Remarks
A kit fox *Vulpes macrotis* was found in Bakersfield, Kern County. A necropsy indicated that anticoagulant toxicosis was possible.

RESULTS OF EXAMINATION
The kit fox liver was submitted to WPCL for anticoagulant analysis, and was found to contain brodifacoum residues at 11.0 µg/g.

Conclusion
Although it is difficult to correlate liver residues with exposure concentration, these residues are several times higher than liver residues found in animals that had received a lethal dose of brodifacoum (Meenen et al. 1999). Coupled with extensive internal hemorrhaging, these residues make it highly likely that the kit fox died as a result of brodifacoum exposure.

Chemical analyses was performed by Abdou Mekebri, Chemist, Department of Fish and Game, Water Pollution Control Laboratory. Necropsy was performed by Robert Hosea, Department of Fish and Game, Pesticide Investigations Unit.
Lab Number P-2721  Date of loss: October 21, 2013  
CAHFS D1312658  Species: San Joaquin kit fox *Vulpes macrotis mutica*  
Necropsy N13-210  Listing status: Federally endangered, State threatened

To: Ruben Arroyo  Report Date: November 22, 2013  
Kern County Agricultural Commissioner

Remarks
Investigation into cause of death of San Joaquin kit fox in Kern County.

Background
On October 21, 2013, a San Joaquin kit fox, *Vulpes macrotis mutica*, was found dead in a flowerbed on El Camino Media in Bakersfield. The fox was designated U196 in the CSU Stanislaus Endangered Species Recovery Program. The fox was transferred to the DFW Wildlife Investigations Laboratory to determine cause of death.

**RESULTS OF EXAMINATION**

The fox was submitted to California Animal Health and Food Safety Laboratory for complete necropsy and was found to be an adult male in good nutritional condition. No fractures were present in the skull, vertebrae, ribs, or limbs. Skin and soft tissue in the neck and chest region were hemorrhagic. There was approximately 80 cc of unclotted blood in the chest cavity surrounding the heart and lungs. No ruptures were observed in the lungs or heart. All other organs were unremarkable. The brain tissue tested negative for rabies.

Liver tissue was extracted and tested for anticoagulant rodenticides and strychnine. The only anticoagulant rodenticide that was detected was brodifacoum at 1.4 ppm. Other anticoagulants tested for but not detected were bromadiolone, chlorophacinone, coumachlor, difethialone, diphacinone, and warfarin. No strychnine was detected.

Brodifacoum is a second-generation anticoagulant rodenticide used to control commensal rodents. Anticoagulant rodenticides have been found widely in scavenging and predatory wildlife in California as a result of secondary exposure. Monitoring of SJKF in the Bakersfield area determined that 73.5% had been exposed to at least one anticoagulant rodenticide and 42.6% had been exposed to two or more different anticoagulant rodenticides (Cypher et al. 2013). Anticoagulant rodenticides cause toxicosis by impeding
blood clotting. Diagnosis of anticoagulant toxicosis requires the presence of one or more anticoagulant rodenticides and evidence of abnormal bleeding unrelated to another identifiable cause, such as trauma. In this case, the death of the kit fox was attributed to systemic hemorrhage caused by brodifacoum exposure.

References:

Lab Number P-2740    Date of loss: November 20, 2013
CAHFS D1314277    Species: San Joaquin kit fox *Vulpes macrotis mutica*
Necropsy N13-241    Listing status: Federally endangered, State threatened

To: Ruben Arroyo    Report Date: January 14, 2014
Kern County Agricultural Commissioner

Remarks
Investigation into cause of death of San Joaquin kit fox in Kern County.

Background
On November 20, a San Joaquin kit fox was found dead in a parking lot of Greenfield Union School District on 1624 Fairview Road in Bakersfield, California by CSU Stanislaus Endangered Species Recovery Program staff and was designated U201. The carcass was lying on its side with no apparent injuries and its legs were extended straight. The fox was transferred to DFW Wildlife Investigations Laboratory (WIL) to determine cause of death.

RESULTS OF EXAMINATION
The necropsy was performed at WIL on November 25, 2013. The fox was found to be juvenile male in excellent nutritional condition. The fox had a stiff-legged appearance which sometimes indicates strychnine exposure (Figure 1). No signs of trauma such as punctures, lesions, or broken bones were noted. Tissues were unusually red particularly on the right side of the body (Figures 2 and 3). Blood was observed near the left eye and oral membranes were red. Blood was found in the lower trachea and lungs (Figure 4). The lungs appeared atrophied. Approximately 10 ml of blood was found in the pericardial sac and approximately 5 ml of blood was found in the abdomen. Tissues were submitted to the California Animal Health and Food Safety Laboratory for histology and toxicology.

Intranuclear inclusions were found in the liver of this fox, possibly indicating infectious canine hepatitis. However, an immunohistochemical test was not available to confirm this test result.

The liver tissue did not contain detectable levels of strychnine.

Anticoagulant rodenticide testing determined the presence of four anticoagulant rodenticides in the liver: 0.25 ppm brodifacoum, 0.14 ppm bromadiolone, and traces of difethialone and difenacoum. Brodifacoum,
bromadiolone, difethialone, and difenacoum are second-generation anticoagulant rodenticides used to control commensal rodents. Second-generation anticoagulant rodenticides persist in body tissue for months and it is not possible to determine the dates, frequencies, or levels of exposure from post-mortem liver concentrations. Anticoagulant rodenticides have been found widely in scavenging and predatory wildlife in California as a result of secondary exposure. Monitoring of SJKF in the Bakersfield area determined that 73.5% had been exposed to at least one anticoagulant rodentine and 42.6% had been exposed to two or more different anticoagulant rodenticides (Cypher et al. 2013). Anticoagulant rodenticides cause toxicosis by impeding blood clotting. Diagnosis of anticoagulant toxicosis requires the presence of one or more anticoagulant rodenticides and evidence of abnormal bleeding unrelated to another identifiable cause, such as trauma. **Given the unexplained bleeding in the respiratory tract and the presence of four second-generation anticoagulants, two in relatively high concentrations, the death of this fox is likely due to anticoagulant toxicosis.**

Figure 1. San Joaquin kit fox from Bakersfield.
Figure 2. Hyperanemic tissues

Figure 3. Hyperanemic tissues, abdomen
Figure 4. Hemorrhaging in respiratory system.

References:


WILDLIFE INVESTIGATIONS LABORATORY

Stella McMillin, Senior Environmental Scientist
Wildlife Investigations Laboratory

Approved

Steve Torres, Program Manager,
Wildlife Investigations Laboratory
Lab Number P-2736 - Revised
CAHFS D1315042

Date of loss: November 22, 2013
Species: San Joaquin kit fox Vulpes macrotis mutica
Listing status: Federally endangered, State threatened

To: Ruben Arroyo
Kern County Agricultural Commissioner

Report Date: January 21, 2014

Remarks
Investigation into cause of death of San Joaquin kit fox in Kern County.

Background
On November 22, 2013, a San Joaquin kit fox was found drowned in a plastic-lined holding basin on a Cal Trans construction site in Bakersfield. The carcass was transferred to the Endangered Species Recovery Program and then to DFW Wildlife Investigations Laboratory (WIL) to determine cause of death.

RESULTS OF EXAMINATION
The carcass was transferred to the California Animal Health and Food Safety laboratory in Davis for complete necropsy and diagnostic tests. The necropsy was performed on December 26, 2013. The carcass was found to be moderately autolyzed with the skin and fur easily sloughing off. The fox was found to be a young adult male in poor nutritional status. The fox was found to have multiple subcutaneous hemorrhages and appeared to have been bleeding internally for at least a couple days. Tests for canine distemper virus and rabies were negative. Liver tissue was analyzed for anticoagulant rodenticide and two anticoagulant rodenticides were detected: 0.30 ppm brodifacoum and 0.34 ppm bromadiolone. Brodifacoum and bromadiolone are second-generation anticoagulant rodenticides used to control commensal rodents. Second-generation anticoagulant rodenticides persist in body tissue for months and it is not possible to determine the dates, frequencies, or levels of exposure from post-mortem liver concentrations. Anticoagulant rodenticides have been found widely in scavenging and predatory wildlife in California as a result of secondary exposure. Monitoring of SJKF in the Bakersfield area determined that 73.5% had been exposed to at least one anticoagulant rodenticide and 42.6% had been exposed to two or more different anticoagulant rodenticides (Cypher et al. 2013). Anticoagulant rodenticides cause toxicosis by impeding blood clotting. Diagnosis of anticoagulant toxicosis requires the presence of one or more anticoagulant rodenticides and evidence of abnormal bleeding unrelated to another identifiable cause, such as trauma.
Due to the presence of internal bleeding, the lack of signs of external trauma (such as broken bones), and the presence of two second-generation anticoagulant rodenticides, the presumptive cause of death of this fox is found to be anticoagulant toxicosis.

Reference:


WILDLIFE INVESTIGATIONS LABORATORY

Stella McMillin, Senior Environmental Scientist
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Deana Clifford, Wildlife Veterinarian
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Cc: Rich Bireley,
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Robert Miller,
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Brian Cypher,
Endangered Species Recovery Program
Lab Number P-3165
Necropsy Number Z16-1082
ESRP U280
CAHFS Number D1612282

Date of loss: September 16, 2016
Sample: San Joaquin kit fox
Vulpes macrotis mutica
Listing status: Federal endangered, State threatened

To: Ruben Arroyo
Kern County Agricultural Commissioner

Report Date: February 27, 2017

Remarks
Loss of San Joaquin kit fox due to probable anticoagulant intoxication.

Background
On September 16, 2016, a kit fox was found dead at an elementary school in Bakersfield. The fox was collected by the Endangered Species Recovery Program, CSU Stanislaus, and submitted to the CDFW Wildlife Investigations Laboratory (WIL) to determine the cause of death.

RESULTS OF EXAMINATION
The necropsy was performed at WIL on September 28, 2016. The fox was found to be a juvenile male. Free blood was observed in the abdominal cavity, the pericardial sac, and the abdominal cavity. No signs of trauma were noted.

Frozen liver tissue and various kinds of tissues in formalin were submitted to the California Animal Health and Food Safety Laboratory in Davis. Histological analysis of heart tissue revealed a sarcoma. Immunohistochemistry was performed on the tumor cells and found them to be suggestive of a histiocytic sarcoma. This type of tumor does not typically cause hemorrhaging. Liver tissue contained three different anticoagulant rodenticides: 0.460 ppm brodifacoum, 0.094 ppm bromadiolone, and 0.360 ppm difethialone. All of these materials are second generation anticoagulant rodenticides used for commensal rodent control by certified applicators. Brodifacoum and difethialone are the two most toxic second generation anticoagulant rodenticides and deaths from intoxication have been reported in canids with brodifacoum liver residues of 0.176 – 0.320 ppm (Poessel et al 2015). Given the liver concentrations of anticoagulant rodenticides above known toxic values and the coagulopathy noted at necropsy, it is probable that the fox died from anticoagulant rodenticide intoxication.

Reference:
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