almost 100% of the fishers tested were exposed to SGAR compounds. The conclusion was that ARs pose a threat to fishers through direct mortality, fitness compromise, and a risk to viable populations.

Research conducted in Alberta, Canada, in 2016 suggested that the impact of SGARs on fisher populations is underestimated and that the incidents of sub-lethal exposures might be greater due to the fisher's aggressive lifestyle (13). Additional research found that the chemical analysis methods used by various

studies were inconsistent and could underestimate the prevalence of SGARs in wildlife (11).

Recently, two ambitious studies, published in 2023 and 2024, focused on the prevalence of AR exposure in fishers in the northeastern United States (2, 12). The research teams included biologists from the Vermont Fish and Wildlife Department. Their results were consistent with those of the earlier California studies and indicated that, "ARs could pose a threat to wild mesocarnivore species in this region." A common method that states Fish & Wildlife Departments use to monitor population trends on certain species is known as "CPUE/Catch Per Unit Effort." According to Vermont Fish & Wildlife's CPUE data in their 2023 furbearer newsletter, the fisher population is in decline.

The Fisher carcasses sampled in this study were obtained from trappers from geographically diverse areas across Vermont (2, 12). Shockingly, 98- 100% of the fishers tested positive for at least one of eleven AR compounds. The results of these studies demonstrate that fishers "are highly exposed to a wide spectrum of ARs across Vermont." The authors stated, "… the near universal exposure of the fishers sampled suggest that AR exposure is widespread and represents and underestimated health risk to wild fishers. (2)"

In 2017, a study of fisher diets showed that, as generalists, fishers consume a variety of species: scavenged deer, rabbits, porcupines, squirrels, other fishers, other predators like raccoon, skunk, and red fox, as well as birds, bats, and reptiles (10). Notably missing from the list of consumed species were those most often targeted by Ars - rats and house mice. This indicates that fishers are exposed to ARs second hand by consuming poisoned non-target animals who may have eaten bait or eaten a poisoned rodent.

Researchers at SUNY Environmental Science and Forestry are currently investigating the relationship between the number of AR compounds found in fisher livers to the decline in local populations (3). Fishers killed by trappers from five northeastern states (PA, NY, VT, NH, and ME) were tested for the presence of AR compounds in their livers. Vermont had the highest incidents of AR exposures with 100% of the fishers testing positive. Preliminary findings indicate that there is a strong correlation between the number of AR compounds found in fishers and the likelihood that local populations have declined. Population estimates back to

1990 were used to calculate catch per unit effort (CPUE) (1). The researchers found that "the higher the exposure level, the greater the probability of a declining catch...It potentially indicates that rodenticide exposure is an important driver of population decline."

AR Regulations

Commercial rodenticide is usually dispensed in ready-to-use or refillable bait stations/containers. The use of ARs is regulated by the Environmental Protection Agency. In 2008, the EPA declared SGARs to be an "unreasonable risk" to children, pets, and wildlife (14). Consumer retailers are prohibited from selling SGARs, meaning most people no longer buy them for use at home. Current use of SGARs is limited to licensed pest controllers, as well as certain agricultural users. Except under regulated conditions, it is illegal for anyone to place any poisons outdoors (including rodenticides). When used outdoors they must be placed within a specific distance of a building/structure.

The regulations associated with ARs are primarily aimed at protecting children and domestic pets from accessing the poisons. But, because they are most often placed outside buildings, they do not protect wildlife from exposure to bait or to poisoned prey. And, despite the EPA regulations, SGARs are still available online to anyone. Unlawful use is a serious problem (2, 9).

In addition to the Federal restrictions, several states have recently enacted legislation to restrict or ban SGARs. California was the first state to restrict the sale and use of SGARS in 2020. Recently, both Massachusetts and Connecticut introduced legislation to ban or restrict SGARs. New Hampshire introduced legislation similar to the California law and Maine is participating in a regional study to evaluate the threats/impact to predators including fishers (9).

Mitigation/Protection Strategies

Due to the reclusive and solitary nature of fishers, it is challenging to accurately assess their population numbers, but fisher population decline is a concern that is shared by most researchers. The data suggest rodenticides may play a large role in this decline. Loss of forested habitat and nesting/denning sites, and trapping, are also major drivers of fisher decline in the northeast (3, 6).

A great deal more research needs to be done to understand the impact of ARs on fisher populations (11). Population size needs to be accurately determined to assess what proportion of a population is being sampled. Exposure paths, the ways that fishers come in contact with ARs, need further study. How are fishers exposed to ARs when their diet does not include the target species or when they are not in proximity to bait stations? What are the effects of sub-lethal exposure on reproduction? All these questions remain unanswered and reinforce the need for more comprehensive population level studies.

Conclusion

Fishers, as well as numerous other predators impacted by ARs, play enormously important roles in Vermont's ecosystems. Considerable evidence has established that they are endangered by SGARs and that this threat is on the population level. According to Audubon Vermont, there are more than 175 rat poison products available on the open market, which do not pose the same level of risk to rodent-predators (9). In addition, many basic non-lethal preventative measures can reduce rodent infestations. Finally, and ironically, healthy populations of raptors and other wildlife will reduce and control levels of problematic rodent populations. As other New England states take steps to restrict and/or ban the use of these poisons, it is important that Vermont joins this effort.

Given the many threats to fisher survival, a moratorium/ban on fisher trapping would add needed protections for this vulnerable species. Impacts from climate change, habitat loss, and AR poisoning are virtually impossible to control. Consequently, it would be prudent to eliminate the one threat to fisher populations that can be controlled, recreational trapping.

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