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THE DENVER WILDLIFE RESEARCH CENTER: AN UPDATE

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The Denver Wildlife Research Center (DWRC) has progressed as part of the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) in its capability to support the APHIS Animal Damage Control (ADC) program and provide the agency and the public with expanded knowledge and new or alternative tools to reduce wildlife conflicts with agriculture and other human endeavors. As a result of this increased capability, the DWRC conducts research and provides data that conform to the Environmental Protection Agency's (EPA) Good Laboratory Practice Standards for pesticide registration and reregistration and to the guidelines of the Animal Welfare Act for animal studies.

In fiscal year 1991, APHIS's methods development research budget was increased by Congress. This enabled the DWRC to once again conduct research on alternatives to currently registered vertebrate pesticides. Nonetheless, the major research focus continues to be on producing data to keep registrations for vertebrate pesticides up to date.

DISCUSSION

The following are summaries of some current or recently completed projects:

Relocation of Golden Eagles

Over the last 2 years DWRC biologists have been experimenting with translocating territorial golden eagles (*Aquila crysaetos*) as a possible management technique for resolving eagle/livestock conflicts. Eagles have been moved several directions to determine how long they remain away from their territories. To date, 16 relocations have been made involving 14 individual birds (6 males and 8 females). Twelve of the 14 relocated eagles returned to the vicinity of their territories after a median time interval between 53 and 73 days. Birds moved in an east or west direction were absent from their territories longer than those moved to the south of their former territories. Mate replacement and reoccupancy of vacant territories by golden eagles occurred rapidly, usually in less than 3 days. In some cases, when relocated eagles attempted to reoccupy their former territories they were challenged by the "replacement eagles." Fighting apparently occurred and, in most cases the original birds re-occupied their territories. Two of the eagles relocated in this study died shortly after returning, apparently from injuries resulting from territorial disputes. The results of this study suggest that relocation of territorial eagles would offer only a short-term solution to livestock

depredations caused by eagles. Further research is needed to develop more long-term and effective tools for managing eagle damage problems.

Breakaway Snare Development

Studies are underway to improve snares for capturing coyotes (*Canis latrans*) while releasing larger animals. Seven types of breakaway snares were evaluated for breaking strength and variability using a universal testing machine. Maximum tension before breakage for individual snares ranged from 64 to 219 kg. Coyotes, mule deer (*Odocoileus hemionus*), domestic calves, and lambs were tested to determine the tension loads they applied to snares. Differences in tension loads among coyotes and nontarget species should allow for the development of snares that will consistently hold coyotes and release most larger nontarget animals. A prototype snare with a shear pin incorporated into the lock showed efficacy in recent tests on coyotes. This snare design will be tested against calves, sheep and mule deer for its breakaway characteristics. If results are positive, the snare will be evaluated under field conditions.

Coyote Attractant Research

Seasonal responses of captive coyotes to 9 chemical attractants (W-U lure, TMAD, SFE, FAS, CFA, artificial smoked fish flavor, artificial beef liver flavor, yeast autolysate and decanoic acid) were evaluated. Twenty-six additional attractants were tested only during the summer. W-U lure and FAS produced the greatest total response times from coyotes during all seasons of the year. FAS and smoked fish flavor evoked the most lick-chew-bite and pulling behaviors during the summer and have potential for improving the

performance of M-44 devices in warm weather.

Coyote Bait Acceptance

Low bait take by coyotes has been among the constraints to development of baiting techniques for controlling livestock predation. The low-density bait applications that the EPA might permit for toxicant registration further compound this problem. The winter and summer portions of a 4-season coyote bait acceptance study have been completed. Nontoxicant tallow baits, containing physical and physiological agents for marking coyote scats and blood, were placed at densities of 5.2, 13, and 52 per km². Marked scats and blood samples provided indices for determining the relationships among season, density, and acceptance by coyotes. At these bait densities, percentages of scats marked were 17, 17, and 33 during summer and 45, 58, and 100 during winter, respectively. Blood sample results indicated that 7, 18, and 27% of the coyotes were marked during summer; 60, 15, and 67% were marked at the same bait densities during winter. Nearly 1/2 of the summer blood samples were obtained from juvenile coyotes. Of these, only 6% indicated acceptance of marked bait, suggesting a possible age difference among coyotes that find and consume bait.

Evaluation of Aerial Hunting Mountain Coyotes

The preliminary report of a 2-year study of seasonal movement patterns of coyotes in the mountains of northern Utah and southern Idaho has been completed. One aspect of a controversy over aerial shooting coyotes in winter to reduce coyote predation on sheep during summer grazing periods involves whether or not coyotes in high mountain areas migrate to lower elevations during the

winter. The recent study, conducted with radio-collared coyotes in the mountains along the Utah-Idaho border, revealed that there was no significant difference in the elevations at which coyotes were found in winter compared with summer and that territorial coyotes used the same areas year around. Movements of subadult coyotes were substantial and were attributable to dispersal, not migrations. All coyotes over 19 months of age, the ones that pose the greatest risk to sheep, occupied the same areas in summer and winter. This indicates that coyotes killed on mountain grazing allotments in winter includes those that are most apt to kill livestock. Interestingly, transitory movements of younger coyotes were along the axis of the mountains, suggesting there was little exchange between mountain populations and those within the adjacent valleys.

Frightening Devices for Coyotes

A final prototype frightening device consisting of a polyvinylchloride pipe housing containing a strobe light, warbling siren, timing circuit, and battery was tested as a means of protecting range sheep on bedgrounds while on grazing allotments in Colorado. In such situations, use of available control tools are often restricted and locations are difficult to access. In 10 of 12 trials where the devices were used by herders around bedgrounds, sheep losses to coyotes were reduced an average of 73% (S. Linhart, personal communication). Producers using the frightening devices during the field trials lost far fewer lambs to coyotes when the devices were in use. Further operational testing of prototype devices has been conducted by ADC personnel and agricultural extension agents to better define potential uses. Efforts are underway to make such devices available to producers through the ADC's Pocatello Supply Depot, Pocatello, Idaho.

Goose Repellents

Extensive pen trials were completed to evaluate the effectiveness of methyl anthranilate and various other repellents for repelling Canada geese (*Branta canadensis*) when applied to turf. The results show that some of these non-lethal formulations are effective for periods > 40 days. Discussions have begun with private industry to commercialize methyl anthranilate, and a series of formulations have been trademarked. We plan additional field tests this fall.

Bulbul Repellents

In cooperation with ADC in Hawaii and the Hawaiian Governor's Agricultural Task Force, a field test was conducted to evaluate the effectiveness of two repellents in reducing bulbul (*Pycnonotus* spp.) damage to dendrobium orchids. Both were significantly effective in reducing bulbul damage at or below registered application rates. The dendrobium growers association will seek 24C registrations for the use of these chemicals on flowering plants.

Rice Seed Repellents

In cooperation with ADC in Texas and the Texas Agricultural Experiment Station, a field trial was conducted with Kocide, a registered fungicide, as a repellent to protect rice seed from blackbirds (*Icterinae* spp.). To date, results are promising, and significant reductions in damage have been observed. Residue data are being collected in support of registration efforts.

North Dakota Bird Habitat Management to Protect Sunflowers

The herbicide Rodeo is being used to reduce cattail (*Typha latifolia*) densities on marshes—the hypothesis being that reduced

densities will cause blackbird dispersal from sunflower crop area?. The herbicide has worked well, and its effects on blackbird populations are being monitored. Sunflower growers in South Dakota and Minnesota have expressed interest in cooperating in these investigations, and we are discussing possibilities with them. Several other research projects continue as a result of our Congressionally—mandated funding to NDSU. These projects include the development and evaluation of bird resistant sunflower cultivars, and the investigation of additional herbicides as cattail toxicants. As part of these studies, the aquatic ecological consequences of the various herbicides are being assessed.

Bird Deterrents For Aquaculture

A commercially available netting system was evaluated for deterring heron and egret (*Ardeidae* spp.) depredation at catfish ponds in Mississippi. The system was neither cost-effective nor beneficial. Additional studies are planned to evaluate the effectiveness of electric fencing. Also, evaluations have begun on the "scary-man" propane exploder system, and initial results suggest that the system could be effective at dispersing double-crested cormorants (*Phalacrocorax auritus*).

Impact Of Birds On The Catfish Industry

Feeding rates of cormorants on catfish ponds were evaluated. Among sites, mean damage was \$342/day, with some sites experiencing fish losses in excess of \$1,500/day. Survey results indicate that > 87% of Mississippi catfish farmers believe they experience significant economic losses to birds. Overall, bird depredation costs Mississippi aquaculture \$3.3 to 6.8 million annually, and is the third greatest source of

economic loss, behind disease and oxygen depletion.

Registration Of Alphachlorolose

An Investigational New Animal Drug Application was approved by the Food and Drug Administration for alphachlorolose. This approval allows the DWRC to cooperate with ADC personnel in conducting field trials of this compound for capturing waterfowl (*Anseriformes* spp.), coots, (*Fulica americana*) and rock doves (*Columba livid*). Two such cooperative trials were conducted in late 1990 in Nevada, where nuisance ducks in Las Vegas and nuisance rock doves at a feedlot near Reno were removed. DWRC scientists plan to complete bioassay pen trials this year with Canada geese and rock doves and to continue to collect required field efficacy data. Registration of alphachlorolose is expected in 1992.

Strychnine Registrations

The DWRC continued its coordination of the Strychnine Consortium, a group of private companies and public agencies that have contributed funds to reregister the technical strychnine product with EPA. Twenty-five data submissions (studies) were submitted to EPA during the last 1 1/2 years, including 12 involving Product Chemistry, 2 Human Health Hazard studies, 2 Wildlife and Aquatic Organism studies, 1 Environmental Fate study, and 8 Efficacy studies. These studies were either conducted at DWRC or contracted to private laboratories and monitored by DWRC staff. The DWRC developed and validated analytical methods for technical strychnine as well as for strychnine in water, avian feeds, soils, and animal tissues to support the contracts and the in-house research. Information on adverse effects of strychnine

also was submitted by DWRC in support of the reregistration effort.

Livestock Protection Collar Registration

The DWRC continued its data submissions associated with the Livestock Protection Collar (LPC) and completed submissions to support the conditional registration of the technical product. Fourteen Product Chemistry and 3 Human Health Hazard studies were submitted to EPA during the last 1 1/2 years. In addition, muscle residues of sodium fluoroacetate (Compound 1080) in 10 coyotes killed in pen tests were analyzed, and estimates of the amount of LPC solution spilled on the necks of collared lambs killed by the coyotes were measured and submitted to EPA to establish the potential nontarget hazards associated with the LPC. EPA also required that the 1080 LPC solution be applied to "simulated coyote kills" of sheep for primary hazards tests with striped skunks (*Mephitis mephitis*) and golden eagles. After much public opposition to these tests and a request from DWRC, EPA rescinded the skunk and eagle data requirements. A 1984 report entitled "Primary Hazard of the 1080 Toxic collar to Skunks and Golden Eagles" was revised and resubmitted to EPA in June 1990 as requested by an EPA audit report.

DRC-1339 Registration

The DWRC is cooperating with Purina Mills, Inc. to reregister DRC-1339 technical. Purina Mills, Inc. has conducted 16 Product Chemistry studies for submission to EPA. DWRC submitted 7 Human Health Hazard studies in 1990 and 5 Wildlife and Aquatic Organism studies submitted in 1991. The DWRC monitored the contracts to private laboratories and conducted all of the backup analytical chemistry methods validation and sample analysis for these studies. DWRC

has conducted and submitted 1 environmental Fate Study and will begin three additional studies this fall.

In February 1991, EPA issued a Data Call-In for DRC-1339 that identified 13 additional studies that EPA was requiring in the next 3 years. The DWRC is working with Purina Mills, Inc. and the APHIS Technology Support Staff to reduce these requirements.

The DWRC requested an amendment for 1 registration and submitted 3 new registration requests (including data) for DRC-1339 to the EPA. The amended registration clearly defines baits to be used, treatment rates, and application sites for controlling blackbirds and European starlings (*Sturnis vulgaris*) at feedlots. The new registrations were: 1) for controlling raven/crow (*Corvus* spp.) depredations on livestock, or the eggs/young of other species designated to be in need of special protection; 2) for controlling rock doves using health, nuisance, or other economic problems in and around structures or non-crop areas; and 3) for controlling blackbirds, starlings, crows, and magpies in non-crop areas associated with roosts (i.e., staging-area baiting).

The DWRC has also been conducting a study of raven/crow depredations on eggs of nesting California least terns at Camp Pendleton, California. Fiscal year 1991 is the third year of a 3-year contract to study the ecology of tern/raven interactions and to develop a method to control depredating ravens. Studies conducted to determine the potential hazards to nontarget animals exposed to egg baits used to deliver DRC-1339 to ravens showed minimal nontarget species visitation of platforms containing untreated eggs. Current studies focus on determining the feasibility of using aversive

conditioning to deter ravens from eating tern eggs.

CPT Toxicity to Starlings

Two studies identified 6 blood components for use in predicting avian mortality from the avicide CPT, which is closely related to DRC-1339. Each study involved 30 starlings and 3 CPT oral dosage levels or 3 whole body exposure levels of respirable CPT particles. A preliminary prediction model based on the blood components (amylase, cholesterol, heterophiles, glucose, lymphocytes, and triglycerides) was highly accurate in predicting mortality and might lead to improved methodology for assessing the efficacy of CPT roost sprays after treatment, or perhaps mortality following DRC-1339 baiting.

In addition, the feasibility of aerosolizing a CPT spray formulation into minute respirable particles (< 10 microns) was demonstrated. Aerosolized CPT caused 100% mortality in starlings exposed in the laboratory at a concentration of 19 ppm. The results demonstrated that starlings are vulnerable to minute particles of CPT.

Zinc Phosphide Registration

Development of a validated analytical method for estimation of zinc phosphide in a steam-crimped oats bait and in whole-carcass preparations of meadow voles (*Microtus pennsylvanicus*) has been ongoing for over 6 months. Concurrently, a protocol titled "Residues of zinc phosphide and phosphine in meadow voles following lethal ingestion of a 2% zinc phosphide steam-crimped-oats bait" was prepared and sent to EPA for review. This protocol and the associated methodology is the final step in filling the data gaps identified by EPA in

1982. DWRC is conducting this study to support technical zinc phosphide registrations.

In February 1991, EPA issued a new Data Call-in for zinc phosphide, requiring 34 new studies over the next 4 years at a cost of over \$3 million. DWRC is working with all zinc phosphide registrants to determine reregistration strategy and to form a consortium to support data gathering.

Gas Cartridge

APHIS is in the process of converting the "old" five-active-ingredient gas cartridge for rodents to a "new" cartridge containing 2 active ingredients to reduce reregistration costs. New cartridge formulations were prepared by the Pocatello Supply Depot with DWRC assistance. Cartridge burn tests were required by EPA for the "new" cartridges; the tests have been completed and meet the EPA safety requirement of a 30 sec delay between the time from ignition of contents to the appearance of flame on the side of the cartridge.

Two field studies also were conducted with the "new" cartridge to determine if it would be effective against yellowbelly marmots (*Marmota flaviventris*) and woodchucks (*Marmota monax*). Results indicated acceptable efficacy of 80% for the yellowbelly marmot and about 70% for the woodchuck. A draft final report was prepared entitled "Gas Cartridge Effectiveness for Controlling Yellowbelly Marmots."

CONCLUSION

These are a portion of the studies currently under way or recently completed at the DWRC. If you have questions or would like to learn more about our work, please

contact the Center or schedule a meeting with the appropriate scientists or research managers in Denver, Colorado or at DWRC field stations. Copies of the DWRC

Publications List and reprints of publications by DWRC scientists may be requested from the DWRC Library (telephone: (303) 236-7873).

