4 November 1997

Dear Interested Person or Party:

The following is a scientific opinion letter that has been requested of me by the Predator Defense Institute. This letter outlines a response to the general question "What effect does reduction of coyotes (older than 6 months) have on the remaining population?" Several opinion requests were made to me regarding claims that reduction of adult coyotes would lessen predation on domestic sheep or game animals such as mule deer or antelope.

Before I cover the three basic biological responses by coyote populations to reduction (described below), it is important to understand the type of "predator reduction" or "coyote control" in question. Most reduction programs, often referred to as control practices, are indiscriminate in nature, meaning the individuals removed (this usually always means "killed") are probably not the offending individuals. Even if some offending individuals are removed, there is great likelihood that the responses described below will take place anyway. Although removal of offending individuals can temporarily alleviate predation rates on the protected species, the alleviation is usually short-term and likely has long-term side-effects that make control activities ineffective. It can not be over-emphasized how powerfully coyote populations compensate for population reductions. Both evolutionary biology and the results of my research the last three years (on the effects of wolves on coyotes) indicate that the basis of this resiliency is embedded in the evolutionary past of the coyote. Coyotes evolved, and learned to coexist, in the presence of gray wolves--a dominant competitor and natural predator.

Demographic compensation

The following demographic responses are based on published research, results of preliminary analysis of coyote study populations subjected to various levels of reduction or exploitation, and the work I have conducted in three study areas over the past 14 years in Washington (an unexploited population, not subject to human control or mortality), California (exploited), and Wyoming (unexploited). There is little, if any, scientific basis for control (reduction) programs that indiscriminately target adult coyotes. In fact, the mechanisms described below suggest that widespread control (even selective control) increases immigration, reproduction, and survival of remaining coyotes. It has been reported that sustained reduction of coyote numbers can only be accomplished if over 70% of the individuals are removed on a sustained basis. My experience with known populations indicates that even with intensive control efforts, this level is rarely achieved.

(1) Actual reduction in the density (and number of coyotes) does occur but is compensated by immediate immigration into the reduction area by lone animals or shifts in surrounding social groups. This is the expected response by species that are territorial and monogamous. The primary objective for loners or replacement coyotes is to find a temporal opening, defend and exploit the food resources in that social group, pair-bond and breed.

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(2) Reduction results in a smaller social group size which increases the food per coyote ratio. This ratio may be even greater because of temporary reductions in overall density. Therefore, this food surplus is biologically transformed into higher litter sizes and higher litter survival rates. Review of literature indicates that the increase in litter size at birth is not as great as was previously reported by F Knowlton in 1972. Rather, the increase in food availability improves the nutritional condition of breeding females which translates in higher pup birth weights and higher pup survival.

(3) Reduction causing higher pup survival is fundamentally a function of the general mammalian reproductive strategy that delays the majority of reproductive energetic investment beyond the gestation period, the post-partum and neonate state (e.g., young pups). The caloric demand of offspring reaches an apex in May, June, and July when coyote pups grow very fast. Thus, the normal litter of six pups has a good chance of (a.) surviving the typically high summer mortality period and, (b.) being recruited into the pack the following winter as adults. By contrast, in the two unexploited populations I investigated, the average litter size at birth was 5 or 6, but due to high summer mortality, only an average of 1.5 to 2.5 pups survive. In populations subjected to less than 70% removal annually, there appears to be an ample number of breeding pairs to occupy all available territory openings and litter sizes of 6 to 8 enjoy high survival rates (most pups born survive to adulthood). This results is a tripling of the number of hungry pups that need to be fed. "Large packages" of prey, (such as sheep, as opposed to voles or rabbits,) make for more efficient sources of nutrition because hunting adults have to invest less energy per unit of food obtained. ADC-funded research clearly indicates that the primary motivation to kill domestic sheep is to provide food for fast-growing pups.

(4) Reductions of adult-sized coyotes 6 months or older, results in smaller pack size which leaves fewer adults to feed pups. This may further add incentive for the remaining adults to kill larger prey as well as putting pressure on the adults to select for the most vulnerable prey venture close to areas of human activity. Because predators like coyotes also learn what is appropriate food when they are pups, and are reluctant to try ‘new’ food sources unless under great stress (such as having to feed a large litter of pups) reduction programs, in effect, may be seen as forcing coyotes to try new behaviors (eating domestic livestock) which they would otherwise avoid. Research has clearly shown that higher numbers of adult pack members provide more den-guarding time and more food brought to pups. Without pressure to "maximize" efficiency in hunting for food for pups, packs may be able to subsist on larger numbers of smaller prey (e.g., rabbits and small rodents) rather than going for livestock or other, larger prey like antelope and mule deer fawns.

(5) Reductions cause an increase in the percentage of females breeding. Coyote populations are distinctly structured in non-overlapping but contiguous territorial packs. Over 95% of the time only one female (the dominant, or "alpha") breeds. Other females, physiologically capable of breeding, are "behaviorally sterile". Exploitation rates of 70% or higher have to be imposed in order to decrease the number of females breeding in a given area. Either a subordinate female pack member, or an outside, lone female can be quickly recruited to become an alpha or breeding female. My research has shown that light to moderate levels of reduction can cause a slight increase in the number of territories, and hence the number of females breeding.

(6) Reduction causes the coyote population structure to be maintained in a colonizing state. For example, the average age of a breeding adult in an unexploited population is 4 years old. By age 6 reproduction declines, whereby older, alpha pairs maintain territories but fail to reproduce. This may eliminate the need to kill sheep or fawns in the early summer in order to feed pups. Exploiting or consistently reducing coyote populations keeps the age structure skewed to the young (average age of an alpha is 1 or 2 years) and in a state of constant social and spatial flux. Therefore, the natural limitations seen in older-aged, unexploited populations are absent and the territorial, younger populations are much more productive.

(7) Reductions cause young adults (otherwise prone to dispersing) to stay and secure breeding positions in the exploited area. This phenomenon is well-documented. There are other demographic responses that negate the effectiveness of control practices but the aforementioned covers the most important.

Alternate prey

An aspect of coyote predation on livestock that is often overlooked is the availability or dearth, of alternate prey. ADC research has demonstrated that coyotes will avoid novel prey, such as domestic livestock. In addition, it is risky for coyotes to predate upon domestic livestock because of human control actions associated with this behavior. Related research indicates that predators switch to alternative prey when a preferred prey item is absent or in low numbers. Voles and other rodents like jackrabbits are a preferred major staple of coyotes in the West. These prey species require cover and ample supplies of forage (grass and forbs). On many western rangelands grasses, forbs, and protective cover have been greatly reduced by domestic livestock grazing, leaving predators with fewer preferred prey to utilize. Present or historic grazing impacts should be assessed as a likely means of predicting overall predation rates on other prey species, especially prey like domestic sheep which are already vulnerable to predators due to their lack of anti-predator behaviors.

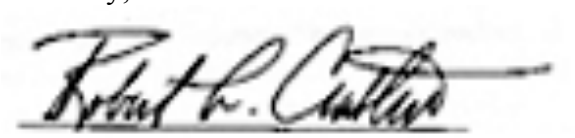
Accelerated selection pressures and learned behaviors

A relatively unexplored, but promising avenue of research is the long-term genetic and behavioral changes in coyote populations subjected to decades of exploitation. It seems obvious that the type of selection pressures and selection rates have been greatly changed for coyote populations, after a century of exploitation at 20% to 70% per year. More nocturnal, more wary, more productive, more resilient individuals have probably been intensively selected for. This in turn may cause coyote populations to resist control practices that previously were effective. In addition, the possibility of social facilitation and learning may be altered or reduced. Coyotes, like many mammals, learn to habitually use certain prey or habitats from other individuals in the population, especially from older adults in their social group (if they have one). Coyotes, already a highly social and adaptable species, are held in a younger colonizing state when they are exploited and learned or traditional behaviors may be lost. Individuals are therefore more susceptible to learning novel prey sources or trying out novel habitat types.

There are many questions to be answered such as, "How will coyote populations respond once predator reduction or control programs are terminated?" or "Are there other management alternatives, both lethal and non-lethal, that may be effective in reducing predation on domestic

livestock?" However, this scientific opinion only addresses a narrow, but important topic of the impacts of human caused reduction of coyote demographic parameters. In conclusion, the common practice of reducing adult coyote populations on western rangelands is most likely ineffective and may even increase the number of lambs, fawns, and calves killed by coyotes. Coyotes are still products of their evolutionary past. Biological and ecological evaluation of control practices would seem to be a requirement for any public or private effort to reduce losses due to coyotes or any other predator.

Sincerely,



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