PREDATOR CONTROL AND UPLAND GAMEBIRDS IN SOUTH TEXAS

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Abstract: The role of predator control is a controversial topic in wildlife management. Research often reports conflicting results regarding response of gamebird populations to predator control. I discuss 2 predator control studies conducted in South Texas, and present a brief review of predator-removal studies.

I have heard throughout my education that wildlife management is "people management." Although the phrase may sound like an oxymoron, one only needs 1 or 2 weeks of post-graduation work to realize the truth of this statement, regardless of your wildlife interests. In deer management, you have controversial topics such as high fences, protein feeders, and "deer farming". Bobwhite management is no exception...... late-season harvest, pen-reared bobwhites, and of course, predator control. Addressing the use of predator control as a tool in wildlife management is a controversial topic requiring "people management" skills. The discussion becomes even more sensitive when dealing with economically important game species, such as northern bobwhite (*Colinus virginianus*) and wild turkey (*Meleagris gallopavo*). Before I discuss predator control relative to these species, it is important to understand the interesting relationship between predators and man, as well as the theory of predation.

PREDATORS AND MAN

The perception of predators has changed through time, changing as the evolution of prehistoric man progressed. In prehistoric times, predators posed a real danger to primitive cultures (Reynolds and Tapper 1996). Therefore, early man killed predator species for safety, as well as for resources such as fur (Trolle-Lassen 1986). As far as anyone can tell from early historical records, prehistoric man did not kill predators to reduce competition for game (Reynolds and Tapper 1996). However, as man developed culturally into herding and agricultural societies, the perception of predators changed into one of competing species threatening to human interests. As time progressed, policies to reduce predator numbers appeared and became typical in early European culture. When European colonizers reached North America in the 16th century, they brought with them their cultural attitudes towards predators (Reynolds and Tapper 1996). American colonies were quick to established bounties for predators following the practices of their European counterparts (Leopold and Hurst 1994). The persecution of several predator species such as wolves (*Canis lupus*), coyotes (*C. latrans*), bears (*Ursus* sp.), and mountain lions (*Felis concolor*) soon followed.

Recently, with an increased interest in conservation, the perception of predators has changed once more. Policies regarding predators have shifted from one of persecution to one of conservation for the predators themselves (Reynolds and Tapper 1996). The public interest in predator conservation has been so great that some species (e.g., wolves) are being introduced back into their former range, the area from which they were originally eliminated.

PREDATION THEORY

Before the role of predator control in gamebird management can be discussed effectively, some basic concepts of predation need to be reviewed. I will not discuss in detail the theory of predation, but rather highlight some important concepts. Numerous reviews exist that thoroughly discuss the relationship between predators and gamebird population dynamics (Taylor 1984, Sih et al. 1985, Newton 1993).

The theory of predation was strongly influenced by the early work of Paul Errington (Errington 1946*a*). Errington's work dominated the philosophy on predator-prey relationships in higher vertebrates for many years (Lindström et al. 1994). Errington (1946*b*) believed that habitat resources (e.g., food, habitable coverts, etc.) were the main determinants of bobwhite density, not predators. He stated that "kinds and number of wild predators, migrant or resident, had no measurable influence on carrying capacity..... predators consumed mainly an ill-situated surplus." That is, predators harvested a surplus of bobwhites, and that if predators did not kill them, competition for resources would (Errington 1963). Predation was a form of compensatory mortality, not additive.

More recently, Leopold and Hurst (1994) stated that predators can either (1) limit or regulate prey populations; (2) increase the vigor of prey population by eliminating the sick or unfit; (3) maintain prey wildness; or (4) maintain community stability. It is important to note the difference between the terms "limiting" and "regulating." Limitation simply means that predation has a negative impact on the rate of population growth (Reynolds and Tapper 1996). It only implies that predators are an important source of mortality (among others), but does not imply that prey populations are kept within the prey's carrying capacity (Leopold and Hurst 1994). However, regulation implies that predators do keep prey populations within carrying capacity, removing the "surplus" of prey that otherwise would die from other sources of mortality (Leopold and Hurst 1994). Regulation drives high prey numbers back down towards an equilibrium level at which productivity is balanced by losses (Reynolds and Tapper 1996). From a manager's perspective, a predator that regulates its prey is of a greater concern than one that merely limits it prey population.

Predation theory recently has been questioned in terms of density dependent and density-independent processes. Predation typically is viewed as a density-dependent process, where prey density influences predation rate and predator numbers. At high prey density, predation rate increase, whereas at low densities, predation rate decreases. However, there are studies which indicate that predation may be density-independent (Kenward 1985, Newton 1992). That is, the rate of predation is not influenced by prey density. This could be possible with generalist predators which have a broad diet. In their search for food, generalist predators consume whatever prey they encounter regardless of its density, low or high.

PREDATION AND GAMEBIRDS

Upland gamebirds such bobwhites and wild turkeys sustain a relatively high level of predation. However, gamebirds cope with such high predation rates through their high reproduction potential. Annual survival for bobwhites have been estimated at 5.3 % in Missouri (Burger et al. 1995), 6.1 % in North Carolina (Curtis et al. 1988), and 16.7 % in Florida (Pollock et al. 1989). Burger et al. (1995) noted high avian predation during fall-spring, with increasing mammalian predation during spring-fall. Studies have documented that fall-spring survival (16%) is approximately half of spring-fall survival (33%) (Curtis et al. 1988, Burger et al. 1995). It is important to note that these survival estimates are based on radiotelemetry. The reliability of the survival estimates provided by telemetry is questioned because they often are biologically unreasonable (< 18% annual survival). Guthery (1997) noted that bobwhite populations may not persist at annual survival rates below 18%. Either these populations are moving towards extinction, or the transmitters inflated the mortality rates of radio-marked individuals. The survival estimates provided above need to be viewed cautiously.

Nest success for bobwhites have ranged from 17% in Georgia (Simpson 1976), 45% in Florida (DeVos and Mueller 1993) to 70% in South Texas (F. Hernández, unpublished data). However, most reports generally report low (< 40%) nesting success (Stoddard 1931, Roseberry and Klimstra 1975). The ecology and survival of bobwhite broods is less documented. Chick survival from hatching to 2-weeks of age have been reported as 13% in Texas (Cantu and Everett (1982), 36% in Alabama (Speake and Sermons 1987), 38% in Florida (DeVos and Mueller 1993), and 38% (to 3-weeks) in Oklahoma (DeMaso et al. 1997). Burger et al. (1995) noted intensive predation on brood-rearing adults, suggesting that predation is a primary factor contributing to high chick mortality (Hurst et al. 1996). However, recall that Burger et al. (1995) provided survival estimates that are potentially biased by telemetry (5.3% annual survival). It difficult to separate if the intensive predation on brood-rearing adults resulted from vulnerability to predators or radiotelemetry bias.

Annual survival rates for wild turkeys hens have been estimated at approximately 50-70% (Kurzejeski et al. 1987, Palmer 1993, Hurst 1995). Nesting hens, nests, and poults are particularly vulnerable to predation (Miller and Leopold 1992). Nest success for wild turkeys also is low (30-40%) (Speake 1980, Hennen 1999, Hohensee 1999). Poult mortality generally is high (70%) to 4 weeks post hatch (Glidden and Austin 1975, Speake 1980, Palmer et al. 1993).

PREDATOR CONTROL IN SOUTH TEXAS: THE EVIDENCE

Only 2 main studies have been conducted on the effects of predator control on bobwhite or wild turkey populations in South Texas. Beasom (1974) conducted predator control on approximately 5,800 acres (9 square miles) in Kleberg County. Predators were removed from February-June 1971-72 through the use of steel traps, M-44's, strychnine alkaloid meat and egg baits, spotlight hunting, and predator calling. A total of 457 predators was removed during the project, with coyotes and bobcats accounting for the majority of the kill (Table 1). Beasom (1974) reported strong increases in turkey production and moderate gains in bobwhite abundance in the experimental pasture compared to the untreated pasture (Table 2). Beasom (1974) concluded that "predator removal definitely seemed to enhance reproductive success of wild turkeys... and to a lesser extent, bobwhite quail in the present study."

Guthery and Beasom (1977) investigated the response of scaled quail (*Callipepla squamata*) and bobwhite (and other species) to predator control in Zavala County. They removed predators using steel traps, snares, M-44's, helicopter gunning, and predator calling on approximately 3,800 acres (1,550 hectares) during January-July 1975-76. A total of 227 predators was removed, with coyotes representing the majority of the kill (Table 1). Pre-experiment populations were higher on untreated pastures for scaled quail (0.89/km) and bobwhites (6.07/km) compared to the predator removal area (0.51 and 3.32, respectively). This trend continued for the duration of the project, even after predator removal. Guthery and Beasom (1977) concluded that "predator removal at this level had little discernible effect on density trends of bobwhite or scaled quail."

DISCUSSION

From the 2 studies presented, it is evident that predator removal can produce different results. In comparing these 2 studies, certain issues need to be kept in mind, such as the nesting biology of the species, replication of study, pre-treatment densities of gamebirds between study areas, and the density of predators remaining after predator control.

The nesting biology of the gamebird at hand may influence the effectiveness of predator control. Determinate layers are birds that produce only 1 nest, whereas indeterminate layers produce ≥ 2 nests. The more nests that a hen lays, the greater the chance for one of the attempts to be successful. Therefore, it stands to reason that predator control would be more effective when dealing with detereminate layers, as they only have 1 chance to produce a successful nest. Turkeys can be considered weak renesters when compared to bobwhites, which may lay 3 - 4 nests in an attempt to raise a brood. The different tendencies for turkeys and bobwhites to renest may partially explain the results of these 2 studies.

It is difficult to pinpoint the true effects of predator control in these 2 studies because both lacked replication. That is, Beasom (1974) had only 1 experimental site and only 1 untreated site. Because of this, it cannot be concluded that predator control solely was responsible for the positive response of wild turkeys and bobwhites. In statistical jargon, this means that the treatment effects were confounded by the site effects. To put it in laymen terms, the populations of gamebirds observed on these sites may be the result of either predator control or the sites themselves, or some interaction of the 2. The same can be said for Guthery and Beasom (1977), who also only had 1 site per treatment. The problem with lack of replication becomes evident when weather conditions differ between years. For example, Beasom (1974) observed smaller differences between the experimental and untreated site in the second year (1972) compared to 1971 (Table 1). He stated that in 1972 "conditions were improved environmentally and vegetatively, and there was a corresponding increase....in production on **ALL** areas." The confidence in either study would be strengthened if there was replication (i.e., several sites per treatment) and a consistent trend was observed between the treatments through time.

Documenting pre-treatment densities of gamebirds also is crucial to understanding these studies. Obviously, the more similar pre-treatment densities of gamebirds are between sites the better. Beasom (1974) did not report pre-treatment densities. Thus, it is uncertain whether higher populations on the experimental site already existed prior to the beginning of the study. Guthery and Beasom (1977) documented that pre-experiment populations of scaled and bobwhite quail were higher on the untreated pasture as mentioned earlier. They stated "that the untreated pasture provided better habitat is supported by the pre-experiment abundance and by subjective opinion."

Lastly, the density of predators remaining after predator control is important to understand the results of these studies. Most readers will note that Guthery and Beasom (1977) removed less predators and observed no increase in density trends of scaled quail and bobwhites, whereas Beasom (1974) removed more predators and documented a positive response in wild turkeys and bobwhites. The astute observer would note that Guthery and Beasom (1977) removed 227 predators within 3,800 acres, and Beasom (1977) removed 457 predators from 5,800 acres. After scaling, it appears that Guthery and Beasom (1977) removed predators at a much lower intensity. To reach the level of predator removal of Beasom (1974), they would have to remove a total of 299 (an additional 72 predators). The readers' conclusion? That Guthery and Beasom (1977) did not remove predators at a great enough intensity to surpass the threshold where predator control may become effective. Here's where the issue of density of remaining predators becomes important.

It does not matter how many predators you remove, but how many are left. Stating that 1,000 predators were removed tells readers' nothing......unless it is mentioned that only 2 predators were left in the entire area, or conversely, that 60,000 still remain. This is an extreme example, but it drives the point home. Concentrating on how many predators each study removed is not the issue. There could have been fewer predators to remove in Zavala County where Guthery and Beasom (1977) conducted their research compared to Kleberg (Beasom1974). When taken in the perspective of the remaining predator densities, it is evident that Guthery and Beasom (1974) had a considerable reduction in predator density. Guthery and Beasom (1974) reduced the density of coyotes and bobcats to about 0.4 to 0.8 predators/247 acres in the experimental site, whereas their density was about 2.0/247 acres on the untreated site. Based on qualitative appraisal of the abundance of sign, they stated that raccoon and skunk populations were probably reduced by 40-60%. Beasom (1974) did not record density (predators/area) but rather abundance (predators tracks/mile) (Table 3). Although abundance declined, it is difficult to compare these 2 studies with these separate measures.

An interesting point that arises is that the proportion of predators killed by species differed between studies (Table 1). Large predators (coyotes and bobcats) accounted for approximately 66% of the total kill for both studies. However, coyotes accounted for 88% (Guthery and Beasom 1977) of the large-predator kill compared to 61% in Beasom (1974). Stated differently, bobcats represented a lower percentage of the large-predator kill (12%) in Guthery and Beasom (1977) compared to 39% in Beasom (1974). Concerning medium-sized predators, raccoons accounted for only 20% of the predators removed by Guthery and Beasom (1977) compared to 44% (Beasom 1977).

Both coyotes and bobcats are considered important predators of wild turkeys (Miller and Leopold 1996). Regarding bobwhites, Henke (personal communication) necropsied approximately 1,000 coyotes (600 from west Texas and 400 from South Texas). He found bobwhite remains in < 1% of both samples. However, feral cats are considered an effective predator of bobwhites (Stoddard 1931). Further, raccoons are considered primary nest predators of both wild turkeys and bobwhites (Hernández et al. 1997, and references therein). The differing results of these 2 studies need to be evaluated in light of all the factors mentioned above.

CONCLUSION

The question remains "Is predator control an effective management tool to increase gamebird populations?" Newton (1994) conducted a review of experiments on the limitation of bird breeding densities. He found 15 predator-removal studies involving various avian prey species, mostly gallinaceous birds. In 14 studies in which nest success was monitored, all documented an increase in nest success under predator removal. In 8 studies in which post-breeding densities were measured, 4 showed an increase. In 11 studies in which breeding densities were measured, 6 showed an increase. Newton (1994) stated that "overall, it seems that, in about half the studies...., breeding density was limited by predation." However, as mentioned previously , the reproductive biology (i.e., determinate vs indeterminate layers) of the species in question needs to be considered.

Marcström et al. (1988) presented one of the best predator removal studies (Newton 1994). This study was conducted off the coast of Sweden on 2 large islands, which sustained populations of several mammalian species. Predators were removed for 5 years from 1 island but not the other. After this period, the treatments were reversed and predator removal continued for 4 years, resulting in 9 years of total study. The response of 4 species of grouse were measured. More young were produced and breeding numbers were higher where predators were removed. Again, it is worthy to mention that the results of studies from 1 species may not be applicable to another (i.e., turkeys and bobwhites).

Perhaps the question to ask is not "Is predator control an effective management tool to increase gamebird populations?" but rather, "Is predator control necessary to have high turkey and bobwhite populations?" Under most circumstances, the answer is no. Given that suitable habitat exists, weather is a primary influence on the population dynamics of these species, especially quail. Some people have gone as far to say “If there’s rain, there’s quail. If there’s no rain, there’s no quail.” The fact that high quail populations can exist as a result of favorable weather regimes in areas without predator control provides evidence for my answer. Some will argue that favorable weather conditions tip the scale in favor of bobwhite survival and reproduction. While there may be some truth to this statement, the fact still remains that habitat and favorable weather patterns largely dictate gamebird populations, not predator control. In addition, from a practical standpoint, predator control is not practical or cost-effective on a large scale at the intensity used by the 2 studies discussed.

The review of Newton (1994) and the study of Marcström et al. (1988) should not be taken as conclusive evidence that predator control is necessary or warranted for increasing gamebird populations. Because neither mortality nor recruitment depend solely on predation, it cannot account completely for a given population density (Newton 1993). Further, habitat plays a critical role in determining population density, while helping to minimize the impact of predation. The truth is that our research base is weak concerning predator-removal studies for wild turkeys and bobwhites (although there is considerable research for other species, see Newton 1994). Most studies for turkeys or bobwhites are short-term (< 5 years), lack replication, or suffer from poor design (e.g., spatially close treatment areas leading to confoundment of treatments) (Newton 1994, Leopold and Hurst 1994). Leopold and Hurst (1994) described a comprehensive approach of strong experimental design to investigate the relationship between gamebird response to predator removal. However, the approach would require collaboration between researchers, natural resource agencies, disciplines, and states and would require considerable economic resources. Whether this approach will ever be accomplished or even attempted is questionable. Leopold and Hurst (1994) acknowledged the demanding effort of such an approach.

The issue of predator control in gamebird management is complex. Some people believe it is not necessary, and resources spent on predator removal are better spent on providing habitat to wildlife. Others believe that predator control is a valid option, in conjunction to habitat management. Predator-prey relations are complex: effects of buffer species, habitat fragmentation, hunting, etc. I believe Reynolds et al. (1988) accurately summarized the complexity of the predation issue in gamebird management when they stated, “Predation is just one of an array of interrelated factors which can influence the dynamics of a gamebird population.....”

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LITERATURE CITED

Beasom, S. L. 1974. Intensive short-term predator removal as a game management tool. Transactions of the North American Wildlife and Natural Resources Conference 39:230-240.

Burger, L.W. Jr., T.V. Dailey, E.W. Kurzejeski, and M.R. Ryan. 1995. Survival and cause-specific mortality of northern bobwhite in Missouri. Journal of Wildlife Management 59:401-410.

Cantu, R., and E.D. Everett. 1982. Reproductive success and brood survival of bobwhite quail as affected by grazing practices. Proceedings of the National Bobwhite Quail Symposium 2:79-83.

Curtis, P. D., B. S. Mueller, P. D. Doerr, and C. F. Robinette. 1988. Seasonal survival of radio-marked northern bobwhite from hunted and non-hunted populations. Proceedings of the International Symposium of Biotelemetry 10:263-275.

DeMaso, S.J., A.D. Peoples, S.A. Cox, and E.S. Parry. 1997. Survival of northern bobwhite chicks in western Oklahoma. Journal Wildlife Management 61:846-853.

DeVos, T., and B.S. Mueller. 1993. Reproductive ecology of northern bobwhite in north
Florida. Proceedings of the National Bobwhite Quail Symposium 3:83-90.

Errington, P. L. 1946*a*. Predation and vertebrate populations (concluded). Quarterly Review of Biology 21:144-177.

Errington, P. L. 1946*b*. Vulnerability of bob-white populations to predation. Ecology 15:110-127.

Errington, P. L. 1963. The phenomenon of predation. American Scientist 51:180-192.

Guthery, F. S. and S. L. Beasom. 1977. Responses of game and nongame wildlife to predator control in south Texas. Journal of Range Management 30:404-409.

Guthery, F. S. 1997. A philosophy of habitat management for northern bobwhites. Journal of Wildlife Management 61:291-301.

Hennen, R. S. 1999. Reproductive ecology and survival of Rio Grande wild turkey hens in southcentral Kansas. M. S. Thesis, Texas Tech University, Lubbock, Texas.

Hernández, F., D. Rollins, and R. Cantu. 1997. Evaluating evidence to identify ground-nest predators in west Texas. Wildlife Society Bulletin 25:826-831.

Hohensee, S. D. 1999. Nest site selection and success of Rio Grande turkey hens in relation to range management practices in the Rolling Plains of Texas. M. S. Thesis, Texas Tech University, Lubbock, Texas.

Hurst, G. A. 1995. An ecological study of the wild turkey on Tallahala Wildlife Management Area, Mississippi, Completion Report, Federal Aid in Wildlife Restoration, Project W-48, Jackson, Mississippi.

Hurst, G. A., L. W. Burger, and B. D. Leopold. 1996. Predation and galliforme recruitment: an old issue revisted. Transactions of North American Wildlife and Natural Resource Conference 61:62-76.

Kenward, R. E. 1985. Problems of goshawk predation on pigeons and other game. Proceedings of the International Ornithological Congress 18:666-678.

Kurzejeski, E. W., L. D. Vangilder and J. B. Lewis. 1987. Survival of wild turkey hens in north Missouri. Journal of Wildlife Management 51:188-193.

Leopold, B. D., and G. A. Hurst. 1994. Experimental designs for assessing impacts of predators on gamebird populations. Transactions of the North American Wildlife and Wildlife Resources Conference 59:477-487.

Limström, E. R., S. M. Brainerd, J. O. Heldin, and K. Overskaug. 1995. Pine marten-red fox interactions: a case of intraguild predation? Annales Zoologici Fennici 32:123-130.

Marcström, V., R. E. Kenward, and E. Engren. 1988. The impact of predation on boreal tetraonids during vole cycles: an experimental study. Journal of Animal Ecology 57:859-872.

Miller, J. E. and B. D. Leopold. 1992. Population influences: Predation. Pages 119-128 *in* J. G. Dickson, editor. The wild turkey, biology and management. Stackpole Books, Harrisburg, Pennsylvania.

Newton, I. 1992. Experiments on the limitation of bird numbers by territorial behavior. Biological Reviews 67:129-173.
Newton, I. 1993. Predation and limitation of bird numbers. Pages 143-198 *in* D. M. Power, editor. Current Ornithology. Plenum Press, New York, New York.

Newton, I. 1994. Experiments on the limitation of bird breeding densities: a review. Ibis 136:397-411.

Palmer, W. E., G. A. Hurst, J. E. Stys, D. R. Smith and J. D. Burk. 1993. Survival rates of wild turkey hens in loblolly pine plantations in Mississippi. Journal of Wildlife Management 57:783-789.

Pollock, K.H., C.T. Moore, W.R. Davidson, F.E. Kellogg, and G.L. Doster. 1989. Survival rates of bobwhite quail based on band recovery analyses. Journal of Wildlife Management 53:1-6.

Reynolds, J. C., P. Angelstam, and S. Redpath. 1988. Predators, their ecology and impact on gamebird populations. Pages 72-92 *in* P. J. Huson and R. W. Rands, editors. Ecology and management of gamebirds. BSP Professional Books, London.

Reynolds, J. C., and S. C. Tapper. 1996. Control of mammalian predators in game management and conservation. Mammal Review 26:127-156.

Roseberry, J.L., and W.D. Klimstra. 1984. Population ecology of the bobwhite. Southern Illinois University Press, Carbondale. Illinois, USA.

Sih, A. , P. Crowledy, M. McPeek, J. Petranka, and K. Stohmeier. 1985. Predation, competition, and prey communities: A review of field experiments. Annual Review of Ecological Systems 16:259-321.

Simpson, R.C. 1976. Certain aspects of the bobwhite quail's life history and population dynamics in southwest Georgia. Georgia Department National Resource. Game and Fish Division Technical Bulletin WL 1. 117 pp.

Speake, D. W. 1980. Predation in wild turkeys in Alabama. Proceedings of National Wild Turkey Symposium 4:86-101.

Speake, D. W., and B. Sermons. 1987. Reproductive ecology of the bobwhite in central Alabama. Federal Aid in Wildlife Restoration Final Report, Project W-44-9, Study XII.

Stoddard, H.L. 1931. The bobwhite quail: its habits, preservation, and increase. Charles Scribner's Sons, New York, New York.

Taylor, R. J. 1984. Predation. Population and Community Biological Series. Chapman and Hall Ltd., London.

Trolle-Lassen, T. 1986. Human exploitation of the pine marten (*Martes marten* (L.)) at the late Mesolithic settlement of Tybrind Vig in western Funen. Striae 24:119-124.

Table 1. Comparison of mammalian predators killed in South Texas between Beasom (1974) on 6,000 acres (Feb-Jun) and Guthery and Beasom (1977) on 3,800 acres (Jan-Jul).

Size	Beasom (1974)		Guthery and Beasom (1974)	
Species	*n*	%	*n*	%
Large				
Coyote	188	61.0	132	88.0
Bobcat	120	39.0	18	12.0
Subtotal	308	67.0	150	66.0
Medium				
Racoon	65	43.6	15	19.5
Skunk	49	32.9	22	28.6
Badger	18	12.1	12	15.6
Opossum	17	11.4	27	35.1
Gray fox	0	0.0	1	1.3
Subtotal	149	33.0	77	34.0
Total	457		227	

Table 2. Indices of reproductive success for northern bobwhite and wild turkeys in an area with predator removal (6,000 ac.) and an area with no predator removal (6,000 ac.) in South Texas, 1971-72 (modified from Beasom 1974).

	1971		1972	
Species	Control	No Control	Control	No Control
Northern Bobwhite				
No. Adult females	134.0	79.0	338.0	254.0
young/adult female	2.3	0.9	4.5	3.6
avg. Brood size	9.6	6.2	6.7	6.5
% increase in pop.	98.7	39.2	213.8	154.6
Wild Turkey				
Poult:hen ratio (road transects)	0.8	0.0	7.9	4.4
Poult:hen ratio (helicopter surveys)	1.4	0.0	4.6	0.6
Poults produced	51.0	0.0	238.0	159.0

Table 3. Approximate initial and ending coyote and bobcat abundance (tracks /4-mile transect) on areas with predator control and areas without predator control in Kleberg County, 1971-72 (modified from Beasom 1974).

		Predator Control		No Predator Control	
YEAR		January	June	January	June
1971					
	Coyote	7.5	1.5	8.5	9.5
	Bobcat	1.0	0.5	1.5	2.0
1972					
	Coyote	12.5	1.0	11.5	10.5
	Bobcat	1.0	0.5	2.0	1.5