PROJECT REPORT

Project Title: Comparative Toxicity of Diphacinone to Northern Bobwhite (Colinus virginianus) and American Kestrels (Falco sparverius)

Research Agency: U.S. Geological Survey

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Background:
A risk assessment by the U.S. Environmental Protec- tion Agency (US EPA) identified several rodenticides that pose a significant risk to birds and non-target mammals (Erickson and Urban 2004), and subsequently some restrictions were placed on the sale, distribution, and packaging of brodifacoum, difethialone, bromadi- olone, and difenacoum (US EPA 2008). This action may be offset by expanded use of other anticoagulant rodenticides, including diphacinone. The hazard of diphacinone to non-target organisms is inadequately characterized. Accordingly, sublethal responses (blood clotting time) and lethality were determined in northern bobwhite (Colinus virginianus), a species traditionally used in wild- life pesticide risk assessments, and also in the American kestrel (Falco sparverius), a well-studied toxicological model for raptorial species (Bardo and Bird 2009). Rather than using ad libitum dietary exposure in which food consumption can be highly variable, a controlled oral dosing regimen was employed to more accurately estimate dose-related sublethal and lethal effect thre- sholds. These and other data will ultimately assist in the development of a pharmacodynamic model of dipha- cinone in birds, and also in selection of efficacious baiting strategies that may mitigate risk to non-target species.

Results:

The acute oral toxicity of the anticoagulant rodenticide diphacinone was found to be about 20 times greater to American kestrels (LD_{50}=97 mg/kg) than to northern bobwhite (LD_{50}=2,014 mg/kg). Several precise and sensitive clotting assays (prothrombin time, Russell's Viper venom time, thrombin clotting time) were adapted for use in these species, and this combination of assays is recommended to detect effects of diphacinone and other rodenticides on coagulation. Oral administration of diphacinone over a range of doses (sublethal to the extrapolated LD_{15}) prolonged prothrombin time and Russell's Viper venom time within 24 to 48 hrs post-exposure. Prolongation of in vitro clotting time reflects impaired coagulation complex activity and was detected before or at the onset of overt signs of toxicity and lethality. These data will assist in the development of a pharmaco-dynamic model to assess and predict rodenticide toxicity to non-target avian species.