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EFFECTS OF SUPPLEMENTAL FEEDING ON HOME RANGE SIZE AND SURVIVAL OF NORTHERN BOBWHITES IN SOUTH GEORGIA

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ABSTRACT

We studied the effects of supplemental feeding on fall-spring covey home range size and survival of radio-marked northern bobwhites (*Colinus virginianus*) for 3 years in southwest Georgia. A total of 372 radio-marked bobwhites were monitored on 2 separate study areas for 25 weeks from fall-spring each year from November 1993 through May 1996. The traditional supplemental feeding program of bi-weekly broadcast spreading of whole grains from November through May was discontinued on one of the study areas during 1993–1994 and 1994–1995. Supplemental feed was distributed on both areas during fall-spring 1995–1996.

During the 2 years of no feeding, fall-spring covey home ranges were larger ($P = 0.04$) on the unfed study area. During the first of these 2 years (1993–1994), fall-spring survival of birds without supplemental feed ($S = 0.127$) was lower ($P = 0.005$) than that of fed birds ($S = 0.432$). During the 1994–1995 season while covey home ranges of birds without supplemental feed were still slightly larger ($P = 0.04$), there was no difference ($P = 0.76$) in survival between bobwhites on the sites with and without supplemental feed. Coveys seen per hour hunted was significantly lower ($P = 0.007$) on the treatment (unfed) area during 2 years.

During the year supplemental feed was distributed on both sites, there was no difference in home range size ($P = 0.87$), survival ($P = 0.90$), or hunting success ($P = 0.82$) between the 2 study sites. Supplemental feeding may reduce bobwhite movements and home range size thereby enhancing survival because of less exposure to predation. However, such an effect will probably vary among years in relation to prevailing weather and native vegetation conditions. The specific mechanisms through which supplemental feeding may effect bobwhite population performance remain unknown and require additional study.

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INTRODUCTION

Supplemental feeding of game animals is controversial and generally looked upon unfavorably by most wildlife professionals (Frye 1954). The issue of supplemental feeding of northern bobwhites is complicated by varying opinions among biologists (Guthery 1986), and conflicting results of meager research on the topic. Frye (1954) documented a substantial increase in bobwhites as a result of supplemental feeding on native habitats in south Florida. Robel et al. (1969) determined that nutritional stress due to the lack of a supplemental food source in winter resulted in weight loss, reduced fat, and increased mortality of bobwhites in Kansas. However, Peoples (1992) found no evidence that supplemental feeding programs benefitted quail in Oklahoma. Guthery (1986) concluded that supplemental feeding, if applied properly, could potentially increase survival in winter and productivity in summer of bobwhites in Texas, but also pointed out that the food limitation hypothesis has not been supported by research results (Guthery 1997).

Despite these conflicting research results and predominately negative attitude of many wildlife professionals toward supplemental feeding, it is a common practice on intensively managed properties throughout the geographic range of the northern bobwhite (Frye 1954, Guthery 1986, Peoples 1992, Simpson 1976, Brennan et al. 1994). Many biologists consider that supplemental feeding only concentrates birds for harvest with no positive, and potentially negative, impacts on the population. Most often cited as a potential detrimental impact is the belief that concentrating birds in a small area or stimulating their repeated activity at a certain point will cause predators to focus their attention there and result in higher mortality rates (Landers and Mueller 1986, Curtis et al. 1988, Jackson 1989); however, this point has not been researched thoroughly.

In the fall of 1993, we initiated a large-scale study on supplemental feeding of bobwhites. This study was designed to examine the effects of supplemental feeding on northern bobwhite survival, reproductive success, and vulnerability to harvest and/or predation on study sites with and without supplemental feed. This paper deals with only a part of that larger study. Here, we examine the effects of supplemental feeding on home range size and survival of bobwhites on an intensively managed quail plantation in southwest Georgia.

STUDY AREA AND METHODS

This study was conducted on a 4,490-ha privately owned wild quail hunting property located in the heart of southwest Georgia's plantation community near the city of Albany. The property has been under intensive bobwhite management for 50 years and supports an abundant wild bobwhite population. The habitat is maintained as a mixture of frequently burned, low basal area pine (*Pinus* spp.) woodlands, live oak (*Quercus virginiana*) savannahs, patch agricultural plantings, and open fields. Field system management consists of rotational agricultural plantings and fall disking to stimulate annual weed production and insects.

Two separate hunting courses were included in this study. The control site was a 316-ha hunting course on the south end of the property and the treatment site was a 194-ha hunting course on the north end of the property. The 2 sites were separated by 3.2 kilometers. Both hunting courses had historically been under similar management, including a supplemental feeding program. Whole corn and milo were broadcast on the ground in a continuous line throughout the whole course bi-weekly from November through May at a rate of approximately 1 bushel per 4 ha/feeding. Hunting success on these 2 courses had been approximately equal for the previous 10-year period based on unpublished plantation hunting records.

Wild bobwhites were trapped and released on both study sites in October–November of 1993–1995 using standard, baited funnel traps (Stoddard 1931). All captured birds were aged, sexed, weighed, and leg-banded. Each fall, a sample of approximately 40 quail from each study site weighing >130g were chosen to be outfitted with a 6-g neck-loop mounted radio-transmitter equipped with an activity switch (Holohil Systems Ltd., Ontario, Canada). Additional birds were captured, radio-marked, and added to the sample as needed throughout the winter and early spring. All radio-marked and/or banded birds were released at their capture site. Each radio-marked quail was located and checked for activity 2 to 3 times weekly from the date of capture through May. Routine hunting was conducted on both study sites approximately once every 2 weeks. Specific causes of non-hunting mortality were determined whenever possible by evidence at the kill site and condition of the transmitter (Curtis et al. 1988).

Beginning in the fall of 1993, supplemental feeding was discontinued on the treatment course while being continued on the rest of the property. Originally designed as a crossover experiment, this study was discontinued at the landowners request in the fall of 1995 at which time the plantation's standard feeding program was reinstated. Due to the unreplicated nature of the study, we realize that treatment effects may be confounded with site effects. Therefore, observed differences in range size and survival may not be solely attributable to supplemental feeding.

Each covey location was plotted on aerial photographs 2 to 3 times per week from November until covey break-up in April. From these, minimum convex polygon home range size was calculated for each radio-marked covey where at least one individual was tracked through the period. Student's t-tests were used to detect differences in mean home range size among treatments and between years.

Survival estimates for the radio-marked bobwhites on both sites for the 25-week feeding period were estimated using the Kaplan-Meier staggered entry design (Kaplan and Meier 1958, Pollock et al. 1989), which allowed for inclusion of additional birds during the study and the censoring of others due to radio failure or emigration. Mortalities that occurred within 1 week of radio attachment were not used in the analysis (Robinette and Doerr 1993). Survival curves were compared between years and among treatments using log-rank tests (Pollock et al. 1989). Population indexes were estimated from records of coveys observed per hour of hunting on the 2 courses for 4 hunting seasons which included the hunting season prior to (1992–1993) and 1 after (1995–1996) the period of no feeding on the treatment area. Hunting success among years and between treatments was compared using analysis of variance in the general linear model (GLM) procedure (SAS Inst., Inc. 1989). Individual hunts were used as the experimental unit with a year by treatment interaction term included in the model. All tests were conducted at the $P < 0.05$ significance level.

RESULTS

Home Range

We monitored 372 radio-marked bobwhites from November to May 1993–1996. This included 189 bobwhites on the control (fed) site and 183 on the treatment (unfed) site. Home range size differed among years ($P = 0.04$) ; therefore, each of the 3 years were analyzed separately. During 1993–1994 and 1994–1995 home ranges of coveys on the areas without supplemental feed (treatment) area were larger ($P = 0.05$ and $P = 0.04$, respectively) than those of coveys on the fed (control) site (Table 1). During 1995–1996, when supplemental feed was distributed on both sites, mean home range size did not differ between courses ($P = 0.90$) (Table 1).

Survival

Log-rank tests indicated there was a significant difference in survival curves between years ($P < 0.05$); therefore, these data were analyzed separately.

Table 1. Home range size (ha) and Kaplan-Meier survival estimates for radio-marked bobwhites on supplemental fed (control) and unfed (treatment) study sites in southwest Georgia, November–May, 1993–1996.

Year	Study site	N	Home range	SD	Survival	95% CI
1993–94	Control	63	3.5	2.1	0.432[c]	0.329–0.536
	Treatment	70	8.3[b]	4.0	0.127	0.080–0.174
1994–95	Control	74	3.3	1.9	0.313	0.229–0.397
	Treatment	60	4.8[b]	1.5	0.271	0.187–0.355
1995–96	Control	52	3.9	0.8	0.305	0.211–0.399
	Treatment[a]	53	3.8	2.4	0.333	0.231–0.435

[a] Supplemental feeding was reinstated on the treatment course at the beginning of this hunting season.
[b] Indicates a home range size significantly ($P < 0.05$) larger than fed study site.
[c] Indicates survival significantly ($P < 0.05$) greater than unfed study site.

During the 1993–94 season, fall-spring survival of radio-marked bobwhites on the site with supplemental feed was higher ($P = 0.005$) than on the unfed site (Table 1). During 1994–1995, there was no difference ($P = 0.76$) in fall-spring survival between the fed and unfed sites (Table 1). During the year supplemental feed was distributed on both sites (1995–96) there was no difference ($P = 0.90$) in fall-spring survival between the 2 sites (Table 1).

Hunting Success

The GLM procedure detected differences ($F = 5.78$, df = 3, 41, $P = 0.002$) in coveys observed per hour of hunting both between years and among treatments. Therefore, these data were also analyzed separately. No difference ($F = 0.05$, df = 1, 12, $P = 0.82$) existed in coveys observed per hour hunted between the 2 courses for the season prior to (1992–1993) or after (1995–1996) the no feeding treatment (Figure 1). During the 2 years of no feeding on the treatment course (1993–1994 and 1994–1995) coveys seen per hour hunted were higher ($F = 8.48$, df = 1, 29, $P = 0.007$) on the course where supplemental feed was distributed (Figure 1).

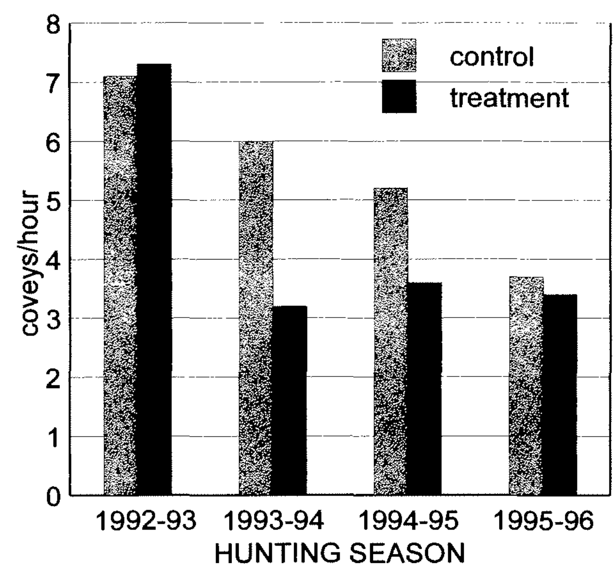

Fig. 1. Bobwhite coveys seen per hour hunted on a supplemental fed (control) and unfed (treatment) study site in southwest Georgia, 1992–1996. Both study sites were fed during 1992–1993 and 1995–1996. The treatment site was not fed during 1993–1994 or 1994–1995.

DISCUSSION

Our results support the observations of others (Frye 1954, Landers and Mueller 1986) that supplemental feeding can concentrate and localize bobwhite coveys during winter. We observed no evidence to support the idea that such concentration has any negative impact on bobwhite populations by increasing predation rates. In fact, during 1 of the 2 years when feeding was discontinued, we observed lower mortality on the site where supplemental feed was distributed. On the area where supplemental feed was distributed, home ranges were smaller and movements were more localized. This may have been attributable to the reduction of foraging time and distances of movements required to meet daily nutritional needs. This was especially true during 1993–1994 when native foods were limited and cover was light due to a drought. The increased movement and activity associated with coveys on places where supplemental feed was not distributed may have made them more vulnerable to predation, most of which (72%) was avian. This is further supported by the fact that once supplemental feeding was resumed on the previously unfed course, home range size was reduced and there were no differences in either home range size or survival between the 2 sites.

Curtis et al. (1988) documented a similar situation in which radio-marked coveys in poor quality habitat had larger ranges and subsequently higher winter mortality due to predation than bobwhites in high quality habitat. In our study, during the year when food and cover conditions were very good (1994–1995) home ranges of unfed birds were still slightly larger; however, their daily activity was much reduced and no difference in mortality rates occurred. Therefore, it appears that localization and reduced movements of bobwhite coveys in winter can, in some cases, have a survival advantage, or at worst, cannot be considered a wholesale negative. This relationship is almost certainly influenced as well by yearly interactions between weather and prevailing cover conditions. Our results combined with those of Curtis et al. (1989) seem to indicate that habitats which provide high quality food and cover result in smaller home ranges, shorter movements, and therefore lower rates of loss to predation. This can be provided by increased cover conditions and abundant food resources whether they are native, planted, or supplemented.

A recent study in Texas (Giuliano et al. 1996) concluded that high protein food sources were needed to overcome drought conditions and that supplemental feeding or habitat management to increase invertebrate abundance were management options. On-going field studies in Albany and elsewhere are investigating this hypothesis and suggest a positive effect on reproductive output under some circumstances as well. Further research is needed into the role supplemental feeding might play from a population level standpoint. Specific data are needed on effects on reproductive output, as well as on varying types of feed and methods of distribution.

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