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the locations having the least social cost, 10 elements including wildlife were utilized in an overlay system similar to those utilized by McHarg (7).

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BOBWHITE POPULATIONS AND HUNTING ON ILLINOIS PUBLIC HUNTING AREAS

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Abstract:

Bobwhite (*Colinus virginianus*) populations on 2 public hunting areas in Illinois have been intensely utilized by hunters since 1964. Hunting has removed an average of 60-70%, and as much as 81%, of fall bobwhite populations, with no apparent detrimental effect on subsequent

population levels. Total harvest and hunting effort were both closely correlated with prehunt quail abundance. Average hunter success was low (1 bird bagged per trip). The most successful hunters were residents of the regions surrounding the areas. The highest hunting success occurred on weekdays during the first week of the season.

This paper describes some of the characteristics of quail hunting and the relationship between hunting and quail populations on 2 state-owned public hunting areas in Illinois during 1964-70. Bobwhites provide the bulk of game-bird hunting on state-owned conservation areas in southern Illinois.

We thank the personnel of the Illinois Department of Conservation's Division of Parks for their cooperation in obtaining hunting data. Paul Moore, G. C. Sanderson, W. R. Edwards, and H. C. Schultz were especially helpful in conducting and reporting the study. This paper is a contribution from Illinois Federal Aid Project W-66-R.

Methods

The study areas, Stephen A. Forbes State Park (now 2,930 acres) in Marion County and Sam Dale Lake Conservation Area (1,300 acres) in Wayne County, and the management programs on them have been described previously (3). Management of the areas has remained unchanged since 1967 with the exception of initiation of more sharecropping on Illinois Department of Conservation lands on Forbes (250-acre increase) in 1968 and on Dale (260-acre increase) in 1970.

State hunting regulations prevail on the areas (8-bird daily limit) except for shorter hunting hours and the compulsory checking procedures. Hunting hours are from 0800 to 1600 daily during the regular season which extends from mid-November to 31 December. Hunters are required to check in at the ranger station before hunting. Each hunter deposits his hunting license and receives a numbered back tag. Hunters must check out at the end of the hunt and declare all game taken. All hunting data are derived from hunter survey cards completed at the end of each hunt.

Quail censuses, using bird dogs, are conducted 3 times each year. We conduct a posthunt census in early January, a prebreeding census in March, and a prehunt census in early November. Population estimates are based on number, size, and location of individual coveys.

Results and Discussion

Hunting and Quail Populations

Results of the censuses and harvest data for 1964-1970 are presented in Table 1. Fall bobwhite populations on the Forbes and Dale Areas fluctuated throughout the study period. Population lows occurred on both areas in 1965, and both populations peaked in 1968. This trend conforms to reported statewide population trends (10).

Quail abundance determined the amount of hunting effort. Regressions of gunning pressure on prehunt quail abundance were significant ($P < 0.05$) for both areas (Fig. 1). Hunting effort increased with increasing quail abundance and, as others have reported (5,7), hunter interest waned as populations decreased. Preno and Labisky (10), however, concluded that in Illinois "bobwhite hunters pursued their favorite game species with a predetermined level of effort that seemingly superseded changes in species abundance" (p. 57). This conclusion was based on a statewide sample, by mail questionnaire, of hunting license buyers and on counts of individual whistling-male bobwhites.

We also found significant ($P < 0.01$) regressions (Fig. 2) of harvests on prehunt populations. Others have reported similar dependencies of harvest on abundance of bobwhites (4) and Gambel's quail (5). Preno and Labisky (10) found no relationship between indices of quail harvest and indices of quail abundance in Illinois. However, they were dealing with spring abundance rather than with fall abundance. We believe that their spring census methods could not produce an accurate index to fall populations, and that harvest does, in fact, depend on quail abundance. Fall abundance of bobwhites, rather than spring, indicates hunting opportunity. In effect, size of the quail populations on our study areas determined the amount of gunning pressure on these areas, much the same as reported for Texas (6).

Hunting removed from 32 to 74% ($\bar{x} = 59\%$) of fall quail populations on Forbes and 54 to 81% ($\bar{x} = 68\%$) on Dale. Bobwhite populations have remained markedly unaffected by this degree of utilization. We found no relationship between the proportionate harvest level of 1 year and fall population size in the subsequent year. Several other studies have shown that hunting has no effect on populations (1,5,8). As further substantiation, we found significant ($P < 0.01$) negative correlations between harvest levels and additional winter losses (Fig. 3) for Forbes ($r = -0.967$) and for Dale ($r = -0.871$). Additional winter losses (expressed as a percent of prehunt densities) occurred between the opening of the quail season and the prebreeding census in March. Total fall and winter mortality averaged 79.5 ± 2.6 (SE) % of fall populations on Forbes and 76.7 ± 1.9 (SE) % on Dale. The negative correlations indicate that low winter losses offset high harvests and, conversely, that high winter losses occurred after low harvests. Bobwhite populations declined to 15-30% of prehunt densities by the following spring, regardless of the harvest.

Quail harvests consistently exceeded 50% of fall populations on both the Forbes and Dale areas. Stoddard (12) proposed a 50% harvest of quail as a possible maximum. Rosene (11) concluded that a 45% harvest was safe if it included crippling loss in the South and crippling and winter losses for the North. Our data for harvests do not include crippling loss. Such losses could not be adequately determined and were considered as part of the winter losses. We can only conclude that, under existing environmental conditions and hunting regulations in Illinois, annual harvest of bobwhites may safely remove 70% of fall populations on similar public hunting areas. This harvest level should be safe in areas having winter conditions no more severe than southern Illinois. We also believe that this high level of harvest will not occur in years

of low quail abundance because lack of hunter interest will preclude such a high proportionate reduction.

Hunting Characteristics

Hunting effort and quail harvest for the Forbes and Dale Areas, 1964-70, are summarized in Table 2. Forbes, with about twice the acreage of Dale, sustained a greater total of hunter trips and gun hours and a greater total harvest than Dale. However, Dale received 39% greater gunning pressure and produced 77% greater harvest per unit area than did Forbes. We believe the greater effort and harvest on Dale to be primarily the result of consistently higher quail densities.

The "average" hunter on both the Dale and Forbes areas flushed about 1 covey per trip and killed 1 bird out of the covey (Table 3). The kill per hunter-trip on our areas was lower than that reported in several other studies. A mean of 2.75 bobwhites were killed annually per hunter trip during 1956-69 in Illinois (10). Harvests of 6.9 bobwhites per hunter trip for the 1950-51 season and 5.4 bobwhites per hunter trip for the 1951-52 season were reported in Texas (8). Hunter success on our study areas may be low due to proportionately fewer experienced quail hunters using public hunting areas. Inexperienced quail hunters killed 1.31 and 1.45 birds per hunter trip on private lands in Ohio during 1959 and 1960, respectively (2). Hunter success may also seem low on Forbes and Dale because biases inherent in using mail questionnaires were not factors in our study.

On the average, hunters on Forbes spent about 40 min more in the field and took 40 min longer to bag a quail than did hunters on Dale, although the time required to find a covey was similar on the 2 areas. Either quail were more vulnerable on Dale or hunters on the Dale Area were better shots than those on the Forbes Area. Data on home counties of hunters may substantiate the latter explanation. On the Dale Area, 58% of the hunters were local residents (within a 6-county area) and only 14% were from the metropolitan areas of East St. Louis, Illinois (2-county area) and Chicago, Illinois (4-county area). On the Forbes Area, 42% of the hunters were local residents (6-county area) and 22% were from the metropolitan areas. Hunters from the East St. Louis area killed only 0.43 and 0.59 birds per trip on the Forbes and Dale areas, respectively. Hunters from the Chicago area killed 0.39 birds per trip on Forbes and 0.85 birds per trip on Dale. Peterle (9) found a negative correlation between the characteristic of residing in a big city and the amount of game killed. The greater success attained by hunters on the Dale Area may also indicate that quail were more vulnerable to hunting on Dale.

On Dale, local hunters bagged 1.13 birds per trip compared with 1.00 birds per trip for all other hunters. On Forbes, the difference was much greater with local hunters killing 1.44 birds per trip and all other hunters killing only 0.76 birds per trip. These findings tend to refute the statement of Preno and Labisky (10) that "the tenacity for hunting, and hence, often success, might be greatest among hunters who travel a considerable distance from their homes in pursuit of their recreation" (p. 33).

Although quail abundance influenced the amount of hunting and harvest in a season, decreasing quail abundance within the season did not steadily reduce effort and harvest. On the Forbes Area, effort and harvest declined through the first 4 weeks of the season then increased slightly from the fifth to seventh weeks. The same trend occurred on the Dale Area but with a considerably greater increase during the last 2 weeks of the season. The kill per gun-hour for weeks of the season (1964-70) is shown for both areas in Fig. 4.

Hunting on weekends was less productive than hunting on weekdays. On Forbes, 54.9% of the gun-hours were expended on weekends and accounted for only 43.9% of the kill. On Dale, 52.7% of the gun-hours were expended on weekends with a resultant 42.4% of the kill. Kill per gun-hour on Forbes was 0.23 on weekends and 0.35 on weekdays and on Dale was 0.29 on weekends and 0.44 on weekdays. The higher success on weekdays was probably the result of less competition between hunters and a higher proportion of local hunters on these days.

Conclusions

Studies of quail populations and hunting on the Forbes and Dale areas for 7 years have shown that the most successful hunters were local residents who hunted on weekdays during the first week of quail season. Although individual hunter success was not great, extremely large proportions of the bobwhite populations were harvested. Evidence indicates that harvests of 70% of fall bobwhite populations were not excessive on these two public hunting areas.

Annual effort of hunters and the harvest of quail depend directly on quail abundance. This dependency indicates that merely providing the land and opening the season does not provide hunting opportunity. Hunting opportunity can be increased on existing public hunting areas by providing more game through effective habitat management.

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Table 1. Bobwhite population densities and harvests and hunting effort on the Forbes and Dale Areas, 1964-1970.

	1964	1965	1966	1967	1968	1969	1970	1971
Forbes								
Prehunt population (quail per 100 acres)	18.2	9.4	14.2	27.1	33.3	26.1	23.3	
Harvest (quail bagged per 100 acres)	11.5	4.5	10.5	17.9	23.4	15.8	7.5	
Hunting effort (gun hours per 100 acres)	49.5	18.6	29.1	52.6	60.1	60.8	51.0	
Posthunt population (quail per 100 acres)		6.7	2.4	3.7	9.2	9.9	7.6	6.0
Prebreeding population (quail per 100 acres)		3.4	1.9	4.9	4.8	7.3	4.6	3.1
Dale								
Prehunt population (quail per 100 acres)	26.9	18.5	29.7	36.4	49.7	41.7	37.1	
Harvest (quail bagged per 100 acres)	21.7	11.4	22.4	22.0	32.2	32.7	20.1	
Hunting effort (gun hours per 100 acres)	60.8	58.4	60.5	60.5	73.4	73.3	64.2	
Posthunt population (quail per 100 acres)		10.5	5.5	10.6	18.1	17.6	9.0	
Prebreeding population (quail per 100 acres)		3.8	3.5	7.8	9.4	12.7	10.0	10.5

Table 2. Hunter efforts and quail harvests on Forbes and Dale Areas, 1964-1970.

	Hunter trips		Gun hours			Harvest		
	Total	Mean	Total	Mean	Per 100 A.	Total	Mean	Per 100 A.
Forbes	2,000	286	7,395	1,056	46	2,096	299	13
Dale	1,657	237	4,939	706	64	1,780	254	23

Table 3. Characteristics of quail hunting on Forbes and Dale Areas, 1964-1970 averages.

	Gun Hours/ hunter trip	Kill/ hunter trip	Gun hours/ kill	Coveys/ hunter trip	Gun hours/ covey
Forbes	3.7	1.0	3.5	1.4	2.7
Dale	3.0	1.1	2.8	1.1	2.7

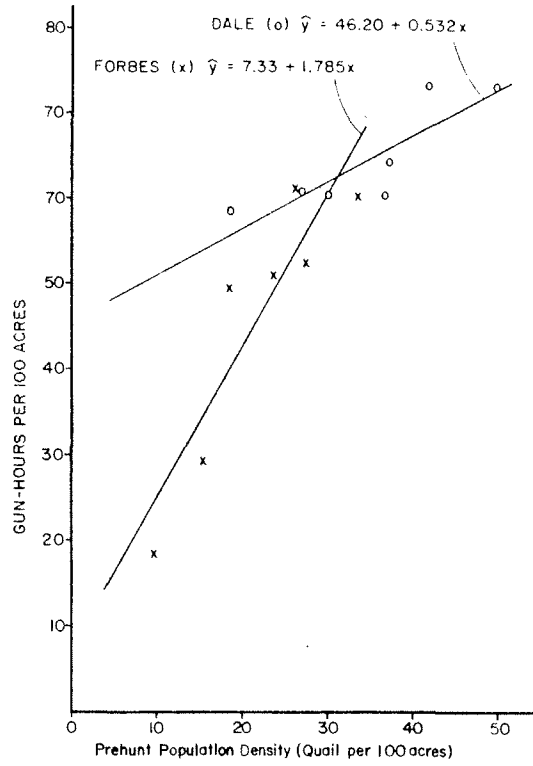


Fig. 1. Regressions of Hunting Effort on Prehunt Bobwhite Abundance, Forbes and Dale Areas, 1964-70.

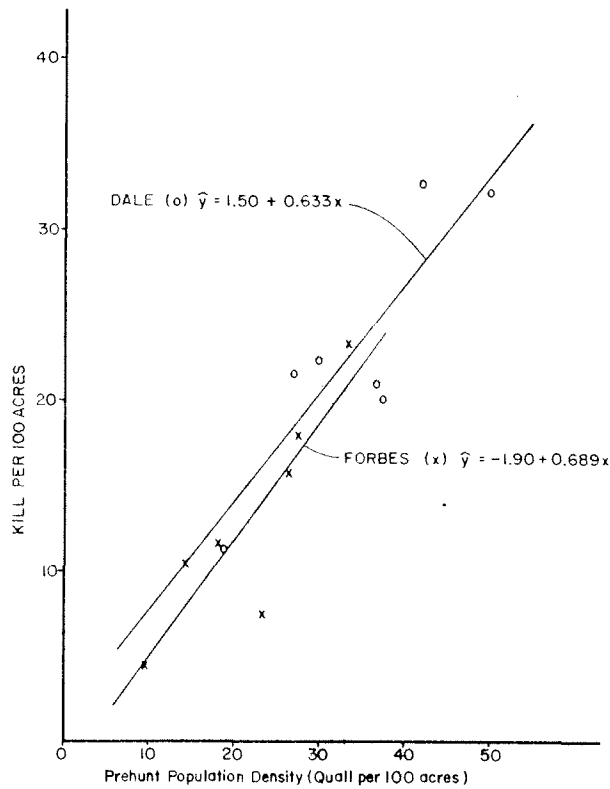


Fig. 2. Regressions of Harvest on Prehunt Bobwhite Abundance, Forbes and Dale Areas, 1964-70.

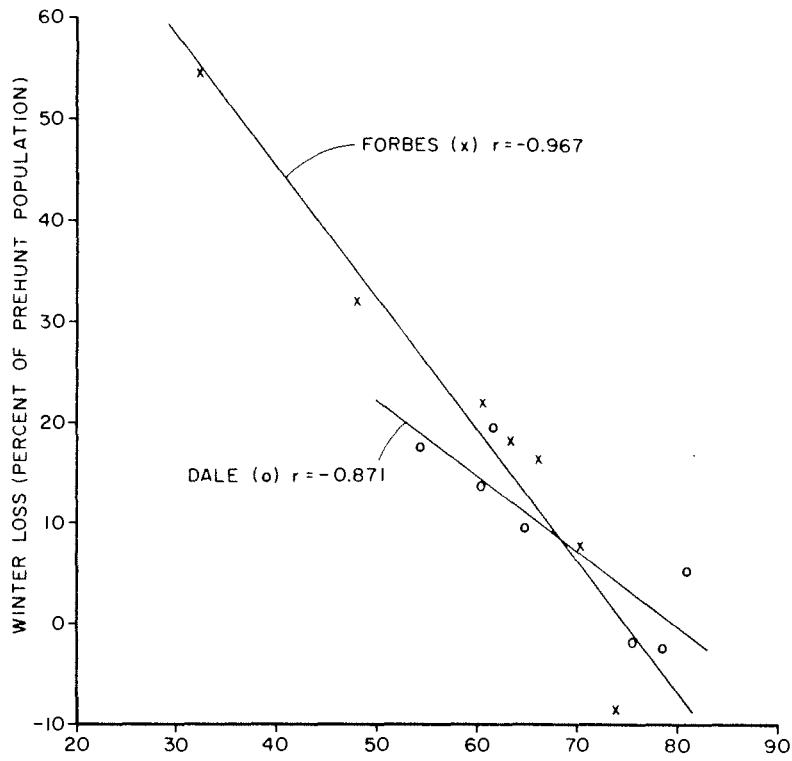


Fig. 3. Relationship of Harvests and Winter Losses of Bobwhite Populations, Forbes and Dale Areas, 1964-70.

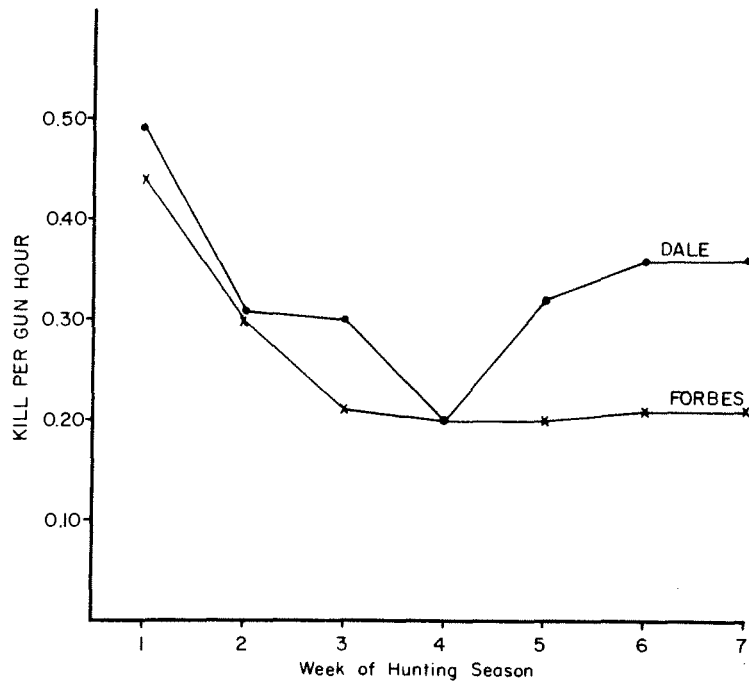


Fig. 4. Hunting Success During Successive Weeks of the Hunting Season, Forbes and Dale Areas, 1964-70.

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QUAIL, LAND USE, AND WEATHER IN ILLINOIS, 1956-70

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Abstract:

Bobwhite quail (Colinus virginianus) populations were at a 15-year high in 1968 and 1969 in Illinois. Analysis indicated that quail abundance over the years from 1956 through 1970 was significantly correlated with changes in land use and weather. Adverse effects associated with increased acreages of row crops and reduced acreages of oats appeared to be offset by aspects of land use, favorable to quail, that were associated with reduced acreages of harvested hay. Quail also appeared to be adversely affected by heavy snow, above-normal rainfall in late winter and spring, heavy summer rains, and drought in summer and fall.

The objective of this analysis was to use stepwise and multiple correlation techniques to identify some of the population, land-use, and weather parameters associated with fluctuations in the abundance and harvest of bobwhites in Illinois during the years from 1956 through 1970. This paper represents a preliminary examination of highly complex relationships.

The concept of the analysis was that abundance and harvest reflect the quality of the environment for quail and that changes in abundance