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Ronald A. Thompson
U.S. Fish and Wildlife Service, Sacramento, California

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THE COST OF PREDATOR DAMAGE CONTROL USING TRAPPING AS THE PRIMARY CONTROL TECHNIQUE

RONALD A. THOMPSON, State Supervisor, U.S. Fish and Wildlife Service, Sacramento, California 95814

ABSTRACT: The justification and economics of the operational animal damage control program in California as conducted by the U.S. Fish and Wildlife Service are discussed. Emphasis is given to the necessity for use of the steel trap. Nearly 83 percent of the depredators are taken by trapping. Annual agricultural losses due to predation were estimated at $4.7 million in California for Fiscal Year 1975. The projected cost-benefit ratio was 1:3.9.

INTRODUCTION

With the possible exceptions of marine mammals and wild horses, there is probably no other issue in the field of animal control today that is more controversial than predator control. These resource management problems have many similarities, but the most common emotional issues rise from the basic fact that animals oftentimes must be captured or killed in order to accomplish natural and economic resource objectives. Contrary to popular belief, but basic to understanding the complex nature of all animal damage abatement activities, is the simple but ultimate realization that the human race does not occupy a natural ecosystem, but one that must be continuously managed (Wade, 1974).

Although predator damage control is but one facet of the science of vertebrate pest management, it is probably discussed more often with less objectivity because of the emotions involved. Also, the general public has been given considerable misinformation about this control activity (Balser, 1974). Biological, aesthetic and economic considerations are paramount to effective programing of predator damage abatement activities. These and other aspects of predator control programs must be discussed before a cost-analysis of one program can be accomplished. The cooperative predator control program in California conducted by the U.S. Fish and Wildlife Service will be used as an ongoing example or model for evaluation purposes.

ECOLOGICAL CONSIDERATIONS RELATIVE TO PREDATOR CONTROL

Predator control, a form of wildlife management, cannot be conducted entirely on the basis of ecological principal and theory, nor solely on the demands exerted by the extremes of special interest groups, both for and against such actions. The decisions that determine the need to control depredations must be based on a combination of economic, aesthetic, social and ecological factors. The majority of these predator-related problems, whether urban or agricultural, occur in ecosystems that have been altered by the activities of man in his own struggle for existence.

In reference to predator-prey relationships, it has been demonstrated numerous times that native predators generally do not control native prey species numbers, in fact, the reverse is closer to the truth. (Nellis, etc., 1972.) (Elton and Nicholson, 1942.) (Clark, 1972.) (Errington, 1956, 1946, 1967a.) (Robinson and Harris, 1960.) (Howard, 1974.)

The modified environment that we occupy has created habitat conditions that are many times conducive to significant increases in species that now compete directly with man for existing food and fiber. A case in point is the coyote (*Canis latrans*), historically a great plains species, which now occupies a vast: majority of the North American Continent. (Howard, 1974.) Regardless of the quality and quantity of existing habitat, coyotes, as with other species, cannot increase without limit. Those limits appear to have a density threshold where ill-defined regulating mechanisms seem to control the upper limits of their populations. (Howard, 1974.)

On the other hand, coyote populations cannot easily be reduced for extensive periods of time. Connolly and Longhurst (1975) hypothesized on their model of a simulated coyote population that the primary effect of killing coyotes to reduce the density of the population stimulated density-dependent changes in birth and natural mortality rates. They further stated that if 75% of the coyotes are killed each year, the population can be exterminated in slightly over 50 years. However, they point out that governmental control agencies operate on a damage control basis, which has little effect on total coyote

populations. From the standpoint of management, program objectives must identify the problem and an effective analysis of the ecological, economic, aesthetic and social factors will provide a sound basis for control decisions and will dictate which proven control techniques will be available for use.

HISTORICAL ASPECTS OF PREDATOR CONTROL AND THE DEVELOPMENT OF TRAPPING

Predator problems and trapping are probably as old as man himself (Bateman 1973.) Paleolithic man left records through his cliff paintings of pit-traps, dating back more than 25,000 years, demonstrating their efforts to capture wild animals to secure the necessities of life.

In North America the American Indian was considered to be a master trapper and was an expert at taking animals for food and clothing. The control of predator damage became a necessity to colonial and frontier farmers and ranchers who lost livestock and poultry to wolves, coyotes and other animals. The coyote became by far the most persistent predator in the Western United States and the steel trap was used extensively for their control. Sewell Newhouse first began making steel or leg-hold traps in Oneida County, New York in 1820 (Bateman, 1973) and steel traps were first used in California by the Federal Government in 1915 for controlling a rabies epizootic - primarily in coyotes.

Basically traps can be divided into two major classes, those that restrain such as the steel trap, cage trap, etc., and those that kill, such as conibears, deadfalls, etc.

Steel Trap

The steel or leg-hold trap is the most versatile of all traps, since it can be used to capture most species of mammals from the size of a gopher to that of a bear in nearly all types of terrain. It also has advantages over other types of traps in that it can be easily concealed beneath the soil, leaves, or duff, and its selectivity in capturing target mammals, without serious injury, can be significantly improved through proper use and professional placement.

Although some traps are manufactured with teeth or spikes on the jaws, the U.S. Fish and Wildlife Service does not operationally utilize such traps and steel traps are not used in taking mountain lions (Felis concolor), or black bears (Ursus americanus) in California. The standard steel trap used by the U.S. Fish and Wildlife Service for controlling depredating carnivores, especially coyotes and bobcats (Lynx refus) is the size 3-N Oneida-Victor double spring steel trap equipped with smooth-offset-mallable jaws, which allows enough pressure to hold an animal and yet reduces the possibility of lacerations or other injury. (Cost $5-$7 each.) This trap is the most humane steel trap available and has been used by the Service since 1939. No trap or device has yet been developed that will fully replace this device under operational conditions. Additionally, a mechanical tension device was developed in California and is now used to reduce the possibility of capturing smaller predatory animals and non-target animals. Tranquilizer tabs attached to steel traps have also been studied under laboratory and field conditions for many years. (Balser, 1965) This technique, using the drugs "diazepam" and "tran-vet" have proven to be effective in reducing the activity and anxiety of trapped animals, thereby making the steel trap more humane. Operational implementation of the tranquilizer tab technique is expected in the foreseeable future. Studies with neoprene and weather stripping wrapped and/or coated trap jaws are still being conducted; however, the foreign odors associated with the wrapping and coating appear to somewhat deter or repel target carnivores.

Cage Traps

Although cage traps are used effectively to capture various fur-bearing carnivores, such as the raccoon (Procyon lotor), skunk (Mephitis mephitis) and gray fox (Urocyon cinereoargenteus), they are mostly ineffective for capturing the larger fur-bearing carnivores such as coyotes and bobcats. This is primarily due to the fact that cage traps are difficult, if not impossible, to conceal. Cage traps have an advantage over other traps in that they are designed to capture an animal alive and unharmed. They also allow for the release of non-target animals and are reasonably safe to use in the presence of human activity, however, they are expensive (Cost - $ 14-$20 each).

Conibear Trap

The action of another type of trap, the conibear, when properly used, quickly kills

the entrapped animal. When considering the degree of humaneness, this trap has an advantage over the steel trap, however, it does not provide the selectivity of the steel trap because non-target or protected animals cannot be released alive. Also, the larger sized conibear, when improperly used, can present a hazard to humans. Also the number of species on which the conibear is effectively used is limited mostly to the water-associated or small fur-bearing animals, primarily mink (Mustela vison), muskrat (Ondatra zibethica), beaver (Castor canadensis), otter (Lutra canadensis), and weasel (Mustela spp) (Cost $5-$8 each).

In addition to these three major traps, there are other traps and snares designed specifically for use in capturing wild animals.

U.S. FISH AND WILDLIFE SERVICE ANIMAL DAMAGE CONTROL PROGRAM

The U.S. Department of the Interior, through the Fish and Wildlife Service, conducts a program of animal damage control that is national in scope and involves both public and private lands. The program is carried out pursuant to the Act of March 2, 1931 (7 U.S.C. 426-426b), as amended, which deals specifically with animal damage control, and states in part:

> "The Secretary....is authorized and directed to conduct such investigations, experiments, and tests as he may deem necessary....on public domain, State,....privately owned lands....of....animals injurious to agriculture.... forestry....wild game animals,....and for the protection of stock...., and to conduct.... control ....of such animals....and may cooperate with States, individuals and public and private agencies, organizations, and institutions."

Damage caused by wildlife is one of a series of environmental factors that reduce agricultural, forest, and range yield. In certain instances, wildlife can threaten human health and safety, damage urban and industrial facilities, and jeopardize certain other wildlife populations. Corrective action is taken, when necessary, on the basis of the specific merits of each conflicting situation as it develops. The following are the four major objectives of the animal damage control program: (a) protection of crops and livestock; (b) protection of human health and safety; (c) protection of urban and industrial facilities; and (d) protection of forest, range, and wildlife resources.

For purposes of this presentation, the supportive data under the objectives of (1) protection of crops and livestock, (2) protection of human health and safety, and (3) protection of urban and industrial facilities will be emphasized as to depredations and other problems.

(1) Protection of Crops and Livestock:

Predation on livestock is a serious problem in many areas of the United States and factual accounts of livestock predation have been well documented. (Young and Jackson, 1951.) (Young and Goldman, 1944.) (Young, 1958.) (Sperry, 1941.) (Rosko, 1948.) (Murie, 1948.) (Errington, 1967.) (Heugly, 1969.)

Information is available on the extent of economic losses over a multi-state area as provided in a survey conducted by the United States Department of Agriculture, in cooperation with the State Departments of Agriculture. Extrapolation of the data by the U.S. Fish and Wildlife Service indicated that the 1970 predation loss to the sheep industry in the 16 Western States amounted to more than 800,000 sheep and lambs (24.6%-Balser, 1974), with a gross value of approximately $17 million. (Reynolds and Gustad, 1971.) Another survey was conducted by the U.S. Department of Agriculture - Economic Research Service in 1974 which indicated that 6% of docked lambs and 2.5% of the stock sheep, (1,890,000 head) in the 15 Western States were killed by coyotes according to the 9,000 producers surveyed (U.S.D.A. Survey, 1974).

An additional study by Nielsen and Curie (1970) in Utah indicated a direct annual predation loss of 48,035 head of sheep valued at $1,109,374 resulting in a total loss to the Utah economy of $3,538,846.

A survey reported by Sampson and Brohn (1955) indicated that Missouri averaged a loss of $125 per farm per year to predators prior to a control program and about $25 per farm each year after control.

Gier (1968) reported on two censuses of state-wide losses to coyotes and dogs in Kansas. In 1945, the reported loss was $1,423,675 and in 1949, the reported loss was $965,808. Gier calculated that in Kansas during 1967 about 12,000 calves were killed by coyotes and concluded that:

> "...Kansas coyotes may....be charged annually with some $500,000 of chickens, $400,000 of calves, $300,000 of lambs, and $150,000 worth of other poultry and livestock. In addition, there are special management costs made necessary to keep real losses from being higher. These costs include such items as extra guards for sheep, keeping sheep and poultry penned late in the mornings, special fencing, and even cost of trapping."

Data are available that indicate losses to predators are relatively low on Forest Service lands where control programs are practiced by the U.S. Fish and Wildlife Service under cooperative agreement with the U.S. Forest Service and local grazing interests. In 1970, sheep losses to predators on United States Forest Service lands were estimated at 1.77 percent and cattle losses were estimated at .055 percent. It should be pointed out that these losses occurred during a four-months summer period after the heaviest lambing and calving losses had already been experienced on private range prior to their being moved to summer ranges in the national forests. (Wagner, 1972.)

A potential bias may exist since the Forest Service counts only adult animals, therefore, a ewe with a lamb under six months of age is counted as one animal unit. (Balser, 1974.) It is therefore assumed that Forest Service predation loss reports are about half of the actual amount. (Balser, 1974.) Coyote depredations to watermelons and other crops occur, but the extent of the damage is not well documented.

(2) Protection of Human Health and Safety:

Rabies is a disease which may affect humans, their pets, and livestock. For instance, there were 4,427 laboratory confirmed cases of animal rabies in the United States during 1972, of which 3,462 or 78% were in wild species - 963 in domestic animals (530 in farm animals) and two humans (exposure in one case was in the Philippines). Among the wild species, a total of 2,095 skunks, 645 foxes, 162 raccoons, and 560 in other wildlife species were included as confirmed cases (United States Public Health Service, 1972). This does not account for all the livestock or wild animals that died from rabies, since many die and are not found or tested.

In the United States, between the period 1961 through 1971, the United States Public Health Service recorded 21 human deaths from rabies. Additionally, it is estimated that between 25,000 - 30,000 people are required to take treatment each year after exposure to this disease. Skunks and foxes are the most common vectors that transmit rabies to man, his pets, or livestock.

During the calendar year 1974, 50 counties in California were declared endemic to rabies, and a total of 358 rabies cases were reported. Of this total, 345 cases (96%) involved wildlife species and skunks represented 66% of the wildlife cases.

Wildlife rabies control activities are conducted only on request from Federal, State, County or local health officials.

(3) Protection of Urban and Industrial Facilities:

The protection of urban and industrial facilities is quite varied and is becoming a more extensive problem as our Nation's population increases and as housing developments are built in "rural-type" regions adjacent to large urban areas. These housing projects tend to displace some wildlife, yet many wild species successfully adjust to their new environment, and conflicts with man often develop. A statement by Howard (1962) reflects this urban-problem:

> "Judgment as to the propriety of controlling vertebrate pests is a relative matter. A homeowner usually will not tolerate the presence of a single rodent, snake, or other animal that he may consider a pest, whereas a farmer usually does not object to most of the same species, unless they become so numerous as to cause him economic loss."

Common examples of animals conflicting with man's urban and industrial facilities include: Skunks emitting odors under houses or causing direct depredations on flower and vegetable gardens; raccoons and skunks destroying turf on golf courses and cemeteries in pursuit of insect larvae, etc.

California Animal Damage Control Program

The U.S. Fish and Wildlife Service currently administers a program of wildlife resource management in financial and administrative cooperation with the California Departments of Food and Agriculture and Health and 34 contract counties (33 counties in F.Y. 1975). The primary program objectives are the protection of agriculture, fishery, urban, range, and forest resources from depredations caused by wild mammals and migratory birds, and the suppression of wildlife-borne diseases such as rabies.

The use of toxicants was never extensive in California for the control of predatory animals prior to their ban in 1972, because their use was opposed by many organizations and individuals, including county governments. Trapping has been and is still currently the primary control technique used in California. In Fiscal Year 1975 nearly 83% of all animals captured were taken by traps (cage, steel, and conibear). Other mechanical control techniques such as aerial and terrestrial shooting, snaring, dogs, and den hunting were utilized to capture the remaining 17%. (M- 44 devices accounted for only 15 coyotes - used under E.P.A. experimental use permit.)

The program is beneficial to a broad segment of the agricultural industry. Turkeys, chickens, goats, sheep and calves, are especially vulnerable to predation, but ducks, geese, rabbits, and other domestic animals, crops and residential facilities sustain damage caused by predatory animals such as coyotes, bobcats, raccoons, skunks, bears, mountain lions and other wild mammals. At times, migratory birds such as herons, mergansers, gulls, etc., cause extensive fish depredations at State, Federal and private hatcheries within the State and control assistance is provided. Rodent and lagomorph depredations on forest and range resources present a problem and technical control assistance is provided to Federal land administering agencies.

In California during 1974, the total cash receipts from the livestock and poultry commodities susceptible to predation was $1,771,843,000. This represents a sizeable segment of the State's agricultural production. A better cost-profit margin allows a rancher or farmer to produce and sell his products at a price that is beneficial to the consumers that purchase these products and the abatement of depredations caused by predatory mammals can benefit the consumer as well as the agriculturalist.

The 1974 production of livestock and poultry was $673,300,340 in the 33 contract counties, which represented 38% of the total production in the State.

A total predatory animal damage loss to agricultural production amounting to $4,732,721 was projected in the 33 contract counties during Fiscal Year 1975. This figure included the influence of agricultural depredations on the related industries of manufacturing, processing and transportation, using the following formula: A x B x C x D = X .

A is equivalent to actual depredation value
B is equivalent to reliability factor
C is equivalent to percentage of ranch land worked
D is equivalent to impact on manufacturing, processing and transportation
X is equivalent to the total projected livestock and poultry depredation.

Animal damage control activities are conducted on a request basis only and a total of 9,717 animal damage control requests were received during Fiscal Year 1975 of which 70% were for damage prevention; 20% involved rural damage; 7% involved urban damage; and rabies suppression was responsible for 3%. This was an 8% increase over the previous year. Coyotes were involved in 56% of these requests and raccoons, skunks, bobcats, badgers, foxes, bears, beavers, porcupines and opossums accounted for the remaining requests.

A total of 43% of the total program is directed toward the control and prevention of sheep, lamb, and goat depredations; 34% is conducted for cattle and calf protection, 6% for turkey protection and the remaining 17% for urban damage, rabies suppression and other industry protection.

The following is a summary of the source and total funds expended in the Fiscal Year 1975 cooperative program:

Department of Food and Agriculture.....	$ 321,019	(21%)
Department of Health	85,315	(7%)
Contract Counties (33)	475,050	(39%)
U.S. Fish & Wildlife Service	327,865	(21%)
Total.....	$ 1,209,249	

During the year, a total of 17,411 head of livestock (valued at $219,568) and poultry (valued at $58,312) were confirmed as killed by predatory animals by our field personnel, of which 4,656 were livestock: Sheep, 3,917; cattle, 421; goats, 207; pigs, 4; rabbits, 105; horses, 2; and 12,755 were poultry: Turkeys, 2,368; chickens, 7,941; geese, 1,945; ducks, 501. Other types of predator damage occurred to domestic game birds, domestic pets, fish, beehives, grain, alfalfa, watermelons, golf courses and gardens of which $102,986 in damages was estimated.

California Program Cost-Analysis

Economists and administrators have a tendency to over-simplify the evaluation of animal damage control programs by dividing the number of animals taken into the total program expenditures. Since $1,209,249 was the total amount of funds expended last year in the California animal damage control program and 14,033 animals were captured, the cost per animal captured would be $86.17. Of the total number of animals captured, 2,138 were released unharmed because they were non-target wildlife or domestic animals and, of course, this cost projected on the 11,895 target wildlife species killed, is then $101.66 per animal and $158.81 per trapped target animal, since 64% or 7,614 target animals were taken with traps. Additionally, 5,879 target coyotes were trapped at a cost of $205.69 per animal.

This simplified evaluating concept is not a valid analytical technique since it ignores the fact that 70% of the program was directed toward the prevention of damage and, except for rabies suppression, the remainder being directed toward abating or terminating damage. The latter effort is extremely time consuming and is not necessarily related to areas with high predator population densities.

A study conducted by Gary Nesse (1974) on the affect of predation on the California sheep industry projected a loss of 27,500 sheep due to coyote predation. Nesse calculated that the economic impact of this loss on the general economy of the State was $2.8 million and that the combined loss to the economy of California because of the predator problem was $5.1 mi11ion.

The U.S. Department of Agriculture, statistics for 1974 indicated that the California loss to coyotes was 3.7% of the docked lambs and 1.5% of the stock sheep with an average sheep and lamb loss of 2.5%, or 41,300 head (U.S.D.A. Survey, 1975.)

A recent study of domestic sheep mortality conducted by Donald Henne (1975) on the 8,383 acre Eight Mile Ranch in Montana revealed that 28.4% of the total lambs and 8.2% of the old ewes were lost to coyote depredation. The average sheep loss on this ranch to coyotes was 20.2%. It should be noted that this study was conducted in the absence of any control effort during the seven months of the study and with limited non-professional control effort during the remaining five months resulting in nine coyotes being removed with no cession of losses.

The U.S. Department of Agriculture, Economic Research Service documented the fact that the average coyote losses in Montana were 13.7% of docked lambs and 8.4% of stock sheep, or an average sheep and lamb loss of 9.4% in 1974. From a comparative standpoint, these data might indicate that losses without control can be expected to be more than double; however, this study area may be a high risk region which would undoubtedly have some effect on the overall evaluation.

The study by Sampson and Brohn (1955) indicated that the average predation loss without predator control programs can be five times higher than the average losses with predator control. This study, together with the previous data cited would provide a sound basis for anticipating an economic loss without control of twice that experienced in our

33 contract counties in Fiscal Year 1975. This was based on calculations of $4,732,721 in agricultural losses with an active control program. It appears to be logical to assume that our program is saving a minimum of 4.7 million dollars in agricultural losses which would result in a cost-benefit ratio of 1:3.9.

SUMMARY

In balancing environmental and economic goals, the environmental goal of totally protecting the coyote is just as unrealistic as the economic goal of eliminating predators in the Western United States. Sound predator management requires a freedom to select many options, that range from complete protection in wilderness sanctuaries to intensive reduction of depredators in lambing and calving areas and balancing of the goals can only be achieved by flexibility and responsiveness in management (Balser, 1974) The planning of control programs requires: (1) that control decisions not be made independently; (2) that planning involves several agencies and interdisciplinary talents; and (3) that an input of accurate data be assured (Berryman, 1972).

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