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Preventing Rodent Damage to Flood Control Facilities

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ABSTRACT: In California, flood control facilities protect millions of people and critical infrastructure from flood events by containing water and debris behind engineered structures. Rodent burrow damage to flood control dams and levees results in failure to meet federal and state structural certification criteria. Non-certified structures pose substantial damage risks during flood events and are ineligible for federal flood insurance and reimbursement programs. Most dams and levees are compacted earth, faced with rock, and topped with gravel access roads. These facilities provide excellent habitat for ground squirrels; the rocks provide cover and the creeks, neighborhoods and nearby agricultural fields provide abundant food. Ground squirrels form the base of the food chain for raptors, coyotes, bobcats, and mountain lions, which routinely foraging along facilities. The Ventura County Watershed Protection District developed an Integrated Pest Management Program (IPMP) to prevent rodent damage to flood control facilities. We found that small amounts of anticoagulant (diphacinone) in bait stations along flood control facilities target ground squirrels with low risk to other fauna. The California Department of Fish and Wildlife, other conservation agencies, and members of the public have requested anticoagulant use be terminated to avoid secondary poisonings. Alternative controls do not provide the level of protection necessary to meet structural criteria. The current registered diphacinone label requires verification of pest infestations before application. However, infestation must be prevented at flood control facilities. Treating the few dispersing squirrels avoids treating an entire colony with anticoagulants, and therefore much less bait enters the food chain. Ventura County lobbied to change the label to allow some bait to be left in the bait stations to control dispersing squirrels. Discontinuing diphacinone is not yet an option, but we plan to conduct studies to further improve bait station design and bait application protocols, coordinate with neighboring landowners, and revise the IPMP to reduce bait use.

KEY WORDS: California ground squirrel, dams, diphacinone, flood control, integrated pest management, levees, *Otospermophilus beecheyi*, rodent control, *Spermophilus beecheyi*

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INTRODUCTION

California ground squirrels (*Spermophilus beecheyi*), and to a lesser extent pocket gophers (*Thomomys bottae*), can cause substantial burrow damage to engineered flood control structures constructed and maintained by the Ventura County Watershed Protection District (District) in Ventura County, California. Earthen dams and levees in both urban and rural settings provide excellent habitat for these native rodents, especially the ground squirrels. Vegetation-free rock faced earthen structures flanked by water and food resources are ideal for this species. Pest control methods must *prevent* damage to critical flood control facilities to maintain the level of safety demanded by state and federal regulators, as well as by the public whose taxes pay for the protection the structures provide. The District deploys the first-generation anticoagulant diphacinone, as well as other non-anticoagulant toxicants, to control rodent damage at flood control facilities.

Environmental quality concerns are foremost to the Ventura County Board of Supervisors, state and federal wildlife agencies, local political representatives, and members of the public. The 2011-2016 County of Ventura Strategic Plan specifically requires the reduction of pesticides applied at County properties and facilities, as well as encourages integrated pest management (Ventura County Executive Office 2011). Although the District prepared an Integrated Pest Management Program for rodent control in 2005 that drastically reduced the quantities of anticoagulant rodenticide used per facility linear mile, pressure to further minimize and ultimately cease the use of anticoagulant rodenticide continues.

Many local large carnivores, specifically bobcats (*Lynx rufus*), coyotes (*Canis latrans*), and mountain lions (*Puma concolor*), as well as many raptors, have tested positive for anticoagulant rodenticide residues (Moriarty et al. 2012). Secondary poisoning risks to non-target wildlife have been well documented in the body of anticoagulant literature. Non-anticoagulant (acute toxicity) rodenticides have lower risks of secondary poisonings to non-target wildlife, but replacing anticoagulants with other toxicants does not necessarily meet the overall goal of pesticide reduction.

In partnership with local experts, the District plans to conduct field studies over the next several years that will potentially result in reduced anticoagulant and other rodenticide applications, while maintaining the integrity of flood control facilities in a cost-effective manner.

FLOOD CONTROL BASICS

The Ventura County Flood Control District was legally formed on September 12, 1944, when the California State Legislature approved the Ventura County Flood Control Act, as Chapter 46 of the Fourth Extraordinary Session of the Statutes of 1944. Its mission was to provide for the control and conservation of flood and storm waters and for the protection of watercourses, watersheds, public highways, life, and property from damage or destruction from these waters. On January 1, 2003, the name was changed to Ventura County Watershed Protection District to reflect evolving community values, regulatory requirements, and funding opportunities. It also reflected the District's desire to

emphasize integrated watershed management and solve flood control problems with environmentally sound approaches. The District is part of the Ventura County Public Works Agency, which also includes the Transportation Department and the Water and Sanitation District.

The District owns and operates a variety of flood control facilities throughout the 1,840-square-mile county, which is home to about 836,000 people. Three major watersheds occur in the county: Ventura River, Santa Clara River, and Calleguas Creek. Each watershed has varying degrees of urban, agricultural, and open space land uses. The District operates and maintains 54 dams with debris or detention basins, 143 miles of flood conveyance channels, 53 miles of underground culverts, 230 miles of access roads, 4 pump stations, and 20 miles of levees. Maintenance actions include year-round vegetation management, grading and sediment management, repairs, and rodent control.

Dams and levees are considered “critical facilities” due to the substantial potential damage to life and property should they fail during a storm event. Dams and levees are earthen or concrete structures which impound water higher in elevation than the surrounding grade. Breaches in dams and levees result in catastrophic facility failure and extensive damage to development and other land uses in the flood plain. Most flood conveyance channels, both with and without rock bank protection, can endure bank erosion and bottom scouring without substantial damage to the higher elevation adjacent lands. Channels are not considered critical facilities.

Critical facilities are regulated by several federal and state agencies. Following Hurricane Katrina in 2005, the Federal Emergency Management Agency (FEMA) increased its oversight of flood control facilities across the nation. Flood Control Regulations are Part 208 of the Code of Federal Regulations, Title 33 Navigation & Navigable Waters. §208.10 Flood Control Protection Works requires levees be maintained at all times to insure serviceability during flood events, and it specifically states burrowing animals must be exterminated. The Flood Control Emergency Act, Public Law 84-99, designates the U.S. Army Corps of Engineers as responders to flood emergencies and allows federal funding to be disbursed to local agencies to repair flood damaged facilities. The facilities must be rated “acceptable” by a qualified inspector and have a favorable benefit:cost ratio to be eligible for funding. This law encourages proper maintenance of flood control facilities, which both reduces failure risks and costs to the taxpayers. The California Department of Safety of Dams (DSOD) regulates dams that are 25 or more feet in height, or shorter dams depending on capacity. DSOD was formed in 1929 following the St. Francis Dam failure in 1928, which flooded the Santa Clara River Valley in Ventura County, killing 450 people. The District operates 8 dams under DSOD regulatory authority.

The District has adopted a “zero tolerance” threshold for rodent damage and vegetation on dams and levees to comply with the regulations. Maintenance methods *prevent* woody vegetation within 15 feet of both the inside and outside levee or dam toes to avoid root damage

to compacted earth or concrete materials. Likewise, rodent burrow damage is also *prevented* within any portion of the critical facilities. Channels are not subject to as rigorous requirements but must be properly maintained to avoid substantial erosion failures during storm events.

INTEGRATED PEST MANAGEMENT PROGRAM

The County Board of Supervisors acts as the District’s Board of Directors. On March 22, 2005, the Ventura County Board of Supervisors voted to support legislative efforts (AB 1548) to restrict or eliminate the use of anticoagulant rodenticides in the County. The Board directed the County General Services and Public Works Agency to avoid the use of rodenticides containing anticoagulants within County-owned property and facilities. The anticoagulants of concern include brodifacoum, bromadiolone, diphacinone, and difethialone. The Board direction was partially in response to National Park Service (NPS) studies in the Santa Monica Mountains National Recreation Area, which found anticoagulants in nearly all mammals tested, from small rodents to large carnivores. In particular, the bobcat population was severely affected by mange, attributed to ingestion of anticoagulants (Moriarty et al. 2012). The small mammals ingest poisons and pass them up the food chain, because they are sick and easier to catch, or they die above ground and are available to scavengers. Raptors also succumb to secondary anticoagulant poisoning by catching or scavenging tainted small mammals.

To address these concerns, the District evaluated its current rodenticide program and researched scientifically viable alternatives (Salmon 2006). A stakeholder group comprising members of the public, NPS, wildlife control specialists, and California Department of Fish and Wildlife (CDFW) assisted in researching and recommending program improvements. The group explored rodent control techniques potentially suitable for District facilities and estimated costs, which contributed to the development and implementation of an Integrated Pest Management Program (IPMP). The IPMP costs more to implement than the previous pest control methods, but provides better control with fewer environmental impacts. Anticoagulant bait (diphacinone) was only allowed for use at critical facilities. The IPMP was approved by the Board of Supervisors, CDFW, and U.S. Fish and Wildlife Service. It was included as an Environmental Best Management Practice for the District’s Routine Operations and Maintenance Program California Environmental Quality Act Environmental Impact Report and subsequent regulatory permits from the U.S. Army Corps of Engineers (Section 404 of the Clean Water Act), Los Angeles Regional Water Quality Control Board (Section 401 of the Clean Water Act), and CDFW. Field implementation has been ongoing since 2008.

The IPMP focused on California ground squirrels and, to a lesser extent, pocket gophers, as these two species cause structural damage to flood control facilities and can damage habitat restoration projects. Ground squirrel burrows weaken the compacted fill of levees and dams, undermine access roads and other structures, and cause erosion, sloughing, and other maintenance problems.

Nearly all District facilities have the potential to support ground squirrels because they are maintained free of vegetation, have adjacent foraging habitat, and have a ground squirrel dispersal source nearby.

The IPMP allowed for diphacinone use by broadcast baiting or in specially modified bait stations only at critical facilities, and with substantial changes in methods. It also prescribed alternatives to diphacinone, including zinc phosphide, aluminum phosphide, trapping, and habitat modification. Many other rodent control methods researched but determined to be ineffective included frightening, shooting, repellents, gas injection (with or without ignition), and biological controls (e.g., raptor perches). Obviously, explosive rodent control treatments are incompatible with engineered flood control structures. The IPMP proposed coordination of pest control activities with neighboring landowners to minimize potential environmental impacts and potentially reduce costs.

IPMP EVALUATION

By 2009, the IPMP was fully implemented at 33 critical facilities within the District. During the first two years, the IPMP met the two primary goals of minimizing anticoagulant bait use and decreasing the incidence of rodent damage to critical facilities. Weekly site visits quantified ground squirrel activity, which allowed the technician to tailor the type of control (if any) needed for that week, including alternatives to anticoagulant applications. This was in sharp contrast to the previous (pre-IPMP) control methods when the bait stations were completely filled once per month regardless of the rodent activity. Broadcast baiting (diphacinone 0.01%) was implemented instead of bait stations (diphacinone 0.005%) at some sites to further reduce anticoagulant use, although bait stations remained at facilities with rock facings. Anticoagulant bait use decreased 10-fold per month per linear mile of facility when compared to pre-IPMP rodent control methods.

Data regarding bait use, target and non-target species presence, presence of animal carcasses, and other information were collected by technicians during every site visit capturing seasonal population trends and adjacent land conditions. In two years, fewer than 5 dead squirrels were observed by or reported to the District during weekly site visits (carcasses were collected and disposed of). IPMP technician patrols also found a dead hawk, 2 seagulls, an opossum, and several mice. The mice and ground squirrel deaths were likely due to the baiting, because they were observed eating the bait on previous visits. Field mice occasionally nested in the bait stations during the winter periods, and were usually found dead in the station. Some bait stations have been raised off the ground, which appears to prevent mice from accessing the stations. The cause of death for the other animals was undetermined.

Monitoring also recorded adjacent site conditions that may affect the facility rodent risk. Agricultural crops and backyard gardens or bird feeders provided ample food for the gophers and ground squirrels, which then disperse to District facilities. The District did not coordinate with adjacent land owners regarding pest control activities, so this component remains untested for efficacy.

By 2010 when FEMA increased levee certification oversight, one fatal flaw in the IPMP was noted: the diphacinone broadcast baiting method does not prevent the damage caused by ground squirrels. Broadcast bait must be applied near the entrances of active burrows, so the facility damage would already have occurred prior to treatment. In 2005 when the IPMP was being developed, the strict requirement for damage prevention had not yet been implemented by FEMA. At that time, the District placed emphasis on the need to reduce bait use per the Board of Supervisors' directive. As the IPMP was implemented through 2011, bait stations were eventually placed where broadcast baiting was originally planned. The broadcast method was only used at critical facilities where bait stations were inappropriate due to vandalism or heavy pedestrian traffic.

Bait stations were found to effectively target ground squirrels that reached District facilities as they dispersed from nearby colonies, searching for new colony sites and food sources. A minimum amount of diphacinone bait in the stations to target these individuals appeared to effectively prevent damage. Larger amounts were placed in the station when adjacent ground squirrel colonies were observed. Individuals consume the anticoagulant bait and die at this early dispersal stage, therefore preventing establishment of new burrows in critical facility structures.

CDFW asserts bait stations result in a continuous threat to the food chain and requests the District not put bait in the stations unless there is a squirrel population present. In 2012, the diphacinone label supported CDFW's position by requiring bait be removed from the stations between rodent infestation treatments. The District countered with the argument that a small amount of bait in the station treats the infrequent dispersing squirrels and therefore prevents infestations. Less bait overall is needed to treat a few squirrels, rather than treating a colony of many squirrels. Rex Baker, Professor Emeritus at California State Polytechnic University-Pomona, agreed with the District and lobbied the California Department of Food and Agriculture and the Department of Pesticide Regulation to change the diphacinone label to allow bait to remain in the stations if reinfestation threats continue. He was successful, and in Ventura County, Henry Gonzales, Agricultural Commissioner, has deemed there to be a constant threat of reinfestation due to the mild climate and suitable habitat conditions for ground squirrels adjacent to District facilities.

FUTURE CHALLENGES

Anticoagulant bait use remains an important tool in the IPMP; the District has not yet found a more environmentally responsible and cost-effective method to prevent ground squirrel damage at critical facilities as required by regulations. Prevention of damage by ground squirrels to critical facilities remains the District's priority and is crucial to the District's mission to protect life and property from damaging flood waters. CDFW, concerned citizens, and others periodically renew pressure for the District to cease application of anticoagulants. CDFW has expressed further concern that suppressing ground

squirrel populations at District facilities reduces the prey base for large mammals and raptors, which constitutes another form of secondary impacts to these predators.

The District plans to conduct studies that quantify bait station and anticoagulant use impacts to the food chain and identify effective IPMP improvements. Study designs are in development for the following four components: 1) determine optimal bait station field protocols to minimize bait use, labor, and materials, while optimizing control, by testing amounts of bait, site visit timing, etc.; 2) use night cameras, track pads, fecal analyses, and other methods to document animal species potentially obtaining bait from the bait stations; 3) conduct small mammal population surveys and test animals for bait exposure at facilities with bait stations, facilities without bait stations, and non-facility controls to document potential effects on prey base for the ecosystem; 4) conduct ground squirrel surveys to find trends in population dynamics in various habitat types adjacent to facilities, and develop ways to control populations in adjacent lands. The studies will be designed and implemented utilizing geographic information system-based maps and models.

CDFW, NPS, experts in the field, and the District will work together to both design and implement these studies. Preliminary designs have been funded by the District; implementation funds have not yet been identified. Once designed and implemented, the study results will provide data-based revisions to the IPMP, including: improved location, design, and maintenance methods for the bait stations to boost efficacy and minimize potential impacts to non-target species; improved compliance with both the District's O&M Program environmental and structural regulatory requirements; and reduced maintenance costs for both the pest control program and facility repairs.

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