EVALUATION OF THE RELEASE OF PEN-REARED BOBWHITES AS A METHOD FOR INCREASING QUAIL POPULATIONS IN OKLAHOMA

By

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INTRODUCTION

Game management has followed five historical steps in man's effort to restore and sustain game populations. According to Leopold (1933, p. 4), these steps were:

> "(1) Restriction of hunting, (2) predator control, (3) preservation of game lands (as parks, forests, refuges, etc.), (4) artificial replenishment (restocking and game farming), and (5) environmental controls (control of food and cover, special factors, and disease)."

While each practice has served to aid game management, none of them alone has solved the problem. For bobwhite quail (Colinus virginianus) management on public lands, restriction of hunting and environmental control have proved to be the most effective tools with which to sustain quail populations. Environmental control, based upon ecological requirements of the individual species, together with basic land management, has definitely increased game numbers in Missouri (Steen, 1950). The first four steps have all been used, and in some instances excessively so, in development of game resources. While each has proved to be a useful tool to the profession, too much stress has at times been placed upon one or another of the practices without definite evidence that the program actually was increasing or even maintaining the supply of game.

Game farms operated by state agencies for the replenishment of bobwhite quail have in many instances received more than their share of emphasis. In a survey made by Buechner (1948), it was found that six of the seventeen important bobwhite states had abandoned their game farms, while three others had decreased production. Only two states, Oklahoma and Kentucky, had greatly increased production of artificially propagated game birds.

In view of the uncertain results of increasing the hunter's bag by pen-reared stock, the Oklahoma Game and Fish Department requested the Oklahoma Cooperative Wildlife Research Unit[1] to undertake an extended study of the game farm quail in the field. This study was initiated by Helmut K. Buechner in the summer of 1948. Buechner selected six study areas representative of various Oklahoma game types. Originally six clubs cooperated in the work. These clubs were: Okfuskee County Sportsman Club, Okfuskee County, representing postoak-blackjack forest and tallgrass prairie type; Kingfisher Coyote Roundup Club, Kingfisher County, representing tallgrass prairie type; Custer City Sportsman Club, Custer County, representing mixedgrass-eroded plains, and tallgrass prairie type; Wewoka Sportsman Club, Seminole County, representing postoak-blackjack forest type; Perry Sportsman Club, Noble County, representing tallgrass prairie type; and Johnson County Sportsman Club, Johnson County, representing postoak-blackjack forest, and tallgrass prairie types. The last club was dropped from the program because the number of birds released was inadequate to furnish information on field survival. Two other clubs, Watonga Sportsman Club, Blaine County, representing sand-sage grassland type and postoak-blackjack type, and Seminole Sportsman Club, Seminole County, representing postoak-blackjack type, were added to the group in the fall of 1948 because of their willingness to cooperate in gathering information.

The writer continued the project by carrying out the actual field research from September 1, 1948 to September 1, 1949. This study included

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[1]Oklahoma Cooperative Wildlife Research Unit, supported by the Oklahoma Game and Fish Department, Oklahoma A. and M. College, Wildlife Management Institute, and Fish and Wildlife Service, U. S. Department of the Interior.

pre-hunting season quail trapping, gathering information from sportsmen during hunting season[2], winter and spring quail trapping, breeding season studies, tagging, releasing and study of 1949 pen-reared quail stocking.

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[2]The Oklahoma hunting season opened on November 20, 1948 and continued to January 1, inclusive. Only Tuesdays, Thursdays, Saturdays, Thanksgiving, Christmas and New Year's Day were quail hunting days.

REVIEW OF THE LITERATURE

Reports of restocking studies are numerous in the wildlife literature, however, interest in the subject has shown an abrupt decline in recent years. To make a complete survey of literature concerning bobwhite quail restocking would entail a voluminous manuscript. The literature was well covered by Buechner (1943), in which he cites 50 pertinent references. To acquaint the reader with the history of bobwhite quail restocking in Oklahoma, the writer has summarized below all known work on the subject in this state, for this study is by no means the first intensive work done in Oklahoma on bobwhite restocking.

Baumgartner and Stoneber (1941) conducted an evaluation study at the Lake Carl Blackwell Game Farm located at Stillwater, Oklahoma in which important results were brought out. They summarized:

> "The returns from 16,586 banded game farm bobwhite quail raised and liberated throughout Oklahoma from the Lake Carl Blackwell Game Farm have furnished the following information: (1) Data on the dispersal of 42 young birds indicated that 60 percent established winter ranges the first year within one mile of the point of release; 24 percent moved from one to five miles; nine percent moved from six to ten miles; seven percent moved from 11 to 20 miles. (2) Only 62 or .37 percent of the bands have been reported by hunters. (3) The limited data at hand suggest that the game farm birds seldom live long enough to nest and raise a brood of young. (4) From data on survival it is estimated that each quail shot by the hunter costs at least $50. Unless the percentage of survival can be materially increased, there does not appear to be justification for the artificial propagation of bobwhites in Oklahoma."

Selko (1940) tabulated information returned with leg-band reports which represented the release of 20,000 bobwhites in Oklahoma. In his work the results are summarized:

Of 20,000 bobwhites released in the summer and fall of 1940, 252 (1.26 percent) bands were returned. In 222 of these returns the movement

could be checked. The movement varied from one-fourth mile to 25 miles, while the average was 2.05 miles measured 'as the crow flies'; seven birds had moved over 15 miles.

Selko found it difficult to estimate the number of leg bands not returned. Some of the reasons for failure of sportsmen to report such kills were: (1) Many individuals fear implications in some manner, (2) Birds killed on refuges were not reported since it was a closed area, (3) Some hunters would not trouble themselves with the report, (4) Some hunters considered the banded birds as 'special birds' and hence should not have been killed.

Much attention was given to pen-reared quail by Duck and Fletcher (1944, pp. 53-56) in their game survey in which they state:

> "Obviously the one function of a quail hatchery is directly or indirectly to increase the hunter-take of birds for the state as a whole, while keeping within a cost range, either by low per-bird cost of production, or by a high percent of establishment and increase, whereby the total expenditure is justified.....
>
> "It must be understood that survival of hatchery-released birds does in no way insure an increase in the total population of quail."

During the summer of 1940 Duck and Fletcher studied refuge areas as related to release of hatchery-reared bobwhites in 44 western Oklahoma counties. They point out that much of the area once supported excellent bobwhite populations, but extensive cultivation to wheat, extremely heavy grazing, and other intensive cropping practices had so reduced the cover and food that quail were no longer found there. As a result of these changes in land use practices, no less than 87.1 percent of the refuge acreage in which stocking was carried on was deemed unfavorable to quail and 84.6 percent of the releases of the birds themselves were concluded to be unjustified. Then only 12.9 percent of the refuge acreage there bobwhites were released was really favorable to quail; and only 15.4 percent of the

hatchery-reared stock was released in places where they had a chance.

The populations of quail on the refuge-stocked areas are compared to those inhabiting the hunted non-stocked areas. A loss of 16 percent occurred from the date of release to the fall census on the refuge areas in 1940, and 15.9 percent in 1941. A census of native populations was not made and the only known number of birds on the area was that of liberated game farm stock. Since this was the case, it was assumed that the loss in pen-reared birds was much greater because some of the birds counted in the fall census were undoubtedly natives.

Winter losses differed approximately one-half of one percent on the two areas; the refuge-stocked area having 54.0 percent decrease in the fall population; for the non-stocked hunting area the winter loss, hunting included, was 54.4 percent. "This suggests that neither stocking nor protection from hunting are effective means of increasing quail."

The stocked refuge areas showed an increase of 30.4 percent over spring breeding populations which amounts to a reproductive survival of 2.8 fall birds for each probable breeding pair. Similarly, the shot-over, non-stocked check areas showed 37.7 percent of the breeding population or reproductive survival of 3.1 fall birds for each probable spring pair. They state: "From these data we are unable to see that the release of hatchery stock effects more than a temporary influence on population levels on average refuge conditions."

Probably the most intensive field research conducted on pen-reared bobwhites in Oklahoma was made by Baumgartner (1941). The work done on that project corresponds very well with much of the research discussed herein. Baumgartner summarizes his work as follows:

"A field study on the dispersal and survival of 1,064 game farm bobwhite released on an area in Northcentral Oklahoma yielded the following information:

1. Under unfavorable conditions for establishment, such as poor range conditions or a surplus of wild birds in the area stocked, neither adults nor young established themselves.

2. When environmental conditions were favorable, both adults and young tended to take up ranges within a mile of the point of liberation; a few individuals dispersed rapidly and moved from two to eight miles during a period of a few days to several months.

3. Adult bobwhite liberated in the summer and autumn apparently were unable to cope successfully with conditions in the wild and did not provide stock for either hunting or breeding.

4. When environmental conditions were very favorable, it was estimated that as many as 50 percent of the young furnished hunting in the late autumn and 45 percent were available as breeding stock the following spring. A few survived a second summer.

5. Survival of the birds that moved off of the areas stocked was apparently so limited that they did not materially supplement the wild populations.

6. Heavy restocking with game farm birds appears to be costly and a rather futile method to increase bobwhite populations for either hunting or breeding stock."

Over a five-year period 57,060 hatchery bobwhites costing $100,000 for production were released in Oklahoma; 722, or 1.26 percent, of these birds were taken by hunters (Hanson, 1947, p.20). He states:

"One band was recovered four years after release, one turned up two years later and ten birds were taken approximately one year after being released. All other recoveries were made during the hunting season immediately following release, usually a matter of two or three months."

By wing examination, Hanson also found 74 percent of the season crop composed of birds hatched in the current year. The yearly production may even run up to 86.0 percent. (This suggests a high death loss before the second year in native quail and hatchery birds would surely follow this trend.)

In a survey of wildlife conservation work in Oklahoma conducted by the Wildlife Management Institute, Gabrielson (1949, pp. 17-18, 35) made the following recommendations in regard to the hatchery program.

> "It is recommended that trapping and transplanting programs be used wherever possible in stocking newly developed habitat or restocking areas with depleted populations.
>
> "It is recommended that the game farm production be tied in closely with the entire management program. Less emphasis should be placed on numbers of birds produced and more on improving planting methods in an effort to secure greater survival. Planting of game farm birds should be limited to areas in which new habitat has been developed or areas where populations are depleted or reduced. Planting should only be done on the recommendation of the resident management agent and then under his supervision. All birds planted should be banded and every effort made to determine the extent of survival.
>
> "Game farms are useful when used intelligently and in a businesslike manner. The results obtained rather than the numbers planted should be the factor that determines the annual bird rearing program. In other words, the game farm should be an integral part of the management program and used as any other management tool should be used--only when and where it gives results.
>
> "While assigned to the Game Division, the game farm operates more or less as an independent unit. For many years, it has carried out a program of propagating and distributing pen-reared quail and to a less extent ring-necked pheasant. There is comparatively little good pheasant territory in Oklahoma and the number of pheasants that can be distributed with any hope of success is limited.
>
> "9,625 bobwhites were distributed in 1946, while in 1947, 20,874 were released, and in 1948, 65,435. Quail released in later years have been banded but returns, as the case in many states, have been low. Judged on the basis of available data, there is little justification for the continuation of this program. The increase in number of birds released is not entirely a fair comparison with previous operations since in the last two years, 3 to 4 week old birds have been delivered to cooperators, who have been responsible for the expense of carrying birds to the time of release. This plan has the advantage of interesting many more people in this phase of the work and does have some public relation values. However, such data as is available does not indicate any greater average survival than that obtained by other methods."

Before 1930 game management had received but little consideration. State programs were of small scale because of a shortage of trained personnel and a

lack of funds with which to put forth an extended research program on their own. The birth of the Pittman-Robertson projects opened the door to solving state game problems and there was an increasing recognition of game importance. States were inclined to set up projects with which they were more closely associated or with which the sportsmen were best acquainted. To quote Rutherford (1949, pp. 11-12, 33-36) a history of the increase, decline, and cessation of artificial propagation in Pittman-Robertson work has been outlined.

> "Ten years ago, most state wildlife programs consisted almost entirely of law enforcement, game bird restocking, and predator control. The majority of sportsmen had been sold on these activities as producers of the highest returns for them. But there were questions in the minds of many state game administrators and more observing nimrods, about the real dividends from investments in large-scale bird stocking and high-powered predator control campaigns (particularly those featuring bounty payments). Technically trained wildlife workers were hired, with the help of Pittman-Robertson funds, to get the facts. They soon proved that widespread and indiscriminate plantings of game birds were not paying their way. This led to a decline in pen-reared bird releases and increased emphasis on habitat improvement. It is universally agreed now that the only excuse for this kind of stocking is to introduce new species or restore birds to suitable habitats from which they have been cleaned out. High production costs and low survivals would bankrupt a game department if it tried to stock sufficient birds on a large enough scale to meet hunting demands.
>
> "Instead of laying out their Pittman-Robertson cash to build bigger and better game farms, the states have swung over to improving wildlife living quarters on the land.
>
> "When the Pittman-Robertson program began, bobwhite restoration consisted almost entirely of stocking pen-reared birds. Sportsmen had been sold on the effectiveness of that approach. Improved game farm techniques enabled game breeders to turn out birds in large quantities. It was generally assumed that liberal dosages of artificially produced quail were the sure cure for ailing populations.
>
> "Field studies conducted since 1938 have proved that game farm products have been grossly over-rated as a means of increasing the supply of bobwhites. Such stockings have all too frequently been carried on with little or no attention to the adequacy of food and cover where liberations were made, or to the ability of released birds to survive under wild conditions. Chronic failures were inevitable. Even where stocking had been carried on to improve

> hunting conditions immediately, hunters' bags the first season have been found to contain only 4 to 33 percent of the birds released. Very few are bagged the second season. The great majority of stocked birds disappeared rapidly from release sites. Because they are abnormally tame, many are taken by predators. Some are lost to exposure and others simply wander away. Studies in Pennsylvania have shown that although popular with the hunters, the restocking program, for the money expended, has been the least effective of the Commission's quail management practices.
>
> "The 1947 spring quail census of Fulton County, Pennsylvania ... showed that wild birds--without any help from game farm additions--were able to maintain their numbers for a period of a year during which nearly all of the 2,000 pen-reared quail were lost.
>
> "The results of nearly 100 field studies in 29 states have proved to wildlife administrators that the dividends from quail stocking programs are low indeed. This has led to a shift in restoration emphasis; quail living quarters are either being created or improved on the land. Without required food and cover conditions, no amount of stocking--be it wild or artificially propagated birds--will put more bobwhites permanently in the coverts."

Oklahoma enacted legislation on April 12, 1939, which complied with requirements of the Pittman-Robertson bill and made her eligible for federal funds to assist in wildlife work. Annual appropriations are divided among the states on a basis of land area and the number of paid state hunting license holders. States are allowed two years in which to obligate their annual apportionment and should they be unable to qualify for their share, the sum reverts to the Fish and Wildlife Service. Oklahoma by 1948 had lost $6,020.24 as a result of being unable to match Pittman-Robertson apportionments; $32,492.50 was at that date unmatched and would revert to the Fish and Wildlife Service unless obligated (Rutherford, 1949, appendix).

Since Pittman-Robertson funds cannot be spent on restocking and such a program, if carried on, must be financed by state license money, it seems feasible to shift some restocking money to Pittman-Robertson unobligated funds and thereby gain $3.00 for each $1.00 spent.

Kelly Debusk (1949, p. 7), Director of Oklahoma Game and Fish, commented on the state's inability to match funds allocated for P-R projects by saying:

> "The sale of firearms and ammunitions continues to mount if the excise tax on such materials is indicative. Last year (1948) $249,000 of such tax money was allocated to our department. We have not yet found sufficient matching money to qualify for all this fund."

Duecimer (1948) brings restocking up to date for the entire country. His work is summarized as follows:

> "The present paper gives special attention to the place in bobwhite management of the method of propagation and release of pen-reared birds. A survey of the literature and policies of 17 bobwhite quail states showed that the method is costly and does not materially increase the shootable population of bobwhite.
>
> "The score at present stands as follows:
>
> (1) One state, Georgia, distributes bobwhite eggs to 4-H and FFA clubs.
>
> (2) Another state, West Virginia, has increased production from 6,000 to 9,000.
>
> (3) Two states, Iowa and Louisiana, maintain production at 5,000 to 8,000 bobwhite per year.
>
> (4) Two states, Mississippi and Texas, have no game farms. Three states, Indiana, Pennsylvania, and Virginia, have decreased production of bobwhite.
>
> (5) Six states, Alabama, Arkansas, Florida, Missouri, North Carolina, and South Carolina, have abandoned their bobwhite quail farms.
>
> (6) Two states, Oklahoma and Kentucky, report a considerable increase in game farm production of bobwhite.
>
> Thus with three exceptions bobwhite game farms in 17 bobwhite states are being maintained at low level, production decreased or abandoned.
>
> "Seemingly propagation and release of game farm birds has a place (1) on suitable areas where bobwhites have been killed out either by overshooting or some natural catastrophe, or (2) where favorable habitat has been created and is not being stocked by native population. Such instances will be few and far between.

"Huntable numbers on an area are regulated not by the birds that may be liberated but by the carrying capacity of the area during the season of greatest stress. If the habitat is improved from the bobwhite quail's own point of view, there will be more birds. If the carrying capacity is not increased, liberation of additional birds may exercise no appreciable effect. The ability of depleted bobwhite populations to bounce back to normal in a season or two from natural increase, as it does in Texas and Oklahoma, can correctly be doubted.

"According to our reports, costs of hatchery production vary from $0.61 to $3.00. Low survival of pen-reared birds results in costs per bird in the hunter's bag up to $2.00, $3.50, $4.00, and even $53.56 in particular cases. Apparently the income from license sales to quail hunters falls far short of the funds required for large-scale restocking.

"In states already possessing large investments in quail farms, the release of pen-reared stock perhaps may be justified as a means of interesting youth groups and sportsmen's clubs.

"Such farms might well be used also as production centers for game wares closely justified, on a regional basis, through sale or exchange of pen-reared stock to nearby states. The game farm birds produced might serve also as research material, perhaps in cooperation with cooperative units or educational institutions or the United States Fish and Wildlife Service for getting answers to some of the questions sure to arise in bobwhite quail food habits, nutrition, life habits, parasites and diseases, adaptation and survival, and population dynamics.

"The available evidence already indicates little success with large-scale restocking programs. Gambell (1946) points out that restocking in any form should be done only in emergencies or when high cost is not an item of consideration. He states that the birds should be released immediately before the hunting season to provide a maximum of return. At the present time, propagated birds are costly. Natural production of game is likely to be far less costly and more practical.

"It may be expected, however, that ultimately sportsmen will insist on one hundred cents of return in harvestable birds for each dollar spent by the game department. Perhaps this may be more certainly secured through expenditures for habitat improvement, for studies to develop better methods of game increase or, by subsidizing each state dollar with three federal dollars for wildlife restoration through the Pittman-Robertson program than through large-scale release of pen-reared birds. Game departments throughout the country are to be commended for their sincere efforts to get the most out of ranges at their disposal. They are continuing and rightly so, to look with a critical eye on all procedures whether new or old, with a view to supporting those which really increase the game."

OBJECTIVES OF THE PRESENT STUDY

This research problem was undertaken for the purpose of conducting a further detailed study of hatchery-raised bobwhite quail liberated in the wild in selected game types in Oklahoma. Main objectives of the project were:

1. To evaluate rearing and releasing methods employed by the sportsmen's clubs.

2. To determine the percent of game farm birds establishing themselves in the wild.

3. To determine the total hunting contribution of hatchery quail and the percent of return of leg-bands from released pen-reared birds by sportsmen.

4. To determine the percent of game farm quail surviving through the hunting season and winter weather to serve as potential breeders the following spring.

5. To evaluate the general efficiency of restocking as a supplement to the native population.

DISCUSSION

GAME TYPES UNDER STUDY

The important game types in Okfuskee County, where the bulk of the work was done, consist of postoak-blackjack forest type with an irregular 'U' shaped area of tallgrass-prairie type which makes up a small percent of the county. Okfuskee County consists of small farms and ranches, small creeks and draws and irregular patches of scrub oak timber. This pattern of cultivated and natural vegetation made a maximum of edges and broken types which are favorable to bobwhite quail.

Custer County, where a lesser amount of work was done, has mixed grass-eroded plains, and tallgrass-prairie types. Quail were limited to a narrow belt in and around canyons and windbreaks which were the only areas of suitable food and cover. Large tracts of wheat land principally former tallgrass-prairie and mixed grass-eroded plains afforded absolutely no cover suitable to quail.

MANNER OF HANDLING BIRDS

Handling at Game Farm

The State Game Farm located at Old Harlington, five miles northeast of El Reno, Oklahoma is one of the most modern game farms to be found. W. A. Gaines, the farm superintendent, has established a smoothly functioning organization which produces 60,000 to 65,000 bobwhite quail per year. Strict rules of sanitation and good management have assured the maximum production of healthy birds.

All quail are hatched by electric incubator and reared inside for two weeks under temperature-controlled conditions. They are then transferred to the field where groups of 25 are conveyed together in rearing coops.

Handling by Sportsmen

At four weeks of age the birds are distributed to sportsmen's clubs who go to the game farm to receive the quail. Once the birds have been taken from the farm, all care and expense is assumed by the club. Each club is bound by contract with the State Game and Fish Department to release quail on lands open to hunting; to leg-band and record band numbers of all quail; and to report legal location and number of birds in each release. Furthermore, each club is required to construct specially designed rearing coops where the birds are held in coveys of 20 until they reach an age of eight weeks. Some clubs liberate 10 birds in a covey, others 20. Sportsmen's clubs are on their own after the birds leave the game farm except for a limited amount of advice and assistance which may be received from the local game ranger.

Release Methods

The Okfuskee County Sportsman Club proved to have a unique method of handling birds during the actual release operation. All equipment and tools used were previously made ready for the job. Releases were scheduled on Sundays as more help was available on those days. Early releases, six to seven a.m., were made in order that the birds might have time to adjust themselves to the environment before night and that sportsmen wishing to attend church might do so. Persons taking part in the release were notified in advance of the chosen date.

The Okfuskee Club's equipment consisted of several special tools designed by that club for greater efficiency in handling. These tools were dropboard, pusher, catchboard and release box. The dropboard was constructed of one-fourth inch plyboard which was dropped between the coop and outer run and served to confine the quail to the coop. The pusher was a strip of one-fourth

inch hardware cloth tacked to a handle and used to force the quail into the coop. The catchboard was a piece of one-inch board of the same dimensions of the coop door. It was fitted in place of the door for catching operations. Two holes, eight inches in circumference over which rubber inner tubing was stretched and tacked, were cut in the board. A slit was made in the rubber which allowed the birds to be removed singly from the coop without danger of others escaping. The release box was a cardboard container, one foot or more square, which was large enough to hold 20 birds. Air holes were cut in the box and an improvised door made by cutting out three lower sides of a three-inch square in one wall of the box. After the birds were caught, banded, crated, and the necessary records made, they were immediately taken to the release site.

During the study it was brought to our attention by two of Oklahoma's game rangers that some of the sportsmen's clubs were not giving proper attention to rearing, handling, and releasing of the hatchery quail. Lack of interest was evidenced by several groups when an inadequate number of men arrived for the release operation. Where the club failed to take the proper action the game ranger became responsible for releasing the birds. Judging from the wide differences in band return records from clubs in the same game type, it appears that a higher survival depends largely upon superior handling technique. Seemingly these evidences of neglect and lack of interest should result in the loss of the right to receive birds from the game farm.

METHODS EMPLOYED IN OBTAINING SURVIVAL OF PEN-REARED BIRDS

Pre-Hunting Season Trapping and Netting

Purpose of Trapping - Many sportsmen regularly insisted that they were able to distinguish game farm quail from native stock by their dissimilar actions, the hatchery quail being the more reluctant to fly and often alighting in trees. The native quail, on the other hand, flushed readily and flew to cover some distance away.

While this observation held true in some cases, it was not so in many others. Unless the leg-bands actually were seen the pen-reared birds could not be positively identified. Since the native and pen-reared quail could not be distinguished without it, trapping was the only means of gaining data concerning survival of the released birds. According to plan, trapping was carried on at two principal periods. Pre-hunting season trapping was carried on in an effort to estimate the number of liberated birds living through the summer and remaining available for harvest during the open season in the fall. Post-hunting season trapping was used to ascertain the number of pen-reared quail surviving hunting season and which constituted potential breeding stock for the following nesting season. Returns of leg bands by successful hunters during the open season naturally gave the survival up to and during that period.

The ratio between pen-reared and native birds was carefully recorded and helped to indicate the supplementary significance of the hatchery stock.

Type of Traps - The traps used were a modification of the Stoddard standard trap (Stoddard, 1931, p. 442). These traps were identical with the standard traps in dimension but were constructed of one-inch mesh chicken wire. In the tops of some of the traps fish netting was secured to prevent injury. This worked satisfactorily except that there was some damage by

rabbits and predators which were caught in the trap. The funnel of the trap was constructed of hardware cloth, the entire length of which was attached to the wire bottom of the trap to hold it in place. It was found during the study that quail would not hurt themselves unless they were disturbed by predators or other causes. Some birds were known to have been in the trap over night without receiving injury.

Netting - The old-time Fike net or wing net (Stoddard, 1931, p. 440) was set up on a number of occasions but did not prove to be a successful means of taking quail in this area as fences, gullies and wooded areas interferred with use of the net and a one-man operator apparently cannot handle it effectively. With a well constructed fike net, a four-wheel drive jeep for transportation, and a crew of two or more, this method might have taken a significant number of quail.

Another method of catching quail was tried but was found to be of little value. This was a circular cast net, six feet in diameter, ordinarily used for capturing bait fish in salt water. Around the circumference of the net, barrel shaped lead sinkers were attached at regular intervals of six inches. In the center was a metal grommet through which small cords pass and fasten to the circumference some six inches apart. These cords acted as a purse string in catching fish; however, they were found to be a hindrance in taking quail and were therefore removed. The method used in this work was as follows: when the bird dog came down on point, the netter moved quietly into position directly behind or to one side of the pointing dog. An attempt was made to see the birds in order that a more accurate cast could be made. The net was held by the circumference and spread by momentum as the thrower made a complete pivot. The net was released at a point where force would carry it over its mark. Adult quail were vulnerable

to the net because they flushed from the ground with great force and became entangled in its meshes. Young quail, four to five weeks of age, did not rise fast enough to become caught and dropped to the grass to escape on foot. An old, steady bird dog was found to be most desirable for this work. It was discovered that one could become accurate for a distance of 15 to 20 feet under proper conditions. Casting accuracy was hindered by high wind and thick brush.

Locating Trap Sites - Location of points where coveys were released was obtained from the cooperating sportsmen's club but these liberation sites could not be pin-pointed without contacting the person who actually made the release. To avoid criticism and to give the game farm birds every benefit of doubt, trapping was carried on only where quail were liberated in 1948 or in the vicinity of such releases. Some sportsmen made regular checks on the coveys which they had turned out and they usually were the most informative persons to contact. After interviewing the sportsmen, the area was searched with the aid of bird dogs and the results recorded. In all instances, traps were set on areas that quail were known to be using. These sets were made in favorite loafing places such as brushy fence rows, coral berry patches, green briar tangles, dogwood thickets, and weedy spots which gave evidence of much use. The frequency with which a covey visited a covert was determined by looking for droppings, feathers and dust baths.

Trapping Technique - No 'surefire' technique was discovered. It was found that any covey, and generally all of the covey, could be taken if enough time and patience were devoted to the task. Points which were thought to influence the catch may be listed as follows:

1. After location of the area most frequented by the covey, the trap was set. The character of the situation greatly influenced placing of the

trap. Where signs were concentrated in a small area, the trap was placed as near as possible to the main used area, dust bath, or loafing spot. Without disturbing the familiar or general aspect of the surroundings, a space the same dimensions of the trap was leveled off and the dirt loosened in order that the bottom wire could be worked out of sight into the loose soil. Where possible, the sets were made in such position that the birds had to ascend a slight incline. Such sets were thought to take more quail than those placed on level ground. After the trap was in position, a few small pieces of brush, weeds, or grass were placed over and around the structure to break the outline. A path was cleared from the point of quail use to the mouth of the trap. Large amounts of shelled sorghum grain were liberally scattered inside the trap, while a thin, narrow line of grain was sprinkled from the opening into the trap to the place used by quail.

2. Traps made of one-inch mesh chicken wire took quail in a shorter time and also took many more birds than those constructed of one-fourth inch hardware cloth.

On one occasion in Custer County, a set was made at a loafing site after the birds had gone to their evening feeding grounds. They evidently finished their feeding and went to roost. The next morning they fed and returned to the loafing site where they were seen through binoculars as they sat in a covey less than two feet from the trap entrance. The observer retreated unnoticed, and upon returning an hour later found the entire covey of nine in the trap. Other sets were made in what appeared to be excellent locations which were often used by the covey. Periods of a week or two would elapse without a single bird being taken, even though they were taking some bait. After such a time, the whole covey, or in some instances, only part of the covey might be captured. On a few occasions the birds shifted range and were never caught. Some individuals of a covey were caught repeatedly, while

others of the same group were never taken.

During extended snow periods when food and even suitable cover was scarce, trapping itself was a simple procedure; however, transportation and other factors made the work laborious and time-consuming. Quail were found by following their tracks in the snow, locating by bird dogs, or sighting coveys while driving along country roads. Under such conditions traps set with or without camouflage took quail regularly. The reason for using any cover at this period was to give the captured birds protection from avian predators and to keep falling snow from filling the trap. During a two-week period, practically continuous snow or sleet kept the trap entrance clogged by drifting. This condition also covered the bait, and although the birds would have been trapped easily, they could not see the bait nor could they get into the trap. To overcome this difficulty, traps were visited every few hours and snow cleaned from the openings. To have visible bait available to the birds at all times, head hegari was placed inside the trap with the stalk or butt end forced into the snow. This left the grain head protruding six to eight inches and it remained visible for several hours. Songbirds (Harris's sparrows, juncos, cardinals, redwing blackbirds, meadowlarks, and others) competed with the quail and many times consumed all the food before quail found the bait. However, at times songbirds may have aided in the capture of quail, as their feeding in and around the traps was thought to attract bobwhites. Large numbers of these birds were caught between visits to the traps. In one trap, ten cardinals, six Harris's sparrows, and four juncos were taken at one time. These birds were a nuisance since it took considerable time to catch and liberate them. Some became 'star boarders' and practically lived in the trap.

Bait Used - In an effort to determine the most acceptable bait, several grains were used. Wheat was found to be of no value in Okfuskee County.

Yellow corn seemed no better since the rodents consumed it at such a rapid rate that quail often had no chance to eat it. Austrian winter peas were used and some were eaten by one covey but they may have learned to like them since the set was kept at this one site for a long period. Sorghum grain (kaffir, milo maize, hegari) was found to be the best bait for the areas under study and all catches were made when this type of bait was used. During the snow period the Okfuskee County Sportsman Club scattered chicken scratch feed which consisted of sorghum grain, wheat, cracked corn and other grains. All grain was readily consumed except the cracked corn which was not taken even by the hungry birds.

Removal of Quail from Trap - Some difficulty arose in removing captured quail from the trap. A large quilt was draped over the trap, making the interior dark, thus quieting the birds. In their attempts to escape, several individuals were injured, none seriously however. Removing the captives from the trap singly sometimes gave the others an opportunity to escape and one quail was lost in this way. Birds had to be released as singles and tended to scatter, making them subject to predation. To overcome these difficulties, a catching bag was constructed from an onion sack. A number of stout strips of inner tubing one-fourth inch wide and three inches long were fastened to the edge of the sack's circumference at regular intervals of three or four inches. To the end of each rubber ribbon a baling wire hook was attached. When the birds were captured this sack was draped over the door and the rubber strips stretched and hooked into the cage wire some distance from the trap opening. This brought the sack up snugly to the trap, encompassing the trap door and leaving the bag as a blind-end tunnel leading away from the trap. During this operation of rigging the catching bag, the quail remain quiet if the quilt has been placed over the entire structure.

To move the birds from the trap into the sack, one corner of the quilt opposite the sack was raised. The trapper then tapped on the wire, frightening the quail to the bag opening which they recognize as an escape route as it was the only source of light leading away from the disturbance. When all birds were in the bag it was unhooked and the birds banded or band numbers tabulated by drawing the leg of each quail through the mesh of the sack. If a large number of birds were caught at one time, it was necessary to remove them from the sack for checking and banding.

Method of Releasing After Trapping - To release all birds at one time, a coat or large cloth was spread over a clump of vegetation. Each quail, after being removed from the sack, was placed under the coat and usually remained until this cover was taken away. On some occasions the quail ran from the place after the cover was lifted; on others they flew, but in either instance they were liberated as a group which tended to prevent their being subjected to predation.

Visiting the Traps - Traps had to be widely dispersed over the county since sets were made where pen-reared birds were known to have been released or thought to be located. Because of this scattering it was impossible to visit the traps more than two or three times per day. The last visit was made between sundown and dark in order that no birds would spend the night imprisoned unnecessarily. Since the traps were widely spread, late feeding birds frequently entered traps after the last visit and therefore remained all night. On several occasions birds were flushed from the trap just as they were about to enter. It was found that close observation with binoculars from a distance ordinarily prevented this trap failure. While each trap was being checked for quail the bait supply was replenished, since, as already explained, large groups of migratory song birds would eat all the grain in a few hours.

Results of Pre-Hunting Season Trapping - Pre-hunting season trapping was started in Okfuskee County, Oklahoma on October 14, 1948 and continued to November 20, 1948, at which date the quail season opened. During the 37 days of continuous trapping, 13 traps were used which constituted a total of 335 trap days. The following table shows results of this trapping period.

METHOD	QUAIL TAKEN	NUMBER PEN-REARED BIRDS
Stoddard Standard Traps	30	11*
Wing Net	2	2
Cast Net	3	1
Predator and Accident	4	1
TOTAL	39	15 (38.46% of total)

*one banded bird escaped before the band number was recorded.
Five quail in this group were caught twice.

The small catch of 39 quail was thought to be the result of unfavorable trapping conditions which were rank vegetative growth, excellent source of food, and mild weather. The number is probably not high enough to be indicative of the actual percentage of survival; however, it did reveal that a fair number of the hatchery birds released during July, August, and September had made the necessary adjustment from prepared to natural foods.

Hunting Season Returns

Distribution of Hunter Report Cards - In a further effort to get information on the ratio of pen-reared birds to native quail, hunter report cards were distributed directly to sportsmen. These people were contacted either at sportsmen's meetings or through the club officials. In addition, 1700 self-addressed postal cards were distributed to the cooperating sportsmen's clubs. Desired information was mimeographed on the blank surface of the card, making it necessary for the hunter to fill in only blank spaces. (See Fig. 1).

Figure 1

HUNTER REPORT CARDS USED

QUAIL HUNTING REPORT

No. of Hunters in Party: _____

Name of Hunter: _____

Address: _____

Date	Location from Town	No. of Coveys Found	No. of Birds Seen	No. of Banded Birds Shot	No. of Unbanded Birds Shot	No. of Cripples Lost	Dogs Used

Remarks: _____

Daily Report Card

Hunter: _____ Date: _____

How many days did you hunt? _____

Number bobwhite killed: Banded: _____ Unbanded: _____

Numbers on the bands: (Please enter exact numbers, or save all bands for turning in to President of Club)

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

Season Report Card

Types of Cards Used - As shown by the figure, the cards were of two types, one requesting daily records of kills made, the other seasonal records. Of the two cards, the daily return proved by far the most informative. Season report cards were usually lost or forgotten and few of these cards were returned. The writer filled out a large number of cards on the basis of verbal information from hunters.

Factors Governing Return - Many factors influenced the success of hunter's results. A luxuriant growth of vegetation during spring and summer months furnished favorable quail habitat over wide areas. Before and during the hunting season almost no rain fell and little ground moisture remained, making conditions impossible for best bird dog work. Some hunters took little interest in the study and failed to make reports.

The cards had to be carefully selected; only those were used concerning the accuracy of which there was no doubt. Most cards were returned by sportsmen with whom the writer was personally acquainted.

Results of Hunter Report Cards - Of 1700 cards sent out, 122 were returned, only 97 of which could be used in tabulating results. Where one hunter submitted both seasonal and daily cards, the ones with the highest kill were used. The cards sent in represent the hunting efforts of 222 hunters on 97 hunts. With the use of an average of two dogs per hunting party, this group found 302 coveys which they estimated contained 4,318 quail, or an average of 14.29 birds per covey. This figure compared closely with average size of coveys seen by the writer during the study. Of the 1,586 quail killed during the hunting season, according to these hunter report card records, 1,496 (94.45 percent) were native stock, while 88 (5.54 percent) were of game farm origin; a ratio of 17 wild birds to one game farm bird. In addition to the birds killed, 102 cripples were reported. This means a total of 1,688 birds killed and crippled. The

figure for crippled birds may have been too low, as numerous cards were filled out several days after hunting and it was thought that some cripples were not remembered, while the kill was more impressive and an accurate report was more likely to be made. If the crippling calculation was correct, of the 102 cripples lost, 5.65 were banded birds and 96.35 were native quail. This conclusion was reached because each group was thought to show the same susceptibility to crippling loss and therefore was represented by the same percentage of loss. It was entirely possible that game farm birds had a lower rate of crippling since sportsmen contended that they were an easier target than the natives. It was reported that the pen-reared birds often flew to trees when flushed from the covey.

It was hoped that a difference in hunter success could be shown by the groups using dogs and those who flushed their own game. The number of hunters not using dogs was too small to show either a difference in hunter success or crippling loss.

The hunting card return was small as compared to the number distributed and improved methods for hunter success reports are herein suggested.

The person gathering information should contact a large number of sportsmen sometime before the opening date of hunting season. He should choose those men who hunt regularly and take the most game during the season; explain to them the necessity for the program and the importance of truthful reports; choose only those men whom he judges to be qualified for such a report; and get their agreement to report their hunting successes daily by telephone. The address and telephone number of each man should be recorded and those not calling in should be contacted the following day. By using this system, more complete data will accumulate and

the factor of forgetfulness will be eliminated.

Analysis of Band Returns in Okfuskee County - Results of leg-band returns for 1947 and 1948 were tabulated for all eight-week old birds released (see Table 2). Few birds were lost to disease and accident and most were successfully liberated. Coveys averaged 15 to 20 birds in 1947 and 10 birds per covey in 1948. Of the 163 coveys liberated in 1947 and the 171 coveys released in 1948, 216 coveys provided from one to nine birds in the hunter's bag. Each release made during 1947 and 1948 was tabulated as to the number of coveys and the number of birds furnishing hunting during the legal season. It will be noted that the total number of coveys furnishing only one bird for shooting was relatively high, while those coveys having five or more of their members killed were small. This in itself suggests a large amount of individual dispersion. The percent of birds killed from each release was tabulated; the percent of the total return was figured for each release; and the total return of all coveys was shown for the two years. The percentage of birds killed from the early releases (July and August) of both years was high as compared to the lower returns for September and October. These returns would indicate that an effort should be made to produce the majority of hatchery quail in the early breeding season. The reason for these high returns of early releases could not be determined, but it was thought that the first progeny may receive more vigor from the parents than do the later offspring. Possibly, also, since the hatchery birds got several weeks start of the native quail in egg production, the coverts were not occupied to the full carrying capacity by native birds when the early releases were made, therefore the game farm quail were more able to establish themselves.

TABLE 2

BANDS RETURNED BY OKFUSKEE COUNTY FOR 1947 AND 1948 HUNTING SEASONS

	Release 1		Release 1A		Release 2		Release 3		Release 4		Total	
	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948	1947	48
Date received	June 17	July 10		June 22	July 21	July 20	Sept.3	Oct.1	Sept.22			
Date released	July 15	July 18		July 18	Aug.17	Aug.15**	Sept.21	Oct.17	Oct.12			
No.birds received	450	400		400	450	600	600	400	980	2480	1800	
No.birds released	445*	398		371	422	592	588	394	978	2389	1755	
No.coveys released	27	40		37	30	55	48	39	55	***163	171	
Average no. in released covey	15	10		10	15	10	12 cov. of 20 36 cov. of 10	10	44 cov. of 20 11 cov. of 10			
No.coveys furnishing shooting	26	28		30	18	35	26	15	38	108	108	
No.coveys not heard from	1	12		7	12	20	22	24	17	52	63	
Coveys having:												
1 bird returned	9	7		6	7	8	11	9	10	37	29	
2 birds returned	8	8		8	3	11	3	5	5	19	32	
3 birds returned	3	8		8	3	7	1		8	15	23	
4 birds returned	5	3		5	3	5	6	1	7	18	13	
5 birds returned	1	1		2	1	3	4		4	12	7	
6 birds returned		1							3	4	1	
8 birds returned				1	1	1				1	2	
9 birds returned							1		1	2		

TABLE 2 (Continued)

	Release 1		Release 1 A		Release 2		Release 3		Release 4	Total	
	1947	1948	1947	1948	1947	1948	1947	1948	1947	1947	1948
No. birds killed	59	70	84		51	94	73	24	302	302	272
Percent of birds killed	14.71	17.59	22.64		12.08	15.87	12.41	6.09	12.63		
Percent of total yearly kill	2.46	3.98	4.78		2.13	5.35	3.05	1.36	4.98	12.63	15.40

* 44 quail not banded therefore return figured on 401 birds
** 7 coveys released at 4, 5, 6, and 7 weeks respectively, totaled 117 birds
*** 3 coveys not banded and therefore not represented in return

Winter Trapping in Okfuskee County

Weather Conditions Favorable - From January 9 to 31, 1949, 6.18 inches of precipitation was recorded in the Okemah area. Most of this moisture was in the form of sleet and snow which stayed on the ground almost continuously from January 9 to February 1. The temperature remained a few degrees below freezing, which accounted for the ground being blanketed with ice and snow during this period. The foul weather was conducive to bait-trapping as most of the available quail food was covered during the January cold period.

Existing Problem - Several problems existed during this trapping period. As snow and sleet fell almost every day, it was nearly impossible to keep bait available in the traps. Some sort of overhead shelter would have greatly aided had the continuous drifting snow been anticipated. Birds were desperate for food and would enter old barns, houses, and sheds to find food and escape the weather.

Equipment Used - The same equipment was used during this period as in pre-hunting season trapping.

Ice on Bands - On one occasion banded birds were found to be handicapped by ice sticking to the leg bands. Nine birds were trapped and all had some ice on their leg-bands. Two birds had chunks of ice the size of a nickel stuck to the metal identification tag. One sportsman reported finding two birds which he was able to catch because of ice forming in this manner. It seemed reasonable that this condition would occur under certain weather conditions only. Ice came in the form of sleet and the temperature remained several degrees below freezing. The warm band picked up ice each time the bird let his foot down and in this way the ball grew until it became a burden.

Results of Post-Hunting Season Trapping - Post season or winter trapping was carried forward in Okfuskee County for 26 days, i.e., between January 14 and February 9, 1949. During this period 13 traps were used, accounting for 239 trap days. The following table summarizes the results of that period.

METHOD	QUAIL TAKEN	NUMBER PEN-REARED BIRDS
Stoddard Standard Traps	101	4*
Illegal kill	2	0
Killed by dog	1	1
Caught by farmer	14	0
TOTAL	118	5 (4.2 % of total)

*2 of these were hen birds released in 1947, surviving two hunting seasons.

Of the 101 birds caught in traps, 42 were handled twice, while two were caught three times.

Quail trapped during this period and recorded in the above table were taken in areas in which game farm birds were liberated. Since wide dispersal up to five miles or further was shown by the hunting return, it was thought that all birds listed were from fair sample areas. To further substantiate this belief, two hen quail had traveled over five miles and were taken on a farm where no birds were released.

Spring Trapping in Custer County

Another period of trapping was carried on from March 4 to March 15, 1949 in Custer County, Oklahoma, during which time results from 41 trap days were recorded.

Of the 34 quail which were taken in Stoddard standard traps, seven (or 20.59 percent) were pen-reared birds. Six of this banded group were

from one covey. These represented the only game farm covey encountered during the study which were not associated with native birds. These birds were survivors of the previous fall's hunting season and had lived through a severe storm as a result of which the ground was covered with snow for almost a month. Of the total group, 14 were trapped twice, while four were taken three different times.

Spring Trapping in Okfuskee County

Spring trapping between March 25 and April 8, 1949 in Okfuskee County produced six quail, none of which was of game farm origin. With the advent of spring and the appearance of greens, quail completely forsook the sorghum grain bait and could not be caught. Covey breakup followed very closely and birds were not stable enough in their habits to be further trapped.

Summer trapping was not conducted since decoy hen quail could not be obtained.

Predation During All Trapping Operations

Predators did not cause serious loss during the trapping period; however, several quail and other species such as cottontail rabbits and song birds were killed in the traps. The predator could not always be identified positively, but through sign and tracks one usually was able to make fairly positive identification. House cat kills were identified by the characteristic neatness of the operation. At no time did a cat remain overnight in the trap. Without too much trouble the cat was able to enter the trap, make the kill, entirely consume the victims except for wings and legs, and leave the trap by the funnel opening. One leg bearing a band was found sheared off flush with the proximal edge of the band and tooth marks were left there. House cats made six successful attempts, killing two

quail and at least four song birds.

Opossums were equally destructive. This was probably due to the abundance of the animal perhaps as a result of the low fur price. Opossum would not have been a predatory factor if birds had not entered traps after the last daily visit, which was about sundown. Under normal hunting and trapping pressure, the number of opossums would probably have been held in check. In most instances where an opossum took trapped quail, the animal remained in the trap. Sometimes it was able to gnaw through the wire mesh but usually not; it was apparently never able to find the opening. So far as identification was concerned, it made no difference whether or not the animal stayed in the trap, as positive determination could be made from the sign. The ground was wallowed down, quail or songbird feathers strewn about, no remains left, and opossum hair appeared on the sharp ends of wires. Three quail were killed by opossums.

During the severe winter weather when snow was on and a general scarcity of wildlife food existed, two bobwhite quail were lost to crows. The snow had drifted in the trap and the crows were able to peck through the wire and kill the captives. This could have been avoided had a light covering of brush been placed over the trap to act as a protection and camouflage.

Two quail were killed in the trap by dogs and two traps destroyed by dogs in their effort to catch some captured Harris's sparrows which were inside.

The number of songbirds lost to predators could not always be determined since only feathers remained as evidence, but at least ten kills of such birds were made during the field work.

Eleven quail, or 4.8 percent of the 229 individuals handled during trapping, were lost to predators.

Nesting Studies

In an effort to obtain figures on reproduction of game farm quail, a summer-long investigation was made. Nesting studies were undertaken in Okfuskee County since the project was already underway and almost 4,000 game farm birds had been released in the previous two years.

To carry on this work, several data-gathering methods were used. By far the most important tool was farmer and rural contacts, plus excellent publicity through the sportsmen's clubs and the local daily newspaper. Some nests were located by systematic search of the area but this was a slow process for one man.

Okfuskee County produces a considerable amount of tallgrass prairie hay which is usually harvested from July 1 to mid-August. Many hay crews, using all types of haying equipment, were harvesting the hay crop during that period. Regular daily rounds were made to the widely scattered operations and information gathered from the crew members. These people cooperated very well but the small number of nests found on meadows would indicate a preference for other nesting cover.

As the opportunity arose, all observed quail were checked for bands by aid of binoculars. Cocks whistling from fence posts or other objects were easily approached and hens feeding along road edges were often observed. Records were kept of those positively identified as pen-reared birds or native quail. During the study no banded birds were observed, while 17 cocks and eight hens or a total of 25 birds were positively identified as native quail. Naturally, many quail were seen whose status could not be determined.

All road kills and other accidental deaths were examined for bands. One native cock trapped and banded during the winter was returned in July

by a motorist who accidentally ran into the flying bird, but no other bands were returned in this way.

Tagging Quail for Survival Check

Trapping proved to be the most dependable tool used for individual quail identification; however, the process did not bring information on sufficient numbers to be entirely satisfactory. It was decided to attempt perfection of a marker to be used on the 1949 hatchery quail which would identify the pen-reared stock in the field. Since the groups, as well as individual birds, were under study, the undertaking was thought worthwhile. With 25 quail furnished by the Oklahoma Game and Fish Department such a marking technique was initiated and perfected to a satisfactory degree. Four hundred experimental hatchery birds were assigned to the Oklahoma Cooperative Wildlife Research Unit for this investigation. These birds, together with the regular allotment to the Okfuskee County Sportsmen's Clubs (Okemah and Weleetka) totalled 1,025 marked quail released in the county in 1949. A plastic tag marker modified from an idea suggested by Taber (1949, pp. 228-231) was attached with an adjusted surgical skin clip to the loose skin of the hind neck taking in almost all the feather tract (Hint, 1950). These tags proved to be visible for a distance of 50 yards or more when the birds were in flight. From 26 personal contacts and 41 reliable observations, it is believed that 80 percent of the birds still retained their markers after a two month period. Fifty-nine percent of the game farm birds killed in the fall of 1949 by one club still carried the markers. It was estimated that 80 percent of the birds remained marked well into the hunting season and tagged quail were still being observed eight months after release.

All information received on pen-reared quail from July 1 to September 1, 1949 was based on field identification positively made by recognition of the tagged birds. Flush sheets served to record all information pertaining to movement from actual release site, number in covey, date, time of day, cover inhabited, and other pertinent data. Much of the information concerning the birds came from farmers who recognized the tags as some unusual attachment and sought enlightenment from the club officials.

The tagging helped to verify earlier findings and brought to light a number of points previously unnoticed regarding hatchery quail. From flush records and reports it was found that some rapid or almost immediate individual and covey dispersals were made after release. One covey established itself near the release point but after about two months dispersed, one being killed in hunting ten miles away and others several miles from the release site. Some coveys were found to favor human habitations and were discovered living in and around out-buildings. Often they flew into barns or called loudly while walking along the ridge roll on the comb of the house. This action undoubtedly resulted in a high predation loss by house cats and dogs.

Bobwhite Calling by Immature Cocks - It is well known that unmated bobwhites, in season, will characteristically utter the "bobwhite" call. Not so well known, apparently, is the fact that immature cocks will give this note. We failed to find any reference to this in the literature. This action was noted on two occasions in the presence of the writer and one other observer. An account of the incident is taken from the field notes as follows. On August 8 a group of eight neck-tagged pen-reared quail were observed on a country road. This group of birds was 12 weeks old at the time of contact and had been in the wild for four weeks. They were feeding toward the jeep in which two of us were watching. As they

neared the jeep and were only eight feet away, one of the three cocks which seemed to be the leader stopped and called "bobwhite" six times in a true nature and adult tone. This bird walked within four feet of the jeep and passed behind where he called "bobwhite" four more times and also gave the covey call several times. When the group did not follow, he returned walking beneath the jeep and led them off the road. On August 11, seven neck-banded twelve-week-old birds were found at a farm house. They were scattered and giving the covey call. Several of the birds flew into an old barn loft where one of the group called "bobwhite" many times. The group coveyed on the ground and moved 100 yards to a mulberry tree hedge where all seven flew into the branches which were from 10 to 25 feet high. These birds were soon joined by an adult native cock; he and the young cock called "bobwhite" many times. These game farm quail were 12 weeks old.

Points Proved by Observations of Tagged Quail -

1. Game Farm birds dispersed widely from release date into the hunting season which was two months later.

2. The game farm bird was, at least in some instances, as wary, wild, and 'foxy' as native quail.

3. The tags had placed no noticeable handicap on the birds which resulted in predation, in fact the Okfuskee Club this year (1949) recorded the highest band return (17 plus percent) in three years of releases.

4. The tagging served as a public relations tool; it stimulated interest in the program and brought a good response in leg-band recovery.

5. Some data were gathered on adaptation of pen-reared quail to natural foods and based on that information the question of their inability to cope with the sudden change was disproved, at least for quail eight weeks of age. On several occasions marked coveys were seen feeding on wheat, sorghum, and weed seed.

6. One group of 20 birds was released July 6, 1949 in close proximity to native cocks which were calling "bobwhite" and therefore considered to be unmated. Reports had come to us of unmated native males taking the responsibility of adopting and rearing game farm birds and the release mentioned was made with that possibility existing. The observer remained several hours with the released birds and had opportunity to watch the relation between the native cocks and the stocked quail. Soon after the release was made, the observer being well concealed, two native cocks flew into the area apparently to investigate the scattered, "covey-calling", pen-reared quail. The mature cocks were seen to go directly into the dense bluestem grass where the tagged birds were calling and at intervals one of the marked quail would give a distress call and leap a few feet off the ground as if something were attacking it. This action continued for some time. Later the cock was observed with the aid of binoculars as he ruffled his feathers, took a stance somewhat resembling a strutting turkey gobbler, and thereupon attacked a tagged bird. The assailant appeared to be intent upon doing physical harm to the victim. The young bird was able to escape but not before being struck by the infuriated cock. There was definitely some antagonism exhibited by the adult quail.

One other reported account of such aggression was received. It was thought that the density of the native quail, both during the nesting and rearing period, may have had some relation to such action. Had a definite low existed in the native population, or had the birds been released in ranges capable of sustaining a quail covey but not occupied by native birds, such belligerence would not have developed. Since the area carried at least a normal breeding population of native birds, the antagonism displayed by wild males may have resulted to some degree in the scattering of stocked birds.

MOVEMENTS OF PEN-REARED BIRDS BASED ON ALL METHODS OF RETURN AND TAGGING

On November 5, 1948, 15 days before the opening of the hunting season, two hatchery quail were taken by trap and found to have traveled five miles from their point of release through excellent quail territory which was occupied by many coveys of native birds.

Since hatchery quail show a general tendency to disperse widely, actual effects of shooting could not be definitely determined. One such covey of hatchery birds shared a range with a native covey near Okemah on the Okfuskee County Sportsman Club trap range property. This location was only one mile from town and its nearness afforded excellent opportunity for sportsmen to train their bird dogs. After being disturbed almost every evening during the feeding period, the birds (native and pen-reared) moved approximately three-fourths mile from the original range where they remained undiscovered until the hunting season.

Shooting during the hunting season may have accounted for some of the movement of the pen-reared stock in general; however, it could not be determined if all movement took place before or after the opening date.

From the 1947-1948 hunting records kept on band returns by the Okfuskee Club, plus field observations, results showed that pen-reared and native quail were thoroughly mixed.

During the course of the summer's work in 1949, tagged coveys were followed and found to make movements of one to two and one-half miles in groups or as singles or pairs. These were all positive identifications made through employment of the "bowtie" marker.

One native cock which had been trapped and banded February 3, 1949 was hit and killed by a car one mile from the trap site on July 2, 1949.

Selko (1940) recorded movements on Oklahoma pen-reared quail and found the average movement to be 2.85 miles. Baumgartner (1944) and Duck and Fletcher (1944) also found pen-reared quail to scatter widely.

PRODUCTION COSTS OF PEN-REARED BIRDS

Cost to State

In 1949, $48,000 or 5.3 percent of the license money was spent on the El Reno Game Farm (Anon. March 17, 1950). During the same period, 65,000 bobwhites were released to sportsmen's clubs for liberation. Of this group, 1,637 (2.5 percent) were taken in hunting in 1949. Also in 1949, five of the 1947 release were killed and 172 of the 1948 liberations furnished hunting (Anon. March 24, 1950). A per-bird cost for produced quail and a per-bird cost of quail brought to bag was figured. Since approximately 10,000 pheasants were raised, an arbitrary production figure of $1.00 per pheasant was used to arrive at a total of $10,000 for pheasants raised. This sum subtracted from the total game farm expense left $38,000 spent on quail; dividing this figure by 65,000 the cost of $.58½ per quail was arrived at. To arrive at the bird-in-the-bag figure, $38,000 was divided by the 1,637 reported 1949 bands, which gives $23.21 for each killed.

Several points which should figure into the game farm economics are omitted since accurate information is unavailable. Among the main points not considered are (1) the prorated upkeep of equipment and buildings on the Game Farm, (2) the number of hatchery birds killed but not reported, and (3) the number of crippled hatchery birds lost in the field.

Cost to Sportsmen

Upon receiving the quail from the game farm, all expenses are assumed by the sportsman club. Naturally, the expended funds for the four-week period would vary with the number of birds received and also to some

extent with the different clubs. By permission, there follows the actual expense account of the Okfuskee County Sportsman Club, which was considered to be a model organization and one which took excellent care of the birds.

In 1947, when the Okfuskee Club quail program was inaugurated, a certain amount of equipment was purchased which would have to be charged to the over-all program. The actual cost of such materials is listed as follows by the club.

Equipment (1947)

Fence		
1. wire	$20.00	
2. posts	9.00	
3. gate	15.00	
4. sign	15.00	
Coop		
Materials — 20 @ $20.00	400.00	
(Labor donated. Estimated cost $10.00 each for hired labor)		
Supply house	100.00	
Miscellaneous equipment	10.00	
TOTAL for 1947		$569.00

Expense (1948)
(Received 1800 quail and released 1755)

Feed and medicine	$103.32	
Labor - caretaker	107.00	
Transportation to and from game farm to receive quail	10.69	
Coffee, etc. (served at release)	11.95	
Prizes for leg band recovery	107.05	
Advertising - reward for poachers	2.40	
TOTAL for 1948		$342.41
TOTAL COST OF EQUIPMENT PLUS REARING EXPENSE UP TO RELEASE DATE IN 1948		$911.41

All expense incurred by the club was thought to be important to the restocking program. The largest "non-essential" cost was the $107.05 spent for prizes given to winners of the drawing. The item "prizes for leg-band recovery" refers to the effort made by the club to determine whether or not the released birds made up any part of the game taken by hunters in the open hunting season. All quail hunters were urged to turn in leg bands from any quail bagged. These were placed in a container and a drawing was made on the basis of which the prizes were given. It is altogether probable that the Okfuskee Club in this manner secured a fairly adequate record of the actual numbers of pen-reared released bobwhites that entered into the game bags of hunters in the vicinity. Such a program received much publicity and was one of the definite reasons for this particular club receiving the highest percent of band recovery in Oklahoma. The value of publicity received has been reflected in the town's support and cooperation extended to the sportsman club. All actual expense for prizes was not carried by the club as Okemah business men donated a number of sporting goods articles.

Allowing an arbitrary figure of 20 years for complete replacement of all equipment and based on the total 1948 expense of releasing 1,755 birds, the cost per bird in the bag was figured. To arrive at the prorated figure of $28.45 per year for equipment depreciation, the total equipment cost of $569.00 was divided by 20 years. This figure added to the $342.41 current cost gave $370.86 total expense for the 1,755 birds released in 1948. By dividing $370.86 (total expense) by 1,755 (birds released) a cost of $.21 per bird released was reached. To arrive at the $1.36 cost per bird brought to bag, the $370.86 (total expense) was divided by the 272 band returns for 1948. The $1.36 cost per bird bagged may be lowered to $.91

if only the bare necessities of feed, medicine, caretaker and transportation are considered. Other expenses such as leg-band recovery undoubtedly partially accounted for the high return and therefore are considered legitimate.

Total Cost

By adding the state bird-per-bag cost of $23.21 and the sportsman per-bag cost of $1.36, the total expense for each hatchery quail killed in Oklahoma is $24.57.

THE PEN-REARED QUAIL QUESTION

Some Points Apparently Favoring Pen-Reared Quail

1. From two to twenty percent of liberated quail furnish hunting the first season after release, while less than one percent support hunting in the second year.

2. Based on second and third year returns, a small percent live through hunting and the winter period to supplement the native stock with their progeny.

3. Pen-reared birds are more tangible to the sportsmen than a long-range habitat program and therefore serve to stimulate sportsmen and public interest in wildlife conservation. The Okfuskee Club considers this point as the most valuable phase of their releasing program and expressed their view by saying that if none of the birds live through, the expense has been worth the improved public relations.

4. Farmer-sportsmen relations were bolstered by the quail release program when the situation was properly handled by the club members.

5. Pen-reared quail might serve to restock areas when weather conditions or severe hunting pressure have completely eliminated the native stock and where natural ingress by native quail is barred by habitat barriers.

Lehmann (1946) cites instances of successful establishment of wild turkey and bobwhite on King Ranch in Texas by trapping and transplanting to an unoccupied range from which the birds had formerly been extirpated by severe weather. Wild turkey were eliminated from the Santa Gertrudis section of the ranch by drouth in 1916-1918. Two hundred birds were moved in from Norias in 1928; about 500 were present in 1945 and by 1946 the

increase was large enough to allow the first shooting in thirty years. Lehmann attributes this increase to transplanting and intensive coyote control in 1946.

Transplanting of bobwhites on the King Ranch has met with marked success. In 1946, an area of approximately 20 sections contained only two coveys of quail; furthermore, it had never supported a shooting population since the hurricane of 1916. Eighty native trapped birds were released in 1946 and 120 in 1947. The present population (1948) is 50 coveys. Original dispersal into the area was prohibited by natural barriers.

> "Selective predator control, habitat improvement, research, and regulation of human harvest are the real pillars of game management on King Ranch. Restocking of adapted species, however, has been a valuable technique. It is expected to continue important in the future, for our goal is maximum wildlife production consistent with livestock considerations."

But it must be remembered that the King Ranch is under one ownership and offers unique opportunity for controlled wildlife management practices. Game management of identical operation and technique would be difficult or impossible to apply to lands of multiple ownership with a limited game policy.

So far as known, in the history of Oklahoma no large-scale depletion of quail population has resulted from severe storms. It is true that the severe 1929-30 winter destroyed many quail over large areas but the entire breeding population was not eliminated to the extent that occupation blanks occurred. The natural build-up from this severe period took only two years (Hanson, 1947), although one still hears unbased assertions that the quail are yet down as a result of that snow storm. It may well be that in many localities quail have been permanently reduced. Such reduction can be explained largely through drought periods, changed land use, and soil depletion evidenced by the drop from one bale of cotton per acre to one-quarter

bale per acre or less. All these cut down food and cover available for bobwhite, and naturally reduced the population. The severe season may have had little or nothing to do with it.

Flash floods often are detrimental to broods and nests but no known losses to adults have been recorded. During the 1948 hunting season many coveys of five to six weeks old quail were observed. These birds were thought to be the result of late nesting by birds which were unsuccessful in their first attempt because of a 6.13 inch rain on June 21 and a 6.4 inch rain on June 23, 1948. These floods are usually of fairly local extent.

6. Pen-reared stock can be used for trading or for sale to other states.

7. Pen-reared stock could be used for experimental purposes and research. One example of this type of experiment was the tagging method developed on this project with birds furnished by the Game Department for that purpose.

8. Some have felt that pen-reared birds introduce new blood; but no reliable game management technician has ever shown that healthy stocks of native birds require any new blood because of inbreeding.

Some Points which Indicate Little Value of Restocking

1. The percent return from hatchery-reared birds is insignificant as compared to the harvestable native crop and the actual over-all population is affected but slightly.

2. The cost of the program cannot be based on a value-received basis.

3. Through release of hatchery-reared birds, the native stock may be hybridized and lose some of its stamina, as has actually happened through releases of Mexican Bobwhites in the East.

4. Many sportsmen and technicians feel that native bobwhites trapped from highly populated areas probably would serve better than pen-reared stocks for restoring blank areas; for the natives do not have to make so drastic an environmental adjustment.

5. This activity often diverts club and state money and attention from the long-range land use and habitat improvement developments which may be, from all that is now known, the only sure method for permanent increase in wild quail populations.

6. Some pen-reared quail are not sporting to hunt as they refuse to fly.

7. All quail, including the native stock, suffer from increased gun pressure as the result of hunter interest stimulated by the release of pen-reared stock.

8. It is hardly good business to invest such a large sum of money in a questionable practice.

9. It is not fair to spend large sums of the sportsman's money on hatchery-rearing of bobwhites which comes in part from license fees paid by sportsmen interested only in other game.

SUMMARY

An evaluation study of release and survival of pen-reared bobwhite quail was conducted by the Oklahoma Cooperative Wildlife Research Unit in cooperation with the Oklahoma Game and Fish Department, and a number of sportsmen's clubs, principally the Okfuskee County Sportsman Club. Four week old quail were received by the sportsmen's clubs from the State Game Farm to be released at eight weeks of age. Proper handling of the birds by the sportsmen's clubs appeared to be an important factor which contributed to a high survival. It is recommended that those groups not giving birds proper care be dropped from the activity.

Trapping was carried on in order to accurately check survival of pen-reared quail. Trapping techniques used on the project are discussed in detail (pp. 17 to 24). Pre-hunting season trapping resulted in the capture of 39 quail, 15 (38.46 percent) of which were released stock. Another method of checking survival was the gathering of hunting season returns. These returns from 222 hunters showed 1,536 quail killed, 1,498 (94.45 percent) of which were native and 88 (5.54 percent) pen-reared. A crippling loss of 102 birds was recorded. In a tabulated analysis of leg-band returns for two years in Okfuskee County, 12.63 percent and 15.40 percent of the liberated quail were harvested; a higher return resulted from early releases (July and August). Post-hunting season trapping in Okfuskee County resulted in the capture of 118 birds, with five (4.2 percent) being released quail. Spring trapping in Custer County, Oklahoma succeeded in capturing 34 quail, seven (20.59 percent) of which were pen-reared. Spring trapping in Okfuskee County gave six captured native quail. Nesting studies did not reveal reproduction by pen-reared quail.

A new tagging technique for field identification of quail aided the research by making identification positive without need for trapping. This marker was composed of a plastic tag attached to the nape of the bird's neck by an adjusted surgical skin clip. Tagging served to prove game farm quail are sometimes as wild as natives; to give accurate information on dates, distance, and extent of dispersal; to prove that hatchery quail were immediately adapted to natural foods; to discover harassment of pen-reared birds by native cocks.

The minimum cost to the sportsman club of producing one bobwhite quail in the game bag was $1.36; to the state, $23.21; for a total cost of $24.57 for each hatchery-reared, released bird-in-the-bag. State costs as figured did not consider original cost or depreciation of improvements or equipment, nor various other items, so are thought to be truly minimum costs.

FINAL STATEMENT

The pen-reared quail program served as a public relations tool in that sportsmen and farmers were brought to a better understanding by their association during the release operations. The activity has stimulated interest in sportsman organizations by giving them a tangible, "ready made" project on which to start.

A rather painstaking examination of activities of Oklahoma sportsmen's clubs, however, showed that the restocking program was receiving more emphasis than any other phase of conservation work. In some instances it was the only program undertaken.

In Okfuskee County, where careful studies were made, releasing of propagated quail contributed only a small percent to the actual bobwhite crop harvested and probably made up only a fraction of the entire bobwhite population.

The sportsmen of the state should assume an interest in all phases of conservation work and request that their license money be spent on programs that will definitely insure permanent game populations. They should raise the question as to the actual increases made as a result of the pen-reared quail program. Figuring from the $24.57 bird-in-the-bag sum, it takes seven $3.50 combination hunting and fishing licenses to furnish one bird for harvest. If this figure is cut in half, the cost is still exceedingly high. Other activities worthy of expenditures which are receiving priority in game work are habitat restoration and improved land use practices, along with conservation education.

If all game work is dove-tailed to fill its particular niche, a sound program results and makes for a sustained game yield which is characteristic of present day game management practices.

LITERATURE CITED

Anonymous. Outdoor Oklahoma. News Release issued by Oklahoma State Game and Fish Department (March 17, 1950).

Anonymous. Outdoor Oklahoma. News Release issued by Oklahoma State Game and Fish Department (March 24, 1950).

Baumgartner, F. M. "Dispersal and Survival of Game Farm Bobwhite Quail in Northcentral Oklahoma." Jour. of Wildlife Mgt, 8:112-118 (1944).

Baumgartner, F. M. and H. S. Stoecker. "An Evaluation of the Artificial Propagation of Bobwhite Quail at the Lake Carl Blackwell Game Farm." Manuscript (1941).

Buechner, Helmut K. "An Evaluation of Restocking with Pen-Reared Bobwhites." Unpublished manuscript (1948).

DeBusk, Kelly. "Leads and Lures." Oklahoma Game and Fish News, Vol. 5, No. 4, p. 7 (April, 1949).

Duck, L. G. and Jack B. Fletcher. "A Survey of the Game and Fur-Bearing Animals in Oklahoma." Oklahoma Game and Fish Commission Pittman-Robertson Series No. II, State Bulletin 3, 144 pp. 53-56 (1944).

Gabrielson, Ira N. "Changing Concepts of Wildlife Management." Missouri Conservationist, 7:3-5, 12 (1946).

Gabrielson, Ira N. Report to the Oklahoma Game and Fish Commission of a Survey Conducted by the Wildlife Management Institute. Oklahoma City: Oklahoma Game and Fish Department, 1947.

Hanson, H. Gordon. "Missing — 56,340 Bobwhites." Oklahoma Game and Fish News, Vol. 3, No. 3, p. 20 (March, 1942).

Lehmann, V. W. "Restocking on King Ranch." Trans. of 13th N.A. Wildlife Conference, pp. 236-239 (1948).

Leopold, Aldo. Game Management. New York: Charles Scribner's Sons, 1933

Rutherford, Robert H. Ten Years of Pittman-Robertson Wildlife Restoration. Wildlife Management Institute, Investment Bldg., Washington, D.C., 128 pp. (1949).

Selko, Lyle. Statewide Bobwhite Quail Management and Restocking Project No. 4-D, Oklahoma Game and Fish Department Bulletin (1940).

Steen, H. C. "Road to Restoration." Manuscript read at 15th N.A. Wildlife Conference, San Francisco (1950).

Stoddard, Herbert L. The Bobwhite Quail Its Habits, Preservation and Increase. New York: Charles Scribner's Sons, 1931.

Taber, Richard D. "A New Marker for Game Birds." Jour. of Wildlife Mgt., Vol. 13, No. 2, pp. 228-231 (April, 1949).

Wint, George B. "Improved Method for Marking Game Birds for Identification in the Field." Bulletin of the Okla. A. and M. College, Stillwater, Okla. (1950). (Processed)