



RAT POISONS NOT ONLY KILL WILDLIFE: THEY CAN ALSO WEAKEN AND SICKEN THEM.

Known “sublethal” impacts include:

- Hemorrhaging beneath the skin and extensive bruising. Internal hemorrhaging in bones, body wall, heart, and elsewhere in the body. Possible heart failure.¹
- Hemorrhaging of the heart, liver, kidney, lung, intestines, and muscles.²
- Anticoagulants associated with inflammatory response and immune suppression in bobcats.³
- Anticoagulants associated with multiple system effects in bobcats.⁴
- Multiple AR exposure events associated with notoedric mange.⁵
- Barn owl clutch size, brood size, fledging success, and nest box occupancy lower in fields treated with anticoagulants.⁶
- Increased vulnerability to other causes of death such as vehicular collisions and predation.⁷
- Coyotes exposed to multiple FGARs and with high FGAR residues tended to be in poorer body condition.⁸
- Chronic anemia, making animals more susceptible to diseases, including mange, and other stressors.⁹
- Reproductive impacts. Female sheep exposed to anticoagulants had more aborted or stillborn lambs (up to 50%); male sheep had lower sperm motility.¹⁰
- Decreased food intake¹¹ and decreased body weight.¹²
- Neonatal transfer to young kits. Decreased resilience to environmental stressors.¹³ Fetuses more susceptible to brodifacoum toxicity than adults.¹⁴

- Increased parasite and pathogen burdens.¹⁵
- Shorter wings, tails, bones, bills, and birth defects.¹⁶
- Rodents poisoned by anticoagulants are more likely to be eaten by predators.¹⁷
- Raptors may preferentially prey upon sickened rodents: The energetically beneficial behavior of favoring substandard prey may increase raptor encounters with rodenticide exposed animals if prey vulnerability has resulted from poisoning.¹⁸
- Exposure to brodifacoum may have prolonged effects that increase toxicity of subsequent AR exposure.¹⁹
- Bromadiolone and chlorophacinone residues from secondary poisoning can be transferred to the eggs of *T. alba*.²⁰

¹ Mendenhall and Pank. 1980. Secondary Poisoning of Owls by Anticoagulant Rodenticides. Wildlife Society Bulletin 8:311-315

² Rattner et al. 2011. Acute Toxicity, Histopathology, and Coagulopathy in American Kestrels (*Falco sparverius*) Following Administration of the Rodenticide Diphacinone. Environmental Toxicology and Chemistry 30(5): 1213-1222

³ Serieys, et al. 2018. Urbanization and anticoagulant poisons promote immune dysfunction in bobcats. Proc Biol Sci. 2018 Jan 31; 285(1871): 20172533

⁴ Fraser, et al. Genome-wide expression reveals multiple systemic effects associated with detection of anticoagulant poisons in bobcats (*Lynx rufus*) Mol Ecol. 2018;00:1–18.

⁵ Serieys, et al. Anticoagulant rodenticides in urban bobcats: exposure, risk factors and potential effects based on a 16-year study. Ecotoxicology (2015) 24:844–862

⁶ Salim, et al. 2014. Sub-lethal effects of the anticoagulant rodenticides bromadiolone and chlorophacinone on breeding performances of the barn owl (*Tyto alba*) in oil palm plantations. Slovak Raptor Journal 8(2): 113-122

⁷ Fournier-Chambrillon, et al. 2004. Evidence of Secondary Poisoning of Free-Ranging Riparian Mustelids by Anticoagulant Rodenticides in France: Implications for Conservation of European Mink (*Mustela lutreola*). Journal of Wildlife Diseases 40(4):688-695

-
- ⁸ McKenzie, et al. 2022. Exposure of Urban Coyotes to Anticoagulant Rodenticides in Southern California: Sub-lethal Effects and Environmental Correlates. *Proceedings of the Vertebrate Pest Conference*, 30(30)
- ⁹ Riley, et al. 2007. Anticoagulant Exposure and Notoedric Mange in Bobcats and Mountain Lions in Urban Southern California. *Journal of Wildlife Management* 71(6).
- ¹⁰ Robinson, et al. 2005. Effect of the anticoagulant, pindone, on the breeding performance and survival of merino sheep, *Ovis aries*. *Comparative Biochemistry and Physiology, Part B* 140:465-473.
- ¹¹ Oliver and Wheeler 1978. The toxicity of the anticoagulant pindone to the European rabbit, *Oryctolagus cuniculus* and the sheep, *Ovis aries*. *Australian Wildlife Research* 5:135-142.
- ¹² Rattner et al. 2011. Acute Toxicity, Histopathology, and Coagulopathy in American Kestrels (*Falco sparverius*) Following Administration of the Rodenticide Diphacinone. *Environmental Toxicology and Chemistry* 30(5): 1213-1222
- ¹² Litten, et al. 2002. Behavior, coagulopathy and pathology of brushtail possums (*Trichosurus vulpecula*) poisoned with brodifacoum. *Wildlife Research* 29:259-267.
- ¹³ Gabriel, et al. Anticoagulant Rodenticides on our Public and Community Lands: Spatial Distribution of Exposures and Poisoning of a Rare Forest Carnivore. *PLoS ONE* 7(7):e40163.
- ¹⁴ Munday and Thompson. 2003. Brodifacoum Toxicosis in Two Neonatal Puppies. *Vet Pathology* 40:216-219
- ¹⁵ Lemus, et al. 2011. Side effects of rodent control on non-target species: Rodenticides increase parasite and pathogen burden in great bustards. *Science of the Total Environment* 409 (2011) 4729-4734
- ¹⁶ Naim, et al. 2010. Growth Performance of Nesting Barn Owls, *Tyto Alba javanica* in Rat Baiting Area in Malaysia. *J. Agric. Biol. Sci.* 5(6):1-13.
- ¹⁷ Cox and Smith. 1992. Proc. 15th Vertebrate Pest Conf. UC Davis. Rodenticide Ecotoxicology: Pre-Lethal Effects of Anticoagulants on Rat Behavior
- ¹⁸ Vyas, et al. 2017. Influence of Poisoned Prey on Foraging Behavior of Ferruginous Hawks. *Am. Midl. Nat.* (2017) 177:75–83
- ¹⁹ Rattner, et al. 2019. Brodifacoum Toxicity in American Kestrels (*Falco sparverius*) with Evidence of Increased Hazard Upon Subsequent Anticoagulant Rodenticide Exposure. *Environmental Toxicology and Chemistry* 2020;39(2):468-481.
- ²⁰ Salim, et al. 2015. The Effects of Rodenticide Residues Deposited in Eggs of *Tyto alba* to Eggshell Thickness. *Sains Malaysiana* 44(4)(2015): 559–564