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# EFFICIENCY OF BAIT TRAPPING AND NIGHT LIGHTING FOR CAPTURING NORTHERN BOBWHITES IN MISSOURI

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## ABSTRACT

We evaluated the efficiency of bait trapping and night lighting for capturing northern bobwhites (*Colinus virginianus*) from October 1993–March 1996 in central Missouri. Fifty-two percent of all birds were captured in bait traps and 48% were captured by night lighting. Of all birds captured for the first time, 59% were captured by trapping and 41% by night lighting, demonstrating the value of using both techniques to capture a large sample size in a limited time. Four percent of all birds captured died before being released. Of the bait-trapped birds, 4% died in the trap and 1% died during processing. Of the night-lighted birds, <1% died during capture and <1% died during processing. Comparing cost and efficiency, it was 3–4 times faster to capture birds by night lighting, but 1.5–2 times more expensive, depending on time of year. Distribution of the survival probabilities did not differ between methods for 1993 and 1995, but did in 1994.

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## INTRODUCTION

Bait trapping and night lighting are common northern bobwhite (*Colinus virginianus*) capture techniques in the Midwest. Knowledge of capture efficiency and cost, and quail mortality are important to planning and conducting research. The Kaplan-Meier method (Kaplan and Meier 1958) is commonly used to estimate seasonal and annual survival of bobwhite quail (Burger et al. 1995, DeMaso and Peoples 1993, Robinette and Doerr 1993, Curtis et al. 1988). One assumption of this method is that capture and handling do not affect survival (Pollock et al. 1989b); however, this assumption has not been rigorously tested. Rather, biologists commonly assign an arbitrary habituation period (e.g., 1 week) after radio marking when an animal's survival time is not considered until it has survived that period (Pollock et al. 1989a). As part of a study on the effect of harvest on quail survival, we evaluated the efficiency of bait trapping and night lighting for capturing bobwhites. Our objective here is to show the utility of using night lighting to rapidly increase the number of quail captured. We also examined post-capture survival to evaluate if potential trapping biases might influence survival probabilities.

## STUDY AREA

This study was conducted on Blind Pony Lake Conservation Area in Saline County, Missouri. The area contains 772 ha of upland habitat, 205 ha of crop field, 422 ha of old fields, and 145 ha woody cover. Topography is gently rolling to flat.

## METHODS

### Bait Trapping

Bait trapping was conducted during the fall (15 September to 15 November), and winter (January). Between 150 and 250 funnel traps (Stoddard 1931) were set during the fall trapping period and 20 to 40 were set during January. Traps were placed in areas considered to be frequently used by quail and were covered with vegetation to conceal captured birds from predators. Traps were baited with cracked corn, milo, and millet. Traps were checked twice daily, approximately 2 to 3 hours after sunrise, and at dusk. Bait lines were checked by 1 person using an all terrain vehicle.

### Night Lighting

We dropped an 8- by 6- m nylon net over roosting coveys. During the second and third field seasons we used a second, smaller net (5 × 3 m). We placed this net directly opposite the primary net overlapping its leading edge. We believe this increased our night lighting efficiency by capturing birds that flushed away from the leading edge of the primary net. Night lighting was limited to coveys roosting in herbaceous vegetation with a relatively open canopy. To reduce thermal stress, we night lighted when temperatures were > -6.7 C. Night lighting required at least 6 persons: 2 for telemetry, 2 to 4 on the large net, and 2 on the small net when used. Telemetry observers used triangulation to approximate location of radio-marked quail and directed net handlers to these sites. Night lighting occurred during the fall (15 September to 15 Novem-

ber), and winter (January and March 1994, March 1995, and February 1996).

### Capture and Processing

We leg-banded all individuals and recorded age, sex, weight, and body fat. Birds were almost always released on the same day or night as captured. In September and October of the first field season (1993) birds weighing >100 g were equipped with a radio transmitter. In November of that year birds weighing > 90 g received transmitters. The remainder of the study (1994–1996) birds weighing >120 g received transmitters. Radio transmitters were necklace style with a mortality sensor (Burger et al. 1995). Radio-marked birds were located  $\geq 6$  days per week.

### Capture Efficiency

Capture summaries are based on data from all 3 field seasons. Time and cost analyses are from the second (1994–1995) and third (1995–1996) field seasons. Capture efficiency is defined as hour per bird captured regardless of the number of people required for different techniques. Cost is defined as labor expense only. Cost per bird captured is calculated assuming a 6-person night lighting crew and a 1-person bait line crew. Actual cost figures were not calculated because of varying pay scales; therefore, cost comparisons are reported. Capture events were classified as “new” if the bird was not wearing a leg band or radio transmitter. Hour and cost per new birds only were also calculated. Both capture methods were conducted in the same habitat with similar quail densities. Because quail densities and habitat types were constant throughout the study, differences in capture efficiency were assumed to be due to use of funnel trap versus night lighting techniques.

For comparison of times we assumed that: (1) time required for handling and processing is equal between trapping methods; (2) stress associated with handling and processing is equal between trapping methods; and (3) time required for set up of each technique is equal. Generally little to no prebaiting occurred for bait trapping. Set up time for bait trapping consisted of clearing a trap area, covering the trap with vegetation, and baiting. Trap lines were moved on the average of once per week. Night lighting set up time consisted of 1 to 2 persons using telemetry locating potential coveys to night light and checking the covey's location for habitat suitability. The time required for set up of each technique is not included in the analysis. Bait trapping time was logged from the first trap of the line to the last. Night lighting time began when the telemetry crew set out towards the covey, and ended when the covey flushed or was captured.

### Survival

We used the Kaplan-Meier method (Kaplan and Meier 1958) to estimate survival, using the staggered entry technique (Pollock et al. 1989a,b). Birds were right-censored if their fate was unknown due to radio

Table 1. Number of northern bobwhite captured by bait trapping and night lighting in central Missouri, 1993–1996.

Year	Bait Trapping		Night Lighting	
	Number new birds	Number recaptures	Number new birds	Number recaptures
1993–94	177	35	133	95
1994–95	220	106	169	23
1995–96	203	55	114	92
Total	600	196	416	310

failure. Survival analyses were calculated for all 3 field seasons individually, using the fall trapping season only. Log-rank tests were used to compare survival distributions between trapping techniques.

## RESULTS

We captured 1,522 quail (including recaptures) from October 1993 to March 1996. Of these, 1,016 (67%) were new captures and 506 (33%) were recaptures. We captured 796 birds (52%) in bait traps and 726 (48%) by night lighting. Seventy-five percent of all bait-trapped birds were new captures, with 25% being recaptures. Fifty-seven percent of all night-lighted birds were new captures, with 43% being recaptures. Fifty-nine percent of all new captures were captured by bait trapping and 41% of all new captures were captured by night lighting (Table 1.)

Four percent of all birds captured died immediately or during processing. Of the bait-trapped birds 4.1% (n = 33) died in the trap and 1.2% died during handling. Seventy-six percent of the bait trap deaths were the result of predation while in the trap. Less than 1% of the birds night lighted died during the night lighting process, and less than 1% of the night lighted birds died due to handling. The overall physical appearance of quail captured by night lighting is outwardly better than quail captured in the funnel traps. Quail tend to hit the top of the trap repeatedly resulting in varying degrees of head and wing scalping. Less obvious injuries may have occurred by both methods, but were not observed. In order to reduce scalping, trap-related stress, and predators, we checked the trap lines soon after morning feeding periods and close to dusk. By comparison, personnel are available on site at the time of capture when night lighting is used.

During the fall, it was 3 times faster to capture a bird by night lighting than by bait trapping; it took 0.9 hours to capture 1 bird by bait trap and 0.3 hours to capture 1 bird by night lighting. However, since our night lighting crew consists of 6 people, it becomes twice as expensive to night light as to bait trap a bird. If the goal is to only capture new birds, it becomes 2.6 times faster to night light (0.5 hours per bird) than bait trap (1.2 hours per bird); however, it is 2.3 times more expensive to use night lighting than it is to bait traps. In the winter months it took 2 hours per bird to bait trap and 0.5 hours per bird to night light. For new birds, it took 2.1 hours to bait trap 1 bird, and 1.2 hours to night light. In the winter months it is 4 times

Table 2. Capture efficiency (hours per bird captured) of bait trapping and night lighting of northern bobwhite in central Missouri, 1994–1996.

	All birds	New birds
Fall trapping season (1 Sept. to 15 Nov. 1994, 1995)	0.9	1.2 Trapping 0.4 Night lighting
Winter trapping season (Feb. 1994, March 1995)	2.0	2.1 Trapping 1.2 Night lighting

faster to use night lighting to capture birds but 1.5 times more expensive (Table 2).

Distribution of the survival probabilities did not differ between methods for 1993 and 1995 ( $X = 1.085$ , 1 DF,  $P = 0.30$ ,  $X = 2.035$ , 1 DF,  $P = 0.15$ , respectively; Figure 1, a and c). In 1994 distribution of the survival probabilities did differ between methods ( $X = 5.830$ , 1 DF,  $P = 0.02$ ; Figure 1b).

## DISCUSSION

The primary objective for the capture phase of any research study is to catch the greatest number of animals for the least cost while incurring the least amount of capture bias, behavioral modifications, and mortality. Given the time constraints we faced during the capture phase in our quail harvest study, we could not have captured our desired sample without using night lighting and bait trapping simultaneously. We captured a similar number of birds by each capture method, although more previously uncaptured birds were captured by bait trapping than by night lighting. Although it was relatively more expensive to capture a bird by night lighting, it was more efficient on an hourly basis. Budgetary constraints may limit the number of night lighting attempts that can be conducted. When planning a study, it may be essential to consider running fewer bait trap lines (to capture the initial bird in each new covey), and spending more time on night lighting.

The most frequently encountered source of mortality was from predators while bobwhites were confined in the bait trap. This could potentially be reduced by covering and “hiding” the traps more thoroughly, by checking the traps more frequently, or by moving traps when predators keyed in on that specific trap or trap line. Theoretically, one should try to avoid recaptures if transmitter replacement or additional data collection is not necessary because of potential mortality associated with handling or stress. If repeated capture increases stress-related mortality, night lighting might be inappropriate because the target covey will always contain marked birds. Our survival probabilities show that there is no difference in survival as a result of different trapping techniques during 2 of the 3 years. The difference in survival during 1994 is probably a result of 1 of 4 night lighted birds dying on the 3rd day of trapping. Other factors which may affect night lighting success are: (1) night lighting is not efficient where vegetation structure at or near roosts is dominated by dense shrubs and vines, and (2) night lighting success might diminish in the winter after potential

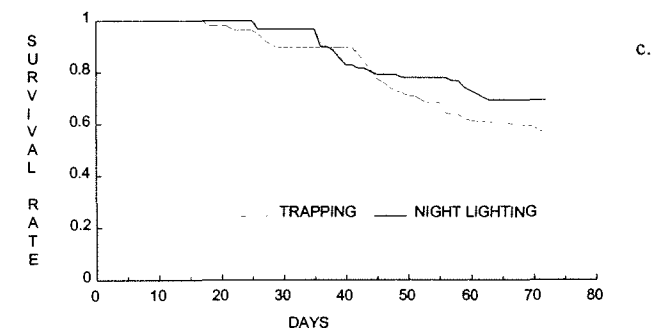
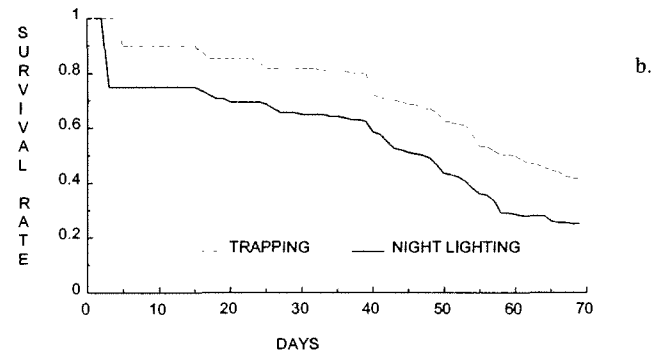
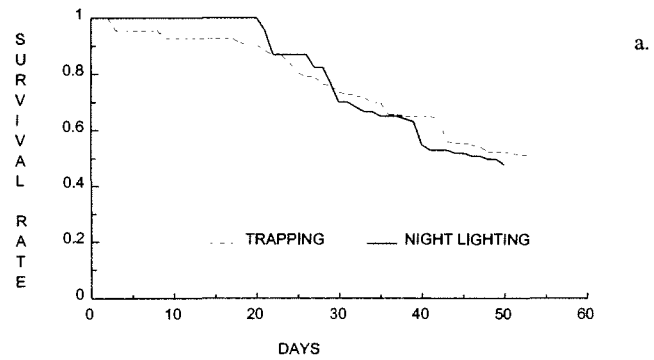


Fig. 1a. Survival probability for northern bobwhites in central Missouri during 15 September–5 November 1993.

Fig. 1b. Survival probability for northern bobwhites in central Missouri during 15 September–15 November 1994.

Fig. 1c. Survival probability for northern bobwhites in central Missouri during 15 September–15 November 1995.

harassment to coveys from hunters and previous night lighting attempts.

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