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RECENT APPROACHES TO CONTROLLING MOUNTAIN BEAVERS (Aplodontia rufa) IN PACIFIC NORTHWEST FORESTS

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ABSTRACT: Biologists of the Denver Wildlife Research Center are currently investigating ways of managing mountain beaver (Aplodontia rufa) populations and are developing methods for alleviating mountain beaver damage to conifer trees being grown for timber in the Pacific Northwest. Studies initiated in 1986 indicated that aversive conditioning with Big Game Repellent Powder (BGR-P) dusted on cull Douglas-fir (Pseudotsuga menziesii) seedlings placed in burrows significantly reduced mountain beaver damage to planted seedlings treated with BGR-P and to untreated seedlings. Trials also showed that strychnine-sword fern (Polystichum munitum) baits prepared with a 4.9% (active) strychnine paste concentrate (SLN Reg. No. ID-870003) are very effective and selective for mountain beaver control. Other subjects discussed include results of several probes with toxic baits and phosphine gas, trials with a drug and a wetting agent to induce hypothermia, destruction of underground nests to prevent reinvasion, and mountain beaver behavior associated with controlling damage.

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INTRODUCTION

This paper presents an overview of mountain beaver (Aplodontia rufa) reforestation problems in the Pacific Northwest, some of the approaches that have been tried, and approaches now being tried to control damage that mountain beavers cause to regenerating conifers. Much of this information stems from research conducted by biologists of the Denver Wildlife Research Center stationed in Olympia, Washington, in cooperation with the Washington State Department of Natural Resources, the Oregon State Board of Forestry, the Weyerhaeuser Company, and others of the forest industry.

Some behavior patterns and traits of mountain beavers that are being exploited for control purposes are discussed; more detailed information on these subjects as well as the biology of mountain beavers can be found elsewhere (Godin 1964, Martin 1971, Borrecco and Anderson 1980, Feldhamer and Rochelle 1982, Evans 1984). Information on mountain beaver damage to forests in the Pacific Northwest can also be found elsewhere (Canutt 1969, Dimock and Black 1969, Black et al. 1979, Borrecco and Anderson 1980, Feldhamer and Rochelle 1982).

THE PROBLEM

Damage by mountain beavers is a major factor limiting successful regeneration of conifers in coastal Washington and Oregon and parts of California and British Columbia (Borrecco and Anderson 1980). Mountain beavers start cutting and destroying conifers shortly after seedlings are planted and continue to injure and destroy trees until trees are 15 to 20 years old. Newly planted seedlings are particularly vulnerable to severe damage (Borrecco and Anderson 1980) as are precommercially thinned stands of trees that are about 12 to 15 years old (Hoyer et al. 1979).

Currently, more than 300,000 acres (about 121,500 ha) of highly productive forest land in the Douglas-fir (Pseudotsuga menziesii) region of the Pacific Northwest are being adversely affected by mountain beavers and this figure is expected to increase (Evans 1987). Estimated loss is in the millions of dollars (Evans 1987) and constitutes a national economic problem.

The damage problem is compounded by escalating costs to reforest lands and manage trees for timber, by state laws and mandates to establish forest plantations in a very short time frame, and by a lack of cost effective ways to control mountain beaver populations and mountain beaver damage.

MOUNTAIN BEAVER CONTROL METHODS - PAST AND PRESENT

In the past, forest managers had a number of available tools to cope with mountain beaver damage to forest crops. Leg-hold traps, Conibear traps, and live traps were used to a limited degree to remove nuisance mountain beavers from small areas (Godin 1964), strychnine on apple or native vegetation was registered and widely used (Nelson 1969), and a toxic tracking foam with OMPA (Octamethylpyrophosphoramide) was registered for experimental use by Weyerhaeuser Company in Washington (Martin 1969, Oita 1969, Evans 1974).

Today, kill trapping with Conibear No. 110 traps (Borrecco and Anderson 1980) and protecting planted stock with plastic seedling protectors (Campbell and Evans 1975, Larsen et al. 1979) are available but are used sparingly because of high costs. A pelleted strychnine bait is also available but registered for use only in western Oregon. All other registered pesticides have been suspended and the pelleted strychnine bait is subject to EPA efficacy Data Call-In requirements for continued registration (Evans 1987).

There is obviously a critical need to develop new and better methods and materials to control mountain beaver forest-damage problems in the Pacific Northwest.

RECENT INVESTIGATIONS INTO CONTROLLING MOUNTAIN BEAVER DAMAGE

Conventional Control Methods

Mechanical barriers.--Vexar-type plastic mesh seedling protectors (Campbell and Evans 1975) and other similar protectors (Larsen et al. 1979) continue to be effective against destruction of conifer seedlings by mountain beavers (Borrecco 1976, Hartwell and Calkins 1978, Campbell and Evans 1984). A split plastic mesh tube (Campbell and Evans 1987) also has potential against mountain beavers. Pending additional funding, studies will be conducted on ways to reduce costs of using these protectors as well as to minimize occasional damage to stems growing out the top of the protectors.

Trapping and snaring.--Judicious trapping and removal programs can effectively control limited populations of mountain beavers, particularly in small wooded or clearcut areas that are relatively void of dense vegetation and/or logging debris (Godin 1964, Hooven 1977, Borrecco and Anderson 1980).

Live traps best suited for removing a few mountain beavers from small tree farms, nurseries, or Christmas tree lots include the 6- by 6- by 24-inch (15- by 15- by 61-cm), double-door, Tomahawk or National live trap baited with apple and set in active burrow entrances or tunnels. The main kill traps used are Conibear No. 110 traps or similar quick-kill traps set without bait and anchored to the ground in main runways and at burrow openings (Motobu et al. 1977). The popularity of kill trapping to reduce mountain beaver damage has declined due to high cost, lack of proven effectiveness in many large problem areas, kills of nontarget animals, and public adversity to trapping.

Field probes on the efficacy of snares for mountain beaver control were conducted in 1987 and 1988 using modified commercial or homemade snares hung in burrow openings and runways. We could find no previous information regarding snares for mountain beavers. Based on our limited pen and field trials, snaring can be developed to be effective and selective and may be less costly than trapping. Snaring, however, may also have public opposition.

Fumigation.--Several pen and field trials with gas cartridges, including those registered for coyote dens (Reg. No. 56228-21), were unsuccessful on radioed mountain beavers. The animals somehow managed to avoid the gas even when cartridges were placed in burrows near mountain beaver nests and the smoke was blown toward the nest system. (See Induced dissemination of control substances.-- for more information.)

Bait carriers and placement.--Screening of bait carriers by us and cooperators have shown that apples, cantaloupe, strawberries, and natural vegetation such as sword fern (*Polystichum munitum*) and salal (*Gaultheria shallon*) leaves and berries were well accepted by mountain beavers and could serve as bait carriers; all were preferred over Douglas-fir seedlings. Peanut butter is so poorly accepted that it almost has repellent potential (Decker 1978). Waxed baits, pelleted baits with plant fiber and fruit attractants, commercial rabbit pellets and lab chow, as well as dried fruits and vegetables are generally poorly accepted by mountain beavers. Some pelletized baits with dried apple are acceptable but are also taken by other animals. A specially pelleted feed for maintaining mountain beavers in captivity and in live traps (on file, Olympia, Washington APHIS-ADC Field Station) has potential as a packaged bait but probably lacks selectivity for mountain beavers. The only carriers with selectivity for mountain beavers appears to be sword fern fronds and cut stems of red alder (*Alnus rubra*); these have been evaluated in our rodenticide screening program.

Proper bait placement is inside burrows, preferably in active main runways out of reach of most other mammals. Although not tested by us, Nelson (1969) states that "dump" exits should not be baited because the bait will be pushed out or buried with other waste materials.

Toxic baits.--Several toxicants were tested as candidate control materials on caged, penned, and free-roaming radioed mountain beavers. Candidacy was based on prior use on mountain beavers and/or high potential for registration at time of testing. Materials included strychnine alkaloid, zinc phosphide, Vacor[R] (RH-787; DRC-6091; N-3-pyridylmethyl N'-p-nitrophenyl urea), and DRC-4575 (TAR-1688; benzenesulfonic acid hydrazide) as well as diphacinone bait blocks registered for pocket gophers (*Thomomys* sp.) and rats (*Rattus* sp.) (J. T. Eaton and Co., Twinsburg, Ohio), and bromadiolone (Chempar Products, New York, NY). Of these, only strychnine appears worthy of continued development toward registration for mountain beaver control. Further work with zinc phosphide baits has been postponed because of erratic field kills of radioed mountain beavers, usually because of bait avoidance following sublethal intakes of bait, high potential hazard to penned black-tailed deer (*Odocoileus hemionus columbianus*) (Campbell et al. 1981a), and high selectivity by deer in preference tests similar to those conducted by Campbell and Bullard (1972). Although Vacor was the most suitable of all acute toxicants tested (Campbell et al. 1981a), it was taken off the market and became unavailable as a rodenticide for mountain beaver control. DRC-4575 indicated good potential for control of mountain beavers (Lindsey et al. 1984) and other rodents (Matschke and Fagerstone 1977) but its current registration potential is questionable (personal communications, G. Matschke, Denver Wildlife Research Center). Bait blocks with 0.0052% diphacinone and manufactured baits with 0.005% bromadiolone were ineffective on penned mountain beavers and had potential of producing unacceptable primary and secondary hazards (Mendenhall and Pank 1980, Carey 1988).

We are continuing to look at strychnine alkaloid as a prime candidate for mountain beaver control. Previous tests (Campbell et al. 1981a) using fresh apple prebait showed good results on radioed mountain beavers with fresh apple baits formulated with strychnine alkaloid powder (Reg. No.

56228-16). Current tests, however, indicate greater selectivity and efficiency with sword fern baits prepared with a 4.9% strychnine alkaloid paste concentrate (SLN Reg. ID-870003), good kills with strychnine paste treated red alder sticks, and good follow-up baiting with strychnine paste apple baits. Primary and secondary hazard trials with strychnine baits also look favorable to support registration. We are also conducting a field probe on radioed animals with an Oregon-registered pelleted strychnine bait for mountain beaver (SLN Reg. No. OR-840029); results will be available by mid-1988.

Innovative Control Approaches

Tracking powder/contact poisons.--As previously noted, toxic foam containing OMPA appeared to be an effective contact poison and/or tracking compound killing over 90% of the radioed mountain beavers tested (Martin 1969). OMPA was also the most toxic organophosphate screened on mountain beavers (Oita 1969). We suspect that most kills resulted from dermal toxicity and/or ingestion of OMPA from stored food contaminated by treated mountain beaver rather than by ingestion of OMPA through grooming activities. Again, OMPA was not registered for mountain beaver control partly because of systemic activity in growing plants and possible hazards to nontarget animals associated with this systemic activity.

Earlier trials with dyes and tracers indicated that jells, grease, or tacky compounds gave inconsistent results as carriers for tracking powders or contact poisons formulated with conventional rodenticides (Martin 1969). In recent tests, we found that a 10% active zinc phosphide tracking powder (Reg. No. 12455-16AA) placed in burrow entrances resulted in only a 33% kill of penned mountain beavers. We also field tested zinc phosphide on perforated plastic lettuce wrap to capitalize on the mountain beavers habit of dragging sword fern to their nest and handling and discarding unwanted materials (see Induced dissemination of control substances.--). In these tests, we tied lettuce wrap treated with 63% zinc phosphide concentrate (Reg. No. 56228-9) to small bundles of sword fern and let radioed animals drag the bundles to their nest. Small pencil-type radios tied to the bundles helped relocate the fronds and lettuce wrap. Tracers were used to verify ingestion and contamination.

Recoveries of test materials and animals indicated some nest contamination, considerable contamination of the fur, considerable handling and rehandling of treated lettuce wrap by mountain beavers, but no kills of radioed animals. Wraps were found packed in underground fecal chambers or with discarded materials. Internal examination of animals for dye/tracers indicated little to no ingestion of zinc phosphide.

Although the results of our tests with zinc phosphide were poor, we believe that the lettuce-wrap drag-in approach and the toxic foam approach have control potential IF a suitable toxic compound with minimal nontarget hazards can be developed for mountain beavers.

Aversive conditioning with Big Game Repellent Powder (BGR-P).--Tests with zinc phosphide baits (reported earlier) and phosphine gas (see Induced dissemination of control substances.--) strongly indicated that mountain beavers rapidly learn to avoid distasteful or obnoxious materials or substances. Pen tests with Mesurol (3,5-dimethyl-4-[methylthio]phenol methylcarbamate) as a candidate repellent and Big Game Repellent Powder (BGR-P; Reg. No. 1021-1420) as a cuing agent supported these findings and paved the way for development of BGR-P as a mountain beaver repellent (Campbell et al. 1987). Although Mesurol was ineffective as a repellent, a series of pen and field tests showed that treating cull Douglas-fir seedlings with BGR-P and placing them inside mountain beaver burrows at the time of planting caused conditioning and avoidance by mountain beavers. In field trials, conditioned mountain beavers avoided nearly all BGR-P treated planted seedlings as well as untreated Douglas-fir seedlings planted alongside them for nearly a year. In operational tests, nearly all mountain beavers were conditioned to avoid BGR-P treated seedlings, and to a lesser extent untreated seedlings after being presented cull treated trees in burrows; overall damage to treated trees during the first year was 21% and most of that damage occurred in one test plot. Damage in control plots (usually causing tree mortality) was 53%. With these data, the registrant of BGR-P (McLaughlin Gormley King Co., Minneapolis, MN) has recently applied for Special Local Needs registration of BGR-P for use against mountain beavers in Washington and Oregon.

Induced hypothermia.--Pen and field studies on mountain beavers in the early 1980's (Campbell et al. 1981b, 1983) showed that reserpine (DRC-4243; 3,4,5-trimethoxybenzoyl methyl reserpate)--a tranquilizer now used to treat hypertension in humans--produced hypothermia and death to mountain beavers that ingested low concentrations of the drug. Mountain beavers show no taste aversion to reserpine. The tranquilizer is partially selective for mountain beavers causing a drop in normal body temperature from 38°C (normal) to 22°C at death; this occurs within 24 to 48 hours at room temperature. Reserpine formulated in water-resistant pellet baits and on fresh apple baits tested favorably on radioed mountain beavers in Oregon and Washington. Pellets with at least 1.2 mg of reserpine per gram of bait (0.12% active) and fresh apple baits with 1.0 mg reserpine per bait generally caused 100% mortality. Douglas-fir baits with 1.1 mg reserpine per bait (0.03% active) caused 67% mortality. Chemical analysis of baits showed weathering losses of the active chemical. Tests of hazards to black-tailed deer showed low risk potential from consumption of pellet baits. Secondary hazard tests on female domestic mink (Mustela sp.), red-tailed hawks (Buteo jamaicensis), and great horned owls (Bubo virginianus) fed reserpine-killed mountain beavers and reserpine-injected deer mice (Peromyscus maniculatus) showed low hazard potential. Mink became slightly tranquil but gained weight. Further development of reserpine is being investigated.

Contrary to the response to ingested reserpine, recent trials--winter 1987-1988 --with the bird surfactant PA-14 (Reg. No. 56228-13) failed to induce hypothermia in mountain beavers even at freezing temperatures. Penned animals were soaked with 20% active PA-14 and periodically rewetted. Animals did not show a hypothermic response to the treatment.

Induced dissemination of control substances.--Numerous trials have shown that mountain beavers can be induced to carry and/or drag miniature radios, bait substances, and many kinds of foreign materials to their underground nest--the focal point of their existence. We used this behavior to attempt to improve the effectiveness of phosphine gas.

Screening tests with aluminum phosphide pellets (Reg. No. 2548-70) and tablets (Reg. No. 2548-69) resulted in 100% mortality of mountain beavers held below ground in individual cages. However, unrestrained mountain beavers were not visibly affected by phosphine gas in pen tests with applications of up to 20 pellets or 10 tablets per burrow location. Results indicated that the phosphine was not flowing into the nest chamber; in some instances, burrows were plugged by the animal.

Two ways of inducing mountain beavers to "carry" phosphine pellets to their nest were tried in pen tests. Both methods kept pellets sealed in perforated bags which were held in waterproof plastic containers; the bags were dragged from the container by mountain beavers in two ways. One method involved attaching the perforated bags of pellets to sword fern fronds and letting the animal voluntarily drag the pellets to the nest or wherever it traveled. The other method involved tying the perforated bags of pellets to snares; this forced snared mountain beavers to drag the pellets wherever they went. Initial results in both approaches were not too promising. Poor kills (33% of test animals) occurred in a sword fern pen test; the remaining animals avoided sword fern packages because of early sporadic release of phosphine. Although 100% of the snared mountain beavers died from phosphine poisoning in pen tests, no kills occurred in field tests. We don't know how phosphine was avoided in field tests. We believe that snaring will require further development for improved efficiency and selectivity. We also believe that the sword-fern drag-in approach has great potential if preignition release of phosphine from all pellets can be arrested and if ignition can be made to be uniform.

Nest and burrow destruction.--Observations of scarified ground without slash piles suggest that reinvasion potential can be reduced if burrows and/or nests of mountain beavers are destroyed. Preliminary studies also suggested that mountain beavers would abandon their burrow system if their nest was destroyed. To test these assumptions, mountain beaver nests were located with telemetry in timber and in an adjacent plantation that had been reoccupied after kill trapping. Treatments included removal of nests only, removal of animals only, removal of both nests and animals, and undisturbed controls. Ammonium nitrate-diesel explosives poured into holes drilled into nest cavities were used to blow up some nests. Other nests were hand dug and removed.

Results were not too promising. Most displaced animals converted their own food caches into nests after nest destruction or took over nearby abandoned nests and burrows of other mountain beavers (Campbell et al. 1988).

DISCUSSION AND CONCLUSIONS

Keys to developing effective and selective methods and materials for controlling mountain beaver populations and damage seem to center on the animal's (1) ability to learn to avoid certain materials, (2) use of specific native plants such as sword fern for food and nesting, (3) great dependency on its nest and burrow system, (4) food gathering and caching behavior, (5) inclination to keep a "clean house", (6) sensitivity to cold, and (7) susceptibility to being duped at least once by man. At this time, grooming habits (i.e., licking) and reproductive traits (i.e., synchronized breeding) do not appear to be exploitable characteristics until more research can reveal definite tie-ins for control purposes. Use of pathogens also appears to have low potential as an easy solution to mountain beaver problems despite availability of host-specific vectors such as fleas. Rather, further research should be directed at (1) registering strychnine and reserpine for mountain beaver control, (2) developing a cost-effective snaring and/or kill-trapping program, (3) developing non-lethal conditioning and avoidance repellents, (4) improving mechanical barriers, (5) developing a better understanding of mountain beaver damage/habitat/silviculture relationships, and (6) gaining a better understanding of environmental behavior in mountain beaver populations.

LITERATURE CITED

BLACK, H. C., E. J. DIMOCK, J. EVANS, and J. A. ROCHELLE. 1979. Animal damage to coniferous plantations in Oregon and Washington. Part 1: A survey, 1963-1975. Oregon State Univ., Forest Research Lab., Corvallis. Res. Bull 25. 44 pp.

BORRECCO, J. E. 1976. Vexar tubing as a means to protect seedlings from wildlife damage. Weyerhaeuser Forestry Res. Tech. Rep. 4101/76/36. 18 pp.

________, and R. J. ANDERSON. 1980. Mountain beaver problems in the forests of California, Oregon, and Washington. Pages 135-142 In: Proc. Ninth Vertebrate Pest Conf., Fresno, California.

CAMPBELL, D. L. and R. W. BULLARD. 1972. A preference testing system for evaluating repellents for black-tailed deer. Pages 36-63 In: Proc. Fifth Vertebrate Pest Conf., Fresno, California.

________, and J. EVANS. 1975. "Vexar" seedling protectors to reduce wildlife damage to Douglas-fir. U.S. Fish and Wildlife Service, Wildlife Leaflet No. 508. 11 pp.

________, G. D. LINDSEY, J. EVANS, S. R. OLMSTEAD, and L. E. JOHNSON. 1981a. Evaluation of zinc phosphide, strychnine alkaloid, and RH 787 (Vacor[R]) rodenticides for controlling mountain beavers in forest clearcuts. U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Job Completion Report, Olympia, WA. 17 pp.

________, ________, ________, ________, and ________.

1981b. Evaluation of reserpine to control mountain beaver (Aplodontia rufa). U.S. Fish and Wildlife Service, Job Completion Report, Olympia, Washington. 18 pp.

________, ________, and J. EVANS. 1983. Evaluation of reserpine baits for control of mountain beavers (Aplodontia rufa) in western Oregon and Washington Douglas-fir plantations: 1982 and 1983. U.S. Fish and Wildlife Service, Job Completion Report, Olympia, Washington. 26 pp.

________ and J. EVANS. 1984. Wildlife-reforestation problems and seedling protection in western Oregon: review and current knowledge. USDI, Bureau of Land Manage., Tech. Note OR-4. 46 pp.

________ and ________. 1987. Evaluation of seedling protection materials. Final Report, Wildlife Services Co., Olympia, Washington. 35 pp.

________, J. EVANS, and R. M. ENGEMAN. 1987. Evaluation of BGR-P repellent to protect Douglas-fir seedlings from damage by mountain beavers. USDA, APHIS, Denver Wildlife Research Center, Special Report, Olympia, Washington. 6 pp.

________, J. D. OCHELTREE, and M. G. CAREY. 1988. Adaptation of mountain beavers (Aplodontia rufa) to removal of underground nests. Northwest Scientific Assoc. (In Press).

CANUTT, P. R. 1969. Relative damage by small mammals to reforestation in Washington and Oregon. Pages 55-59 In: Proc. Symp. on Wildlife and Reforestation in the Pacific Northwest. Oregon State Univ., Corvallis.

CAREY, M. G. 1988. Reduction of a small wild mammal population exposed to anticoagulant baits. Northwest Scientific Assoc. (In Press).

DECKER, D. 1978. Foods as potential bait substrates for mountain beaver toxicants. Weyerhaeuser Forestry Research Tech. Rep. No. 042-4101/78/41, June 1978. Western Forestry Res. Center, Centralia, Washington. 13 pp.

DIMOCK, E. J. II and H. C. BLACK. 1969. Scope and economic aspects of animal damage in California, Oregon and Washington. Pages 10-14 In: Proc. Symp. on Wildlife and Reforestation in the Pacific Northwest. Ore egon State Univ., Corvallis.

EVANS, J. 1974. Pesticides and forest wildlife in the Pacific Northwest. Pages 205-219 In: Proc. Symp. on Wildlife and Forest Management in the Pacific Northwest, Forest Research Lab., Oregon State Univ., Corvallis.

________. 1984. Mountain beaver. Pages 610-611 In: The Encyclopedia of Mammals, D. Macdonald (ed.), Facts on File Publications, New York, New York.

________. 1987. Mountain beaver damage and management. Pages 73-74 In: Proc. Symp. Animal Damage Management in Pacific Northwest Forests, Spokane, Washington.

FELDHAMER, G. A. and J. A. ROCHELLE. 1982. Mountain beaver. Pages 167-175 In: Wild Mammals of North America: Biology, Management, and Economics, J. A. Chapman and G. A. Feldhamer (eds.), John Hopkins Univ. Press, Baltimore, Maryland.

GODIN, A. J. 1964. A review of the literature on the mountain beaver. USDI, Fish and Wildlife Serv., Washington, D.C. Spec. Sci. Rep. Wildl. No. 78. 52 pp.

HARTWELL, H. D. and J. S. CALKINS. 1978. Field evaluation of standard Vexar tubes for protecting Douglas-fir seedlings from mountain beaver damage, North Creek Plantation. Res. Prog. Rep. Study No. 14, State of Washington, Dept. Natural Resources. 6 pp.

HOOVEN, E. F. 1977. The mountain beaver in Oregon: its life history and control. Res. Paper 30. Oregon State Univ., Forest Research Lab., Corvallis. 20 pp.

HOYER, G. E., N. ANDERSON, and R. RILEY. 1979. A case study of six years of mountain beaver damage on the Clallam Bay western hemlock plots. DNR Note No. 28. State of Washington, Dept. Natural Resources, Olympia. 5 pp.

LARSEN, J. E., D. L. CAMPBELL, J. EVANS, and G. D. LINDSEY. 1979. Plastic tubes for protecting seedlings from browsing wildlife. ED&T 2217, U.S. Forest Service, Missoula Equip. Develop. Center, Montana. 19 pp.

LINDSEY, G. D., D. L. CAMPBELL, J. EVANS, and S. R. OLMSTEAD. 1984. Toxicity of DRC-4575 to mountain beavers (Aplodontia rufa). U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Job Completion Report., Olympia, Washington. 4 pp.

MARTIN, P. 1969. Development and use of toxic foam to control mountain beavers. Part I. Field evaluation of lethal agents by radio-tracking. Pages 82-83 In: Proc. Symp. on Wildlife and Reforestation in the Pacific Northwest, Oregon State Univ., Corvallis.

________. 1971. Movements and activities of the mountain beaver (Aplodontia rufa). J. Mammal. 52(4):717-723.

MATSCHKE, G. M. and K. A. FAGERSTONE. 1977. Effects of a new rodenticide, benzenesulfonic acid hydrazide, on prenatal mice. J. Toxicol. Environ. Health 3:407-411.

MENDENHALL, V. M. and L. F. PANK. 1980. Secondary poisoning of owls by anticoagulant rodenticides. The Wildl. Soc. Bull. 8(4):311-315.

MOTOBU, D., J. TODD, and M. JONES. 1977. Trapping guidelines for mountain beaver. Weyerhaeuser Forestry Res. Rep. 042-4101/77/20. 28 pp.

NELSON, W. E. 1969. Operation of animal-control practices. Pages 75-76 In: Proc. Symp. on Wildlife and Reforestation in the Pacific Northwest, Oregon State Univ., Corvallis.

OITA, K. 1969. Development of toxic foam to control mountain beavers. Part II. A tracking compound of toxic foam. Pages 84-85 In: Proc. Symp. on Wildlife and Reforestation in the Pacific Northwest, Oregon State Univ., Corvallis.