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TECHNICAL WILDLIFE BULLETIN NUMBER 11

Game Management Division
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Madison 1

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EVALUATION OF STOCKING BREEDER HEN AND IMMATURE COCK PHEASANTS ON WISCONSIN PUBLIC HUNTING GROUNDS

by

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Pittman–Robertson Project 9-R

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PART I: INTRODUCTION

After almost 10 years of annual population increase, Wisconsin's pheasant population began to decline in the early 1940's. This decline occurred despite relatively large releases of game-farm-reared pheasants. However, since the Wisconsin pheasant population, as well as the continental population, was originally established by releasing pheasants into the wild which were reared under captivity, it appeared that it would be gainful to continue this program. It was on this premise that Wisconsin continued to expand its artificial propagation program up to about the time of the population decline.

Wisconsin's program of artificial pheasant propagation has been centered around cooperation from numerous rod and gun clubs. These clubs are allocated day-old chicks from the state game farm at a level proportionate to the facilities they built for holding and rearing the chicks. The conservation department also supplies the clubs with enough feed to rear the birds up to about 10 weeks of age. These expenditures have resulted in many clubs developing a relatively large equity in the pheasant propagation program. Many clubs have organized their membership on a program centered on rearing pheasants.

The trend of pheasant stocking has followed the trend of the pheasant kill quite closely, although the two are not necessarily related (Figure 1). Reports on studies made by Kellogg (1939), Buss (1946), and many out-of-state investigators indicated that hunter recoveries of game farm birds released in the wild each year were far from what was desired, and hardly justified the expenditures.

By 1940, many states with small programs began to abandon the rearing of game farm birds. But Wisconsin was in a different position. It had a huge program involving many sportsmen's groups that had spent considerable money in building rearing facilities. In addition, the large variation in returns between the different studies, and particularly the high returns achieved by a few of the clubs which had made their own evaluations, indicated that this relatively large game-farm-rearing program should not be abandoned without further study.

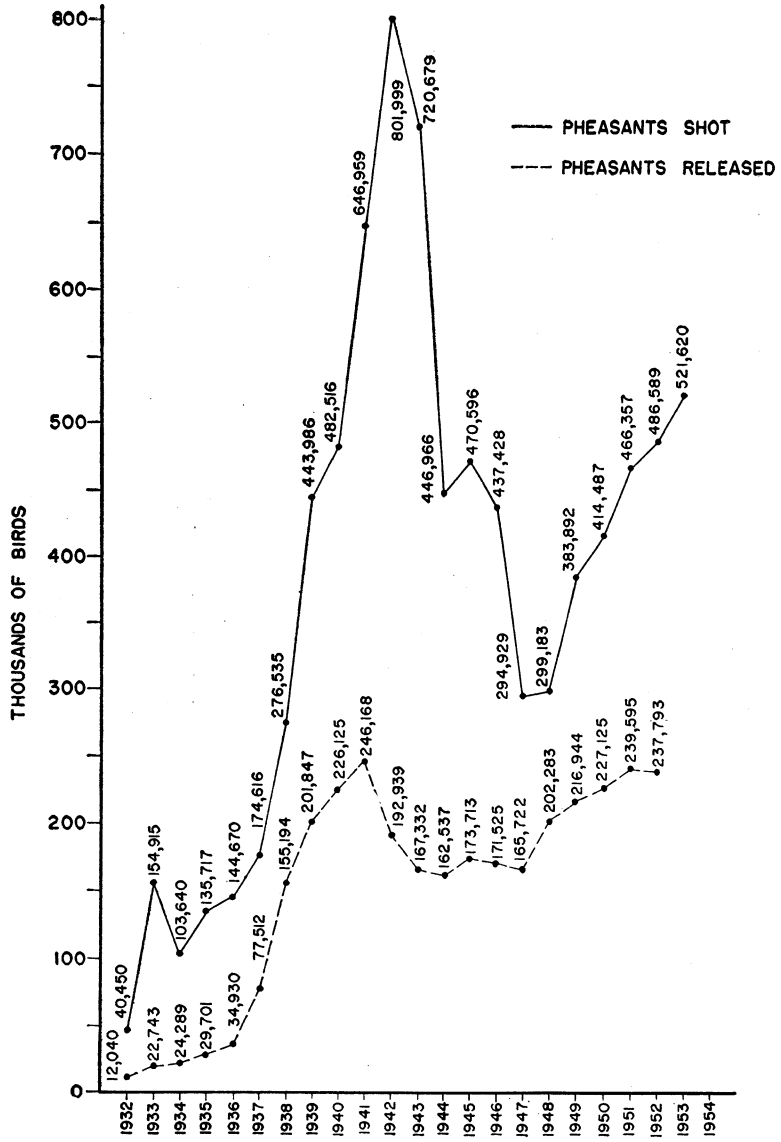


Figure 1. The number of pheasants shot during hunting seasons and the number of artificially propagated pheasants released in Wisconsin, 1932 to 1954.

Therefore, intensive studies were initiated by the Wisconsin Conservation Department in 1940 (Buss, 1946), and greatly expanded in 1946, to critically evaluate the potential contribution of the game farm pheasant to the breeding population and to the shootable fall population. One approach to this evaluation was to determine whether releases of adult birds in spring would contribute more birds for less dollars to the hunters' bags than the release of young cocks in late summer and fall. A second approach was to investigate better methods of rearing and releasing game farm birds using special diets. The diet phase of the study will be reported in a separate publication.

In this report, separate discussions will be presented on: (1) The results of stocking adult breeders in spring; (2) the results of stocking immature cock birds in summer and fall on special areas (the results of stocking *immature hens* are not considered here; they are part of another study which will be reported later); and (3) a comparison of the contributions of each of these practices, contained in a general evaluation of stocking at the end of the report.

PART II: STUDIES ON SPRING-RELEASED HENS

Introduction

The first intensive effort to determine whether the returns of game-farm-reared birds in the hunters' bags and the state pheasant population itself could be increased was to study the spring planting of adult hen pheasants as a supplement to the wild breeding population. The success of such a spring stocking program would depend upon the survival rate of the game-farm-reared hens and whether or not these hens would actually breed and produce young the same spring that they were released. Buss (1946) reported that some spring-released hens did breed the same year they were liberated.

But there were still several unanswered questions: How many hens survived to breed? What proportion of the survivors actually reproduced? How did the reproductive behavior of the spring-released hens compare with that of the wild pheasants inhabiting the same coverts?

To obtain some information on these problems, experiments were initiated in 1946 to study the reproductive success of the spring-released hen. Determination of egg production was made by examination of the ovaries of collected specimens. Information on nesting, brood size, hatching dates and survival of spring-released hens was obtained through intensive field observations by automobile, jeep and on foot. The studies reported here were carried out on the Kewaskum Public Hunting Ground, Washington county, in 1946; Potter's Marsh, Sauk county, in 1947 and 1948; and Mazomanie Public Hunting Ground, Dane county, in 1952, 1953 and 1954. Further details on methods used will be included in the following discussions.

Results and Discussion

Egg Production

During the spring of 1946, studies on the egg production of spring-released hens were started on the Kewaskum Public Hunting Ground in Washington county. This 960-acre area is made up of rolling farm land which surrounds a tamarack and hardwood swamp. Over the period from March 28 to April 3, 1946, 350 hens and 80 cocks were banded

and released. From these releases, nine hens were collected between May 12–15 for ovary examination to determine whether they were laying eggs. Such an examination was possible through the technique developed by Meyer, Kabat and Buss (1947). Ovaries from three additional released hens were obtained from road kills. The ovulated follicle counts are summarized in Table 1. Each ovulated follicle represents approximately one egg laid. The table shows that all of these hens had ovulated except No. 1 which was killed by an automobile on April 23. This ovary showed evidence of stimulation and would probably have reached a stage of ovulation at a later date.

Examination of the largest ovulated follicle in No. 4 indicated that its egg was ovulated on May 10 or two days before the date of collection. If this hen layed an egg every 1.3 days (Buss, Meyer and Kabat, 1951), her first egg was then ovulated on April 2, one day before she was released.

No. 11 ceased laying on the date of collection as evidenced by the presence of an egg in the oviduct, and the small unruptured follicles. Nos. 2 and 8 ceased laying a few days before the dates of collection.

From this sample of spring-released hens collected for ovary examination, it was evident that many of the hens layed eggs. However, some hens appeared to have started to lay their first eggs at a date later than average, and also some hens did not lay as many eggs as observed for the average of a group of wild hens.

Table 1

Ovulated Follicle Counts on 12 Spring-Released Pheasants from the Kewaskum Public Hunting Ground, 1946

Pheasant Number	*Collection Date*	*Count of Ovulated Follicles*	*Remarks*
1	4–23	0	Largest unovulated foll. 3 mm. diam.
2	4–28	5	5 " " 5–8 mm. diam.
3	5–12	21	13 " " 5 mm. or over
4	5–12	29	10 " " 5 mm. or over
5	5–13	8	17 " " 5 mm. or over
6	5–13	25	7 " " 5 mm. or over
7	5–13	17	17 " " 5 mm. or over
8	5–13	3	5 " " 5 mm. or less
9	5–13	7	9 " " 5 mm. or over
10	5–14	14	10 " " 5 mm. or over
11	5–14	17	2 " " 5–6 mm.
12	5–15	8	Egg in oviduct—still laying

Nesting

After it became evident that the spring-released hens produced eggs the same year they were released, it was then necessary to determine if the hens were laying eggs in nests or merely dropping them at random. If nesting, some would probably build their nests in hayfields. One of the easiest methods for locating pheasant nests is to cruise newly mowed hayfields. In some instances, as the fields are being mowed, hens are killed on their nests. These hens could then be identified as spring-released (banded) or as wild (unbanded) hens. With this in mind, a nesting study consisting entirely of cruising newly mowed hayfields and searching for nests and dead hens was undertaken on the Kewaskum area during June and early July, 1946.

A total of 115 acres of hayfields was cruised and 14 pheasant nests were found. Six of these nests were definitely identified (from the mower-killed hens) as belonging to spring-released hens. In these 6 nests, the clutches varied from 7 to 9 eggs, and averaged 7.7 eggs. The average from this small sample of nests was lower than the average clutch size of 12 eggs found in wild pheasant nests in other Wisconsin studies. However, if hay mowing was phenologically late, these nests might represent late nesters (including renesters) which usually have smaller clutches.

Brood Size

After obtaining information on egg laying and nesting of the spring-released hens on the Kewaskum area, records were kept of all pheasant broods observed during the summer of 1946. Eleven broods were identified as having been produced by the spring-released hens, ranging from 2 to 9 in number of young, and averaging 6 chicks per brood. Although the released hens were producing broods, no comparison could be made with wild broods as there were too few wild birds living on this area.

Further studies on the brood productivity of spring-released hens were made during the summer of 1947. These studies were conducted on Potter's Marsh, a 4,020-acre public hunting ground in eastern Sauk county. Since roadside observation from an automobile is the most efficient method available for seeing whole pheasant broods in Wisconsin, Potter's Marsh with its boundary road, farm lanes, and intersecting marsh roads proved quite adequate for these studies.

On March 6, 1947, a spring release of 200 hens (banded on the left leg) was made on the area. A late fall release of 200 hens (banded on the right leg) had also been made on December 10, 1946. By making these two types of releases, we hoped to be able to determine the effect of the time of release on productivity. The hens released in the fall would have a longer period of time to acclimate themselves to their new environment than hens released in spring just prior to the nesting season. This area was ideal for a fall release because of large tracts of standing corn, an abundance of wild foods and good winter cover.

Brood observations started in July and ended the first part of September. The area was cruised nearly every day by auto, and a route was followed that covered the boundary road, farm lanes, and the roads running through the marsh. Most of the observations were made during the early morning hours, and again just before sunset.

As broods were observed the hen was identified as to the time of release, and a record made of the location, age and number of young. A few broods were observed only once, but subsequent observations were made on most of them. One brood was seen 18 different times. Data on the number of broods seen and the average brood size are shown in Table 2.

Table 2

Average Size of Broods from Spring-Released and Wild Pheasant Hens (Complete Broods)

		No. Broods Observed (and Average Brood Size)				
Area	*Year*	*Spring Release*	*Fall Release*	*Wild*	*Unidentified*	*Statewide (Wild)*
Potter's Marsh	1947	5 (3.6)	13 (5.5)	8 (7.0)	--------	59 (6.8)
Potter's Marsh	1948	41 (7.6)	--------	29 (8.5)	8 (7.0)	155 (8.1)
Mazomanie	1952	29 (7.1)	--------	27 (7.6)	--------	274 (7.6)
Mazomanie	1953	3 (6.7)	--------	15 (9.3)	--------	461 (7.9)
Total	1947–1953	78 (7.1)*		79 (8.2)*		

*A significant difference exists between these two means at the 95 per cent confidence level. The calculated F value is 4.6.

The wild hens had the largest broods of all the hens observed. The size of broods from the fall-released hens was larger than that of broods produced by the spring-released hens, which might indicate that the reproductive success of the latter was affected by the time of release. However, these samples were small and the difference may not be significant.

Since part of the area was inaccessible to automobiles, many broods were probably not being seen. Inclusion of these missed broods could provide a more adequate sample of the pheasant reproduction on this area; therefore, the studies for 1948 were planned so that a jeep would be available for brood observations. This vehicle, a four-wheel-drive Willys, opened new sections of the area for observation, since it was capable of not only covering the marsh roads inaccessible to ordinary automobiles, but also could skirt fields that entirely lacked roads.

During the spring of 1948, 316 hen pheasants were released on Potter's Marsh. Approximately half of these birds were from wild stock trapped during the preceding winter in Milwaukee county. These birds had been held at the Experimental Game and Fur Farm, Poynette until the time of their release. The remainder of the pheasants released were from regular game farm stock. These two types of releases were made in an attempt to compare the production of game farm and transplanted wild hens. The birds were released over a period extending from March 22 to April 12. During this same time, 92 cocks were released to supplement the wild cocks, and thus insure a good breeding ratio.

Records of all broods observed on the area were kept from the first of July to the first part of September. During this period, 49 banded hens, 29 wild hens and 18 unidentified hens were seen with broods. Frequently, a brood that is under observation will move into heavy cover before a complete count can be made; consequently, when brood sizes are being compared, only completely counted (called *complete broods*) are used. The results of the 1948 brood observations on Potter's Marsh are presented in Table 2.

Table 2 also shows brood data collected during the summers of 1952 and 1953 on the Mazomanie Public Hunting Ground, Dane county. In the spring of 1952, 179 cocks and 562 hens were released on this area between March 20 and April 15. This area appears to have most of the qualities characteristic of good pheasant range (abundance of winter cover and feed), yet in the winter of 1951–52 for undetermined reasons there was only a very small number of birds present on the 9,918-acre area. In 1953, 400 hens and 192 cocks were released.

The average brood size for spring-released hens based on data collected on all four study areas was 7.1, while the average size of broods produced by wild hens was 8.2 (Table 2). The difference in brood size means is statistically significant at the 95 per cent level of confidence. The statistical analysis indicates that the difference can be attributed to the variation between spring-released and wild hen brood sizes and not to differences in location or type of hen.

In comparing brood production of winter- or spring-released hens reared at game farms with wild birds for any one year, it is necessary to consider differences resulting from handling and feeding while the birds were in the pens. Because of the difficulty of evaluating such differences as may exist between game farm and wild birds, variations from year to year are not statistically analyzed. In some cases, for example, feeding rations are different enough for a variety of reasons to possibly cause variations between birds. In two years out of the last four, the starting rations fed to chicks were so inferior that they had to be returned to the feed companies that sold them to the state. Before new rations could be introduced, the chicks had undergone large losses, poor growth rate and retarded feather development. Ration studies are now being carried on in an attempt to prevent this factor from confounding study results in the future. On the other hand, wild birds may also be adversely affected in some years by the natural diet available. Therefore, it is probably desirable to compare results covering a period of several years. By use of a carefully designed study, a number of uncontrolled variables could be evaluated and the data more accurately interpreted.

A comparison of the average brood size of game farm hens with the transplanted wild hens is shown in Table 3. Some groups were liberated from gentle-release pens (Kozlik, 1948), and others directly from crates. Each group was banded differently with colored aluminum bands so as to be distinguishable from any other group. Birds in any two groups, such as A and A^1, are matched releases. The gentle-release birds were held in gentle-release pens for about 10 days. Each release from the pens was matched with a like number of birds liberated directly from the crates. As the release pens had only a capacity of about 50 birds, groups C and C^1 were used to supplement the number of birds released in groups B and A^1 respectively. Group D was a release of hens that had been held as replacements, including some surplus birds from pen experiments conducted at the game farm.

There was some variation between the brood sizes of birds released from gentle-release pens and from crates. A comparison of the average brood size of the hens transplanted from Milwaukee county and hens released from the game farm may be made by combining the data on both groups of hens. The broods of the transplants averaged 8.0, about one bird larger than those of the game farm hens (7.1). This suggests that wild birds, though held for a time at the game farm and transplanted to strange territory, apparently have a higher production potential than game farm birds.

Table 3

Comparison of Average Brood Sizes of Game Farm and Transplanted Wild Hens, Potter's Marsh, 1948

	Group	*Method of Release*	*Number of Birds Released*	*Number of Broods Observed*	*Average Brood Size*
A	Milwaukee Co. wild-trapped birds —red band on right leg	Gentle-release pen	47	10	8.8
A[1]	Milwaukee Co. wild-trapped birds —red band on left leg	Crates	50	7	6.3
B	Game farm birds—black band on right leg	Gentle-release pen	50	10	8.3
B[1]	Game farm birds—yellow band on left leg	Crates	52	7	6.7
C	Game farm birds—yellow band on right leg	Gentle-release pen	51	6	6.5
C[1]	Milwauke Co. wild trapped birds —black band on left leg	Crates	49	4	7.3
D	Game farm birds—Aluminum band on right leg. Miscellaneous release	Crates	17	5	6.4

Hatching Date

Information on hatching dates was obtained from the brood observations made during the summers of 1948 on Potter's Marsh and 1952 and 1953 on Mazomanie, and is presented in Table 4. These dates are obtained by subtracting the age of the brood from the date it was observed. The age of broods was determined from size and color patterns. Pen studies on known-aged birds sharpened the observers' aging ability. As added criteria, molt characters, obtained from trapped birds, were used.

The wide range of hatching dates for pheasants in Wisconsin may account for the variation in average hatching dates between years for wild and game farm birds shown in Table 4. Since the hatching period for both groups extends over a period of about two months, differences between groups of the type observed do not appear to be significant either biologically or from the standpoint of game management.

Broodless Hens

In the Potter's Marsh study, all broodless hens were also noted. Of the eight broodless hens seen, five were banded and two were wild. One unidentified broodless hen was also seen. In the Mazomanie study, 69 per cent (18 out of 26) of the released hens observed after August 1 (a date when most hens have terminated their reproductive activity) had broods, while 92 per cent (22 out of 24) of the wild hens had broods. This difference in the number of broodless hens is an important consideration in evaluating the contribution of the spring-released hen.

Table 4

Hatching Dates of Broods from Spring-Released and Wild Hens

Area	Hatching Date	Released Hens No.	Released Hens %	Wild No.	Wild %	Unidentified No.	Unidentified %	Total No.	Total %	Av. Hatching Date (Statewide)
Potter's Marsh 1948	5/11–5/20	2	4.1	--	-----	--	-----	2	2.1	
	5/21–5/31	12	24.5	3	10.3	7	38.9	22	23.0	
	6/1–6/10	13	26.5	12	41.4	4	22.2	29	30.2	
	6/11–6/20	8	16.3	6	20.7	3	16.6	17	17.7	
	6/21–6/30	8	16.3	2	7.0	2	11.1	12	12.5	
	7/1–7/10	4	8.2	5	17.2	--	-----	9	9.4	
	7/11–7/20	2	4.1	1	3.4	1	5.6	4	4.1	
	7/21–7/31	--	-----	--	-----	1	5.6	1	1.0	
	Total	49	100.0	29	100.0	18	100.0	96	100.0	
	Average Hatching Date	June 9		June 15		June 9		June 12		June 16
Mazomanie 1952	Average Hatching Date	June 15 (32 broods)		June 9 (29 broods)						June 15 (410 broods)
Mazomanie 1953	Average Hatching Date	June 14 (7 broods)		June 20 (14 broods)						June 15 (543 broods)

Survival

The studies of spring-released hens reported thus far show that at least some of these birds layed eggs, nested, and brought off broods during their first breeding season in the field. The question that remained to be answered was whether a sufficient number of these released hens survived to produce enough young to make such spring releases practicable. An indication of this survival could be obtained by observing as many as possible of the released hens and their broods.

During the 1948 brood production studies of the 316 spring-released hens (which were color-banded for identification), the study area at Potter's Marsh was intensively cruised to obtain information on the survival of these birds. A good share of the marsh was cruised by jeep, which accounted for observations on 104 hens. However, some of the marsh was inaccessible even to the jeep and this area was cruised on foot with the aid of a dog. By this method 49 additional hens with broods were tallied. Since these broods were flushed by the dog, it was impossible to identify the hens, but by using the same ratio of banded hens to wild hens, as was determined for the identified hens with broods (seen from the jeep), additional banded hens could be accounted for. Some of these hens may have been seen more than once, but considering the short span of time in which the observations were made, it is improbable that there were many repeats. Those areas that were cruised with the dog included some that were just as near to the release sites

(some even closer) as were the areas covered by jeep. Therefore, the data obtained from the flushed hens and their broods should represent a proportional number of banded hens and not be biased by an undue number of wild birds. Following are the figures used in arriving at the percentage of survival for the spring-released hens:

Banded hens:	with broods	49	
	broodless	5	
		54	(64% of total identified hens)
Wild hens:	with broods	29	
	broodless	2	
		31	(36%)
Unidentified:	with broods	18	
	broodless	1	
	flushed by dog	49	
		68	

Total: 54 banded (observed)
43 banded (64 per cent of 68 unidentified hens)
97 banded hens (at least) accounted for from 316 hens released = minimum of 31% survival.

This figure of 31 per cent is the *minimum* survival percentage for the released hens, since undoubtedly there were other banded hens present on the area that were not seen, even allowing for those among the unidentified hens.

The per cent of hens (minimum) which were successful in rearing a brood may also be estimated from these data, based on the number of banded, broodless hens observed. Forty-nine, or 90 per cent, of the banded hens observed had broods. Expanded to the total hens with broods (97), this means that at least 88 out of 316 hens released had broods—a minimum of 28 per cent successful.

Total Production

Estimates of the number of young in the fall population which had been produced by the spring-released hens can be derived from data on hunting season returns and brood production. Such estimates are shown in Table 5 for Potter's Marsh in 1948 and for Mazomanie in 1952 and 1953. The total production of cocks in the wild is obtained primarily from data on the hunting season kill: the number of wild juvenile cocks bagged and those reported as crippled but unrecovered. To this figure is added the residual juvenile wild cock population which is estimated to be one-sixth of the total cocks shot, based on a winter sex ratio of six hens to one cock. The percentage of broods observed during the summer which were accompanied by banded (spring-released) hens was

used to determine the proportion of the juvenile wild cock population (as shown by the kill) contributed by the spring-released hens. Assuming an even sex ratio in the juveniles, this figure can then be doubled for the total number of hens and cocks produced by the spring releases.

Table 5

Spring-Released Hen Production

	Potter's Marsh 1948	*Mazomanie 1952*	*Mazomanie 1953*
Hunting season kill			
Wild juvenile cocks shot (in bag)	190	314	620
Unrecovered cripples (juvenile wild cocks)	33	50	62
Unshot reside (1/6 of total bagged and crippled, based on 6.1 statewide winter sex ratio)	37	61	114
Total production of young cocks in the wild	260	425	796
Per cent of total broods observed accompanied by banded hens	64%	52%	25%
No. juvenile wild cocks produced by spring-released hens (per cent banded hens x total wild cock production— correction for greater wild hen brood size)	(64%x260–12%) 146	(52%x425–7%) 206	(25%x796–39%) 121
Total wild young produced (hens+ cocks, assuming one hen for each cock)	292	412	242
Total hens released in spring	316	562	400
Chicks per spring-released hen	0.9	0.7	0.6
Cocks per spring-released hen	0.5	0.4	0.3

The production estimates show that each spring-released hen pheasant contributed on the average less than one young bird to the fall population on each of the study areas, and only a half a cock or less.

What could be some of the possible reasons for this low production by spring-released hens? Observations on banded birds on Potter's Marsh during the summer of 1948, cited earlier in this section, suggested low survival of the released hens, 31 per cent of 316, with 28 per cent of the total hens released successfully raising broods.

Could there have been more hens on the area producing broods that we did not see, or did these observations give a true picture of actual conditions?

The following analysis of the production of the successful spring-released hens observed and their contribution to the fall kill provides at least a part of the answer to this question. The calculated production of the 88 (28 per cent of 316) successful hens was 669 young, or 335 cocks, since brood size averaged 7.6 on Potter's Marsh in 1948. The survival of these young cocks to the hunting season may be estimated

from trapping returns of wild birds. Wild cocks had been trapped, banded and liberated in August on the study area in 1948 and 1949 at the time brood observations were being made. Thirty and 64 wild cocks were trapped in these two years respectively, and 73 and 56 per cent of these were recovered by checkers during the hunting season—an average return of 62 per cent for the two years. Applying this information to the 335 cocks produced by the observed spring-released hens, an estimated 208 of these birds should have been alive in October.

On the other hand, the analysis of the hunting season kill and the residual population remaining following the hunting season shows that the total number of cocks produced by the spring-released hens was 146 (Table 5).

According to these calculations, the total production of cocks by spring-released hens derived from the fall kill approaches the calculated production of the successful hens observed during the summer. If a substantial number of spring-released hens and their broods had been missed during the summer observations, there should be a much greater discrepancy between the two estimates than there appears to be. This suggests that the 88 hens observed with broods constituted a high proportion of the survivors from the release of 316 hens in the spring. About two-thirds of the spring-released hens, therefore, failed to survive to the time when the summer observations were made.

Thus the low production of the spring-released hens appears to be due to the disappearance of the hen between the time of release and summer. In general, this disappearance of the hens could be caused by mortality or movement off of the area. In the first place, the spring-released hen may have a "tough" time making the adjustment to wild conditions. To her advantage at the time of release is the fact that she is well-nourished. Furthermore, the rigors of winter are over; the ground is bare and food and cover are seemingly available. On the other hand, inferior hens are carried artificially through the winter, whereas Nature selects out the inferior birds in the wild. The game farm hen is used to hand-outs and artificial protection from natural enemies. She is adjusted to living with other birds and may seek them out in the wild; shuffling about may expose her to more predators. She is also exposed to the diseases of the wild to which no natural adaptation has been developed. Becoming acquainted with and adjusted to the wild habitat may constitute an added stress upon the hen pheasant at a time when reproductive activities are in themselves exerting a marked stress upon her. Stress studies show that the hen in mid-summer is in a worn-down condition from her breeding effort, and may be more susceptible to

mortality from all causes at this time (Kabat, Thompson and Kozlik, 1950 and unpublished data).

Relatively crowded pen conditions may also result in reducing natural reproductive tendencies. It is possible that the spring-released hens may abandon many nests. Repeated egg laying and incubation efforts may place an increased burden on the hen, which could result in higher mortality.

Possible movement of hens off of the area following release might also account for the disappearance of the spring-released hens. The Potter's Marsh area was large, 4,020 acres, and could probably absorb local movements. It is surrounded by steep, wooded hills, with the exception of one side which is bounded by a river. Generally the land surrounding the marsh is submarginal for pheasants. Likewise the Mazomanie area is large (9,918 acres) and is bounded by hills, a wide river and the town of Mazomanie itself. These conditions should have reduced movement of spring-released birds.

A limited amount of information was obtained on the movements of banded hens during the course of brood observations on Mazomanie in 1953. The 400 hens released in spring were banded with different color combinations for each release site. Table 6 summarizes the distances moved by a hen with a given band combination from the point of release to the point where she was observed during brood observations. A total of 20 banded hens was observed; of these, 50 per cent moved less than one-half mile and 75 per cent moved less than one mile. The greatest movement, by one hen, was 3-½ miles. Although the number of birds observed was small and observations were limited to the roads encircling and bisecting the marsh, this information tends to suggest that the movements of spring-released hen pheasants from the time of release in spring to summer (late July through early September) were small.

Table 6

Movement of Banded Hens, Mazomanie, July–September 1953

Distance	*No. of Banded Hens*
Less than ½ mile	10
½–1 mile	5
1 –1½ miles	1
1½–2 miles	0
2 –2½ miles	1
2½–3 miles	1
3 –3½ miles	1
3½–4 miles	1

If the behavior of pen-reared adult hens is similar to that of wild birds, it is probable that the observed spring and summer movements by the released hens represented the extent of most of the movement and possible egress that might have occurred from the areas. Previous studies have shown very little winter movement. Buss (1946) reported that out of 876 birds banded each winter for three years on two areas, the University of Wisconsin Arboretum and the Nevin Fish Hatchery, located only 1-1/4 miles apart, there were no birds that had crossed from one area to the other during the winter. However, in the spring of 1943, Cyril Kabat collected 105 hens that had been banded the previous winter on these two areas and found that two of the hens had moved from the Nevin Hatchery to the Arboretum from winter to spring. If such movement is common, then the migrating birds must either die or return to the area on which they were banded in winter.

Summary

Ovulated follicle studies have shown that spring-released hens produced eggs the same year in which they were released into the wild. Some were later than average in laying their first egg, and some did not lay as many eggs as did the average wild hen.

Nesting studies showed that many spring-released hens laid eggs in a nest in the same season of release. Clutches of hens nesting in hayfields at the time of mowing averaged 7.7 eggs.

The average brood size of spring-released hens was about one bird smaller (7.1) than that of wild hens (8.2). Mean hatching dates between years for wild and game farm birds showed a wide range of variation.

A minimum of 31 per cent of the spring-released hens survived from spring at the time of release to late summer when brood observations were made. A minimum of 28 per cent of 316 hens successfully reared broods up to the months of August and September.

These studies on breeding activity have established the fact that at least some of the spring-released hens do survive and breed during the spring in which they are released. However, an analysis of the total production of the spring-released hens suggests that each two spring-released hens contributed less than two young birds or less than one cock to the fall population. Although the brood size of the individual hen was relatively high, the total production by the spring releases was low. This was apparently caused by the disappearance of about two-thirds of the hens, probably due to mortality during the spring and early summer, and their consequent failure to bring off broods.

PART III: HUNTING RETURNS ON COCKS STOCKED IN LATE SUMMER AND EARLY FALL

Introduction

The early reports of low survival of pen-reared immature pheasants released into the wild were so numerous and the conclusions drawn by the investigators were so strong that game managers were generally in agreement that past pheasant stocking programs were not paying propositions. Thus in 1947, Wisconsin, through its Pittman–Robertson pheasant research project, decided to determine whether the hunting returns on game farm pheasants stocked in the late summer and early fall could be increased by improved stocking procedures and by developing higher quality birds, or if this approach failed, to consider that artificial pheasant propagation be greatly curtailed in this state.

One year after the study began, it became apparent that returns of released cocks through hunting were much higher than had been anticipated. The study thereafter had a twofold purpose: 1) To try to improve survival, and 2) to evaluate the methods used in the past to obtain survival data on released game farm birds.

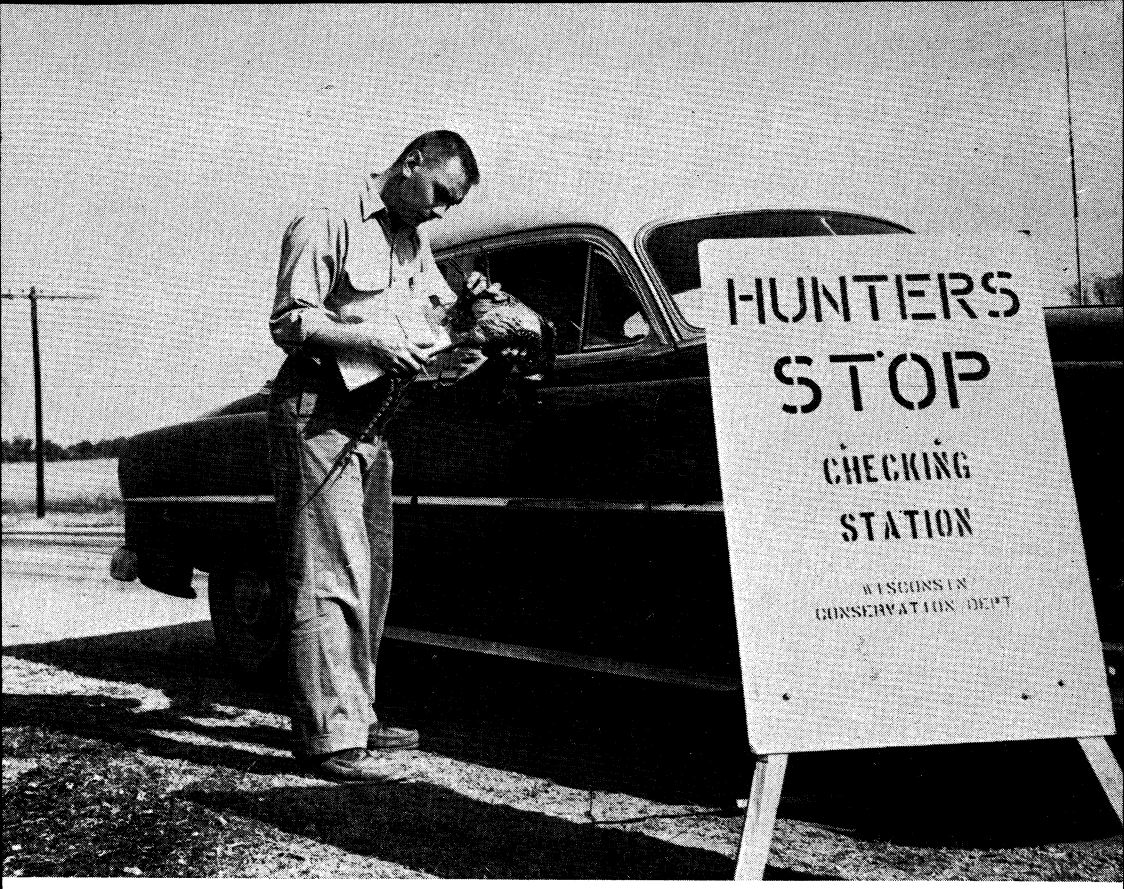
The procedure employed was to conduct studies which involved: The release of high quality birds in selected good habitat; the use of special diets and careful release methods. In this report these latter factors are not discussed in detail, but only incidentally to the other findings. Further details may be found in past quarterly progress reports. Several different methods of getting information on the number of these birds shot by hunters were also used. The feature of these studies was the intensive method used to get data on hunter returns of game-farm-reared birds released in the wild. Public hunting grounds were selected as study sites because they afforded better controls over the methods used to collect data and also they represented the type of habitat into which most of the game farm birds were or were supposed to be released each year. Wisconsin's huge artificial propagation program provided an excellent opportunity to set up experiments in which a large amount of data could be obtained.

Methods

All of the artificially propagated pheasants used in these studies were produced at the Wisconsin State Experimental Game and Fur Farm. They originated from regular ring-necked game farm breeders. All of these birds were released on the public hunting grounds by state conservation department employees, either by or under the direction of research project personnel, in periods beginning in mid-August and ending in early to mid-September, except those in a mail report study. These latter birds were reared and released in summer by the state game farm and cooperators (Kellogg, 1939). The experimental project birds ranged in age from 10 to 18 weeks, but averaged 11-½ weeks of age. All Wisconsin birds were released from crates or gentle-release pens (Kozlik, 1948) and allowed to leave the crates or pens under their own volition. The crates were placed in good cover and picked up only after the last bird had leisurely wandered out. Rarely did birds fly wildly. In 1948–1951, approximately one-half of the cocks were fed a special hormone diet.

The different methods employed to get information on the number of summer-released game farm birds that were shot by hunters were, in order of decreasing intensity: a) Personal contact, b) field stations, and c) limited field contact, all of which were used in the current studies, and d) mail report checks used by Kellogg (1939).

In the first method, *the personal contact check,* nearly all of the hunters using four study areas, Potter's Marsh, Yellowstone, Brodhead and Mazomanie Public Hunting Grounds, were personally contacted during the years 1949 to 1954. These areas were selected because they could be accurately checked and represented the types of habitat in which most Wisconsin pheasants are released. Potter's Marsh, 4,020 acres, was relatively isolated, being surrounded by high bluffs and a river. The habitat of the Brodhead area, 3,300 acres, was continuous and relatively similar to the adjoining lands. Mazomanie, 9,918 acres, was somewhat similar to Potter's Marsh in that it was bounded by a river and high bluffs. It appeared to have all the qualities of good pheasant range, and yet during the winter of 1951–52, there was a very small number of birds on the area. About half of the peat land was drained for the production of truck farm crops including sweet corn. Mazomanie had more abandoned or idle acres than any of the other areas. Yellowstone, 1,875 acres, was a poorer area for pheasants than the other study areas, and had in the past produced low hunting returns. All areas contained



In the "personal contact check" nearly 100 per cent of the hunters using an area were personally contacted in the field.

marsh land, an abundance of both nesting and winter roosting cover, and a good supply of winter feed supplemented by artificial feeding in abnormally adverse years.

Checkers were stationed on the areas at all of the exit points from the beginning of the hunting season through the last day. As each hunter came out of the field his bag was checked. All banded birds were recorded and later the band numbers were rechecked to make certain that no duplication of tags occurred. Even with such an intensive method a few hunters were missed during each day's check. Also a few birds undoubtedly drifted off the area and were not examined, and some cripples were not recovered. However, counts of cars and parties in the field and subsequent contacts of hunters returning to the area indicated that the hunter check coverage was nearly 100 per cent successful by the end of each fall period.

In the second method, *field station checks,* four checking stations were manned at important hunter concentration points in each one of ten

different public hunting grounds, varying in size from 800 to 8,900 acres, during only the first weekend of the hunting season. As many hunters were contacted as possible. For the balance of the season the third method, described below, was employed to get hunter returns.

In the third method, *limited field contacts,* unmanned checking stations were set up at each end of the area. The study sites used for these purposes were seven different public hunting grounds ranging in size from 2,300 to 8,900 acres each. Hunters were solicited to deposit the bands from the birds they shot in containers at these unmanned checking stations and/or write on slips issued to them the number of birds shot and the band numbers if the birds were tagged. Solicitation was accomplished by newspaper publicity and by game managers who periodically patrolled the areas and placed notices requesting the above information under the windshield wipers of hunters' cars parked on or adjacent to the areas, as well as by use of arrow markers directing attention to the band containers. On the basis of the type of cooperation received as shown by the number of hunters reporting, this hunter check was probably about 20 per cent efficient. A similar method is now used on the Crex Meadows Public Hunting Ground to get hunter returns each year. Norman Stone, district game manager, has found that 50 per cent of the hunters whose cars received notices submitted filled-out hunting slips.

The fourth method, *mail report,* used in Kellogg's study, involved banding and releasing into the wild 80,000 cocks which were reared by the state game farm and cooperators. Hunters who shot these birds were requested to submit the numbers of the bands to the Wisconsin Conservation Department through the mail on cards provided them. This method and the results were reported by Kellogg (1939).

On the areas where the personal contact check method was used (except on Yellowstone in 1949) a project assistant was assigned to patrol the area each day of the period between the release date and opening of the hunting season to discourage violations and to evaluate such events if they did occur despite precautions. Samples of wild birds were also trapped, banded and released in 1948 and 1949 on these areas. In all the areas, other than those checked by personal contact, no patrolling or trapping was done.

Results and Discussion

The results of the intensive studies conducted to evaluate the survival of summer-released game farm birds as measured by the number recovered through hunting are shown in Table 7. The method used to get band returns on summer-released birds in these studies was the "personal contact" method in which all or nearly all hunters using a study area were contacted in the field by departmental personnel. The returns shown in Table 7 range from 24 to 68 per cent and all greatly exceed the 5 per cent return reported by Kellogg (1939) and most other early investigators in other states.

The 1940–1942 returns are also considerably higher than those reported by Kellogg (1939), but they are, however, lower than the more recent studies with the exception of Yellowstone (1949). The Yellowstone study was set up for comparison with Potter's Marsh (1949). This area was selected because of its relatively poor habitat, this being borne out by the small number of wild birds (17) taken by hunters compared to Potter's Marsh where 182 area-born pheasants were recovered (Table 7).

Table 7

Hunter Returns on Summer-Released Game Farm and Wild Pheasant Cocks (Personal Contact Check)

			Game Farm Birds				*Wild Birds*	
Year	*Hunters Checked*	*Area*	*Date of Release*	*Release Age (Weeks)*	*Number Released*	*Per Cent Recovered*	*No. Shot*	*Per Cent of Total Bag*
1940–42*	-----	Jefferson	July 17 to Sept. 24	8–12	1,020	37	401	51
1948	1,534	Potter's Marsh	August	10	614	58	212	38
1949	1,478	Potter's Marsh	August	10–12	612	52	182	35
	446	Yellowstone	August	10–12	350	24	17	5
1950	~~580~~	Brodhead	Aug.–Sept.	11½–13½	580	48	385	58
1952	1,967	Mazomanie	Sept. 3	12–15	200	55	347	73
1953	2,629	Mazomanie	Aug.–Sept.	9–13	600	50	653	77
1954	2,958	Mazomanie	Sept. 16	16–18	400	68	397	48
Total (1948–1954)					3,356	51		

*Buss (1946)

Note: The opening date of the pheasant hunting season in the Southern Counties during the years of study has ranged from October 13 to October 23, with October 18 being the average opening date.

Table 8 summarizes the recoveries of released birds in all of the Wisconsin studies. In order to present a complete tabular picture of the returns on all birds shot by hunters, the hunting pressure and other

features of the hunter check, tables showing the day-to-day hunter check information for each study area are included in the Appendix.

Table 8

Hunting Season Returns on Summer-Released Game Farm Birds

Year	*Birds Released*	*Method of Obtaining Hunter Returns*	*Per Cent Recovered*
1948–1954*	3,356	*Personal Contact* (100 per cent hunter check by personal contact)	51
1940–1942	1,020	*Personal Contact* (100 per cent hunter check by personal contact)	37
1951	2,750	*Limited field contact* (Part of first weekend hunters personally contacted; direct solicitation with little or no personal contact for rest of season.)	32.2
1950	2,000	*Field station* (Voluntary check, direct solicitation with little or no personal contact)	12.8
1938**	80,600	*Mail report* (Hunters' reports were completely voluntary)	5.7

*The releases from 1940 to 1954 were made by conservation department personnel.
**All of the birds were raised from day-old chicks, banded and released by sportsmen's clubs (Kellogg 1939).

What are the factors that were responsible for the widely different results in Table 8 obtained in these studies on summer-released game farm birds?

Habitat

Was it habitat change? It is generally recognized that some features of pheasant habitat such as marsh acreage and brushy cover in Wisconsin have deteriorated greatly during the last ten years. Hence, when Kellogg made his study in 1938, habitat conditions were presumably much better than in the last five years, yet the recent study results revealed a much higher return on the released birds.

During the period from 1948–1954, 21 different study areas were used for release sites. The habitat in all but one of these areas was similar, yet the number of game farm birds checked in hunters' game bags and those reported by hunters varied greatly, from 12.8 to 51 per cent (Table 8).

When an attempt was made to deliberately study two areas, Potter's Marsh and Yellowstone, which were characterized by good and relatively poor habitat respectively, a considerably higher hunter recovery on released birds was obtained on Potter's Marsh (Table 7). Despite the fact that the Yellowstone area contained poorer habitat, the returns from this area were nevertheless higher than the early study reports. The Yellowstone area was not routinely patrolled prior to the season to

prevent violations as were Brodhead and Potter's Marsh. This could possibly have been a contributing factor in the relatively low return on both wild and game farm birds.

Quality of Game Farm Birds

Has the quality of game farm birds improved greatly? Experience in handling birds, better rations, and new disease control methods undoubtedly have improved the quality of game farm birds. However, the fact that the early releases were responsible for the establishment of pheasants in Wisconsin indicates that these birds were not completely inferior to the present stock. The wide variation in results shown in Table 8 also suggests that the increase in survival as indicated by hunter returns of summer-released birds was not primarily due to the improvement in quality. Very different results were obtained in the 1948–1954 studies, yet the birds released in these areas were fed similar diets, came from the same breeding stock, and received the same type of handling in each year's study.

Age

The age of the artificially propagated bird and its time of release bears a relation to survival and recovery through hunting. This has been shown by Buss (1943) and others and is discussed in more detail in Part IV of this report. In general, the older the birds, and the closer their release date is to the hunting season, the higher the returns. The release of young birds may result in low returns as is suggested by a Minnesota study in which a 14.6 per cent return was obtained on birds released at 6 weeks of age (Ledin and Bue, 1953).

In the more recent Wisconsin studies, most birds were released at approximately 10–12 weeks of age and at generally similar dates, except on Mazomanie 1954, where 16–18 week-old birds were released.

Size of Wild Population

The question has been asked: Were there more wild birds on the study areas on which the relatively small numbers of hunter recoveries of summer-released birds were reported? Some authors have expressed the thought that the release of game farm birds into areas containing high wild populations may result in the eviction of the artificially propagated birds, thus decreasing survival and hunter returns.

Evidence that appears on the surface to support the above concept was reported by Buss (1946) for the period 1940–42. The kill of wild birds was highest on these areas and the per cent of recoveries among the lowest of any of the Wisconsin studies in which intensive hunter checks were made. It might be speculated that here was an example of a release of game farm birds made on an area containing many wild pheasants—a condition that resulted in a depressed return of game farm birds. But it is common knowledge that in order to get a high return of game farm releases, hunting pressure must be high. An increase in hunting pressure is shown by license sales and field checks, and further, the observations of Kozlik and Kabat reveal that the number of hunters using the 1940–42 study areas was scarcely half that using public hunting grounds at the present time. Hence the lower return reported by Buss might have been due in part to the presence of more wild birds but probably more to the relatively low hunting pressure that prevailed at that time, not only on those study areas but also throughout the state.

Further light on the relationship between the size of a resident population on a given area and hunter returns of game farm birds liberated in summer in the same place is shown in the data collected at the Brodhead Public Hunting Ground. The kill of wild cocks at Brodhead indicated that the size of the wild population exceeded that of the Potter's Marsh area even though no hens were stocked there in spring. Yet the return on the summer-released cocks was very similar to that at Potter's Marsh. Superficially at least the amount of food and cover in summer and fall and the size of the two areas were very similar. The hunter return of 48 per cent and a minimum survival of 63.6 per cent for the summer-released cocks obtained from the fall kill, trapping and field observation revealed that this relatively high wild population of cocks had little or no bearing on the kill and survival of the summer-released birds.

Since all of the Wisconsin studies with the exception of Kellogg's (1939) were conducted on public hunting grounds where hunting pressure is high, it might also appear that relatively low wild populations and high returns on game farm releases were related. However, evidence indicates that this was not the case, since relatively high returns on game farm birds were obtained on areas where large numbers of wild birds were bagged.

Hunting Pressure

Could the greatly increased hunting pressure in the past six years have caused the increased kill of released game farm birds? Although the

effect of hunting pressure appeared to be involved in Buss's 1940–42 studies (that is, the return on game farm birds was depressed), it was not the only controlling factor on the 21 public hunting grounds comprising the areas included in the 1948–1954 studies (Table 8). Hunting pressure was very high on all areas checked using the methods previously described, but the percentage of released game farm birds recovered by hunters varied.

Vulnerability of Game Farm Pheasants

Are game farm birds easier targets for pheasant hunters? This is a hotly contested question. The results of the 1948–1954 studies (Table 7), in which the kill of game-farm-released birds was at times higher than that of wild birds, might support the argument that game farm birds are easy marks. If game farm birds were easy marks, then the bulk of the season's kill on the artificially propagated pheasants would occur in the early part of the season when hunting pressure is greatest. Hence after the first week of hunting the proportion of wild birds bagged daily compared to game farm birds should increase as the season progresses. The daily ratio of released to wild pheasants shot on five public hunting grounds is shown in Tables I—V in the appendix. A comparison of the proportion of released birds appearing in the kill the opening weekend and the remainder of the season is shown in Table 9. These data indicate that the released birds apparently held up well, and were not too disproportionately reduced in number during the first few days of hunting.

It is interesting to note that out of 175 cocks released *during* the hunting season at Potter's Marsh in 1948, 91 or 52 per cent were returned. This return compared to that for the summer-released and wild, immature cocks on a day-to-day basis indicates that even these relatively unacclimated birds are not completely vulnerable to the hunter.

Table 9

Ratio of Summer-Released Cocks to Juvenile Wild Cocks Recovered During the Hunting Season

		Opening Weekend		*Remainder of Season*	
Area	*Year*	*Total Sample*	*Per Cent of Released Birds*	*Total Sample*	*Per Cent of Released Birds*
Potter's Marsh	1948	457	67	92	59
Potter's Marsh	1949	430	68	51	57
Yellowstone	1949	68	93	29	72
Brodhead	1950	441	46	172	40
Mazomanie	1952	255	28	128	23
Total		1,651	57	472	43

Further evidence on the relative vulnerability of young wild and released cocks is offered by the returns of trapped wild birds. Wild cocks were trapped, banded and liberated at the time of the release of the game-farm-reared cocks on Potter's Marsh in 1948 and 1949. While only 30 and 64 wild cocks were trapped in these two years respectively, 73 and 56 per cent of these were recovered by checkers during the hunting season. While the samples are small, they nevertheless suggest little difference in superiority of the wild birds over the game farm birds in either survival or vulnerability to the gun.

Methods for Obtaining Band Returns

Thus far in this report we have considered a number of factors that might have been responsible, separately or collectively, for the much higher returns on summer-released game farm birds than had been previously described by most investigators. While some of these factors might have in part caused an increase in the returns, none of these appeared to be of primary importance. One major factor remains for consideration and that is the methods used to get information on band returns in this and other investigators' studies.

The results of the studies used to get band returns by different check methods are shown in Table 8. Although the results of the various methods were considerably different, there did appear to be a direct relationship between the intensiveness of the check method and the per cent of bands returned. The more intensive the checking method, the higher were the returns. When all or nearly all hunters using the study areas were personally contacted by project personnel, a very high return, an average of 51 per cent in 1948–1954, was obtained. Minimum returns were obtained by Kellogg (1939) who relied entirely on voluntary submission of bands through the mail. The study conducted by the authors which most nearly approached Kellogg's study was the "field station" check. In this check, hunters were asked to voluntarily deposit either the bands from recovered pheasants or slips of paper with the band numbers written on them in containers at unmanned checking stations. This was a much more intensive method than that employed by Kellogg yet the returns were only seven per cent higher.

The later Wisconsin studies dealt only with public hunting grounds, whereas Kellogg's study dealt with random stocking throughout the state. Yet when the "field station" check was used on a public hunting ground, the results obtained were not greatly different.

The results obtained in hunter checks in Dunn county during the 1946 pheasant hunting season, which permitted the shooting of both hens and cocks, provide an interesting comparison of check methods. During the course of the season, intensive personal contact checks were made on areas in the county-at-large wherever hunters were concentrated, the purpose being to examine as many birds as possible (Kozlik, 1947a). After the hunting season ended, an intensive survey of all the hunters hunting pheasants in Dunn county was made with game kill report cards. After three solicitations, kill returns were obtained for 90 per cent of the 3,300 licensed pheasant hunters in Dunn county for the season of 1946 (Kozlik, 1947b). The information on the pheasant kill obtained from both sources is summarized in Table 10.

Table 10

Hunter Checks in Dunn County—the 1946 Pheasant Hunting Season

	Game Kill Report Cards	*Personal Contact Check*
No. of hunters	2,971	300
Per cent reporting	90%	(ca. 10% of Dunn county licensees)
Banded cocks	292 (14%)	60 (30%)
Banded hens	200 (9%)	64 (32%)
Unbanded cocks	1,140 (53%)	38 (19%)
Unbanded hens	523 (24%)	41 (20%)
Total cocks reported	1,432 (66%)	98 (48%)
Total hens reported	723 (34%)	105 (51%)
Total pheasants	2,155*	203

*Omitting 290 unbanded pheasants for which no sex was given on the game kill report cards.

It is interesting to note that when the bags of the hunters were examined in the field, the proportion of cocks and hens shot was about equal. The game kill report cards, however, indicated almost twice as many cocks shot as hens. This suggests that hunters were reluctant to report hens. The lower proportion of banded birds reported on the report card suggests also a reluctance or negligence in reporting bands.

Another important fact that this Dunn county study (personal contact check) reveals is that apparently the hens released in the summer survived into the hunting season as well as did the cocks.

Sportsmen's clubs sometimes band some cocks and keep records of the number of released birds recovered during the hunting season. A sample of the information collected by two clubs is presented in the Appendix (Table VI).

Survival

Hunter returns on banded birds represent minimum survival of the pheasants living up to the time of a hunting season. "Minimum survival" refers to the fact that only those birds actually checked are included as "survivors of the release". Considering that juvenile mortality occurs throughout the two-month period between the date of release and the hunting season, that some birds leave the study area, that crippling loss is relatively high, that some birds escape the gun, and that some hunter-shot, banded birds are missed even in the near 100 per cent personal contact check, a return much higher than 51 per cent is highly improbable. Follow-up studies, which included trapping and observation work, were made on the number of game farm birds left surviving on the check areas in 1948–1950. The 1950 study showed that a minimum of 63.6 per cent of all the game farm birds released on the Brodhead area were alive at the beginning of the hunting season. If unrecovered cripples, banded birds not brought into field check stations, and those wandering off the area are added to this total of 63.6 per cent, it is apparent that game farm cocks had an extremely high survival.

During 1949 to 1951, approximately one-half of the cocks were fed a special hormone diet, which increased the absolute returns on the specially-fed birds by 6.8 per cent and hence the relative return by 13.7 per cent. However, when this 6.8 per cent advantage gained by special feeding is deducted, the highest returns from the personal contact checks still come close to 50 per cent. The increase due to hormone feeding was not separated from the total results, because considering the objectives of the study, this difference was very small. Furthermore, control pheasants (fed regular rations) made up half of the release study birds.

Some past studies also supported this report of high indicated survival of released birds but the interpretations of these data collected in the past did not show these higher figures. For example, one of the interesting features of Kellogg's studies was that a return of 4.7 per cent was obtained in the second year after the release, and, as in the first year return, the *voluntary hunter report* method was used to get these data. This infomation indicates a rather high return of game farm birds for the second year after liberation, considering that the first year return was 5.7 per cent, that the different study approaches have shown that voluntary reports are approximately a tenth as efficient in getting returns, and that the annual turnover of pheasants is very high.

Additional information on survival in time of liberated pen-reared birds is shown in the returns during the hunting season of birds which

had been released the previous spring (Table 15). On Potter's Marsh in 1948, for example, 15 per cent of the 92 cocks released the previous spring were recovered the following fall. Since seven months elapsed between release time and the hunting season, and assuming that the mortality rate was constant and that some of these cocks survived after the season, about 10 per cent of these birds died each month. This gives some idea of what return might be expected from releases made early in the year or from one year to the next.

Wisconsin's year-round studies conducted on shot and unshot populations have indicated that 70 per cent or more of the birds (up to 90 per cent of the cocks on shot areas) alive on an area one fall are gone by the next (Pittman–Robertson Quarterly Progress Reports 1947–1951). What chance does a project have, then, of trying to get reasonably accurate data on the number of game farm birds surviving from one year to the next? If only 10 to 30 birds out of every 100 wild birds survive for more than one year, it is obvious that investigators will have to (1) use the nearly 100 per cent personal contact method, (2) release a large number of birds, and (3) select areas large enough to eliminate the loss of birds through egress, in order to get even a remotely fair appraisal of the number of hunter returns on game farm birds which were released one or more years previously.

Summary

Studies conducted over a period of years on several public hunting grounds in Wisconsin have shown that an average of 51 per cent of the game farm pheasant cocks released in the summer before the hunting season are taken by hunters during the following hunting season. This high return is in marked contrast to an earlier report of a 5 per cent return. Although this high average return was obtained on public hunting grounds, it is strikingly higher than the 5 per cent return obtained from the statewide study.

The analysis of check methods and returns on summer-released game farm birds shows that the low returns obtained in early Wisconsin studies and in reports from other states resulted from the use of checking methods which were not sufficiently intensive. Personal contact checks with hunters yielded from five to ten times as many banded birds as did voluntary returns. It is absolutely necessary to check in the field all hunters using the study areas, if band returns are to truly indicate the number of summer-released game farm birds recovered through hunting.

PART IV: EVALUATION AND MANAGEMENT IMPLICATIONS

There are two main facets of the stocking program, one involving birds raised at the state game farm and liberated by conservation department personnel on public hunting grounds, and the other involving chicks raised by cooperating sportsmen's clubs and released on a county-wide basis. The studies of stocking which have been reported in this paper pertain to hens and cocks raised at the game farm and released by department personnel in selected habitat on public hunting grounds. In the following evaluation of the results of these studies, consideration is given primarily to the relative cost of liberating different-aged pheasants as well as the returns received and numbers of birds surviving following the releases. These comparisons are made between spring- and summer-released birds, and between summer- and fall-released pheasants.

The number of artificially propagated pheasants released by the state on public hunting grounds is relatively small. Releases by cooperating sportsmen's clubs in the counties-at-large make up the major portion of the stocking effort. Studies of this phase of the stocking program have not yet been completed. A final evaluation of the entire stocking program therefore is not yet possible. With this in mind, we have attempted here to evaluate and discuss the management implications of the information at hand, pointing out at the same time where knowledge is still lacking and where more study is needed. A bird's-eye-view of the entire stocking program is first presented in order to provide a background into which we may fit the results of both present and future studies. The concluding portion of this section deals with a preliminary discussion of the relationship between stocking and habitat management programs.

Purpose of Stocking

In order to properly evaluate any returns from stocking artificially propagated pheasants, it is necessary to review the purposes of this practice as it applies to Wisconsin.

(1) *Establish breeding populations.* The first practical purpose of stocking pheasants in Wisconsin or any other state, regardless of whether

these birds are local wild transplants, imports from their native ranges in Asia, or products of local game farms, is to establish breeding populations in areas having no resident birds. The European bird now universally known as the "ring-necked pheasant" was first successfully established in Wisconsin in 1916 (Buss, 1946). Many small plantings were made in the following years by private persons and sportsmen's organizations. Wholesale plantings were begun by the conservation department in 1928. Most of these birds were produced on state game farms.

(2) *Increase the population.* The second purpose of stocking following successful establishment is to increase the population by annual release up to the point where a native population can sustain itself or else is no longer increased by stocking.

(3) *Re-establish populations.* In local areas with suitable habitat, environmental accidents may have temporarily depleted the resident population of birds to a very low point. In order to speed up the restoration to past density levels, game farm birds are released to build up the breeding population.

(4) *Increase immediate hunting opportunity.* The possibility of increasing hunting opportunity in the same year as the release is made is an objective of stocking which is especially pertinent to areas near large urban centers where hunting pressure is abnormally heavy. Since privately-owned lands adjacent to highly populated human communities are often posted against free hunting, the Wisconsin Conservation Department has leased or purchased public hunting grounds to provide sufficient hunting area. Such areas must be able to attract hunters throughout the entire open season in order to justify the expenditure involved. But if the shootable pheasant population is reduced greatly within the first few days of hunting, these areas will be used only for a few days of each hunting season. Therefore, the current practice in respect to this problem has been to try to build up the pheasant populations on the public hunting grounds to a high point by: a) Augmenting the wild breeding population with releases of adult hens in spring and young hens in fall, and b) increasing the shootable cocks by augmenting the wild birds on the area through releases of immature cocks in summer and just before and during the hunting season.

(5) *Sustain shootable population.* Stocking helps to sustain a shootable pheasant population in areas in which the habitat does not provide enough food and cover to allow a breeding population to build up. However, such areas may have enough food and cover to sustain some

birds during certain periods of the year, at least long enough to provide some hunting on summer and fall releases or on birds produced by spring-released hens.

* * * * * *

Wisconsin is concerned with all of the reasons given for stocking pheasants each year, except that of establishing a general statewide breeding population. Game managers recognize the improbability at the present time of this objective for northern Wisconsin since this part of the state is largely outside of the pheasant range.

A list of the types of releases made by the state conservation department and by cooperating sportsmen's clubs throughout the state is presented in Table 11 and Figure 2. A summary of the costs of the stocking program at the game farm is shown in Table 12.

Table 11

Stocking Program in Wisconsin

Time of Year	*Type of Release*	*Primary Purpose of Release*
Spring (March–June)	Hens—Adult	To augment wild breeding population for current season.
	Cocks—Adult	To provide breeders.
Summer (July–August)	Hens—Adult spent breeders*	To dispose of surplus breeders.
	Immature (10–12 weeks)	To augment wild breeding population for the following spring.
	Cocks—Immature (10–12 weeks)	To increase fall shootable population.
Fall (September–October)	Cocks—Immature (14–20 weeks)	To increase fall shootable population.

*Hens used as breeders and released after their egg-laying duties are completed.

Table 12

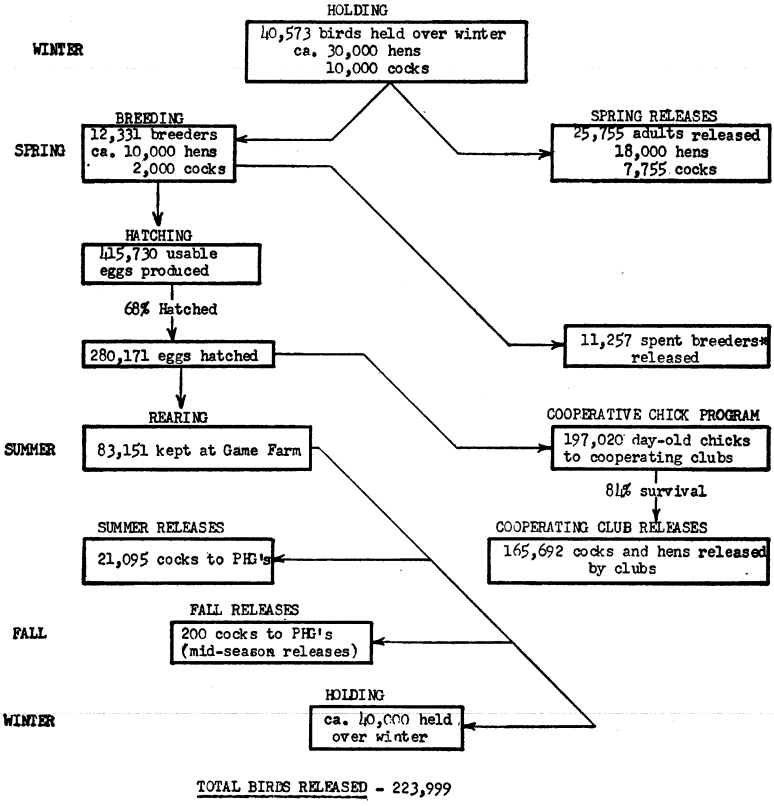
Cost Analysis—1952 Propagation Program—Game Farm

Hatching		$ 5,209.91
Rearing		99,497.46
Holding		60,311.03
Breeding		32,376.04
Cooperative chick program:		
Day-old chick program	$ 8,103.31	
Cooperative rearing (includes cost of feed distributed to clubs)	45,753.32	53,856.63*
TOTAL COST		$251,251.07

*This figure includes essentially the distribution and feed costs; hatching, rearing, etc. costs are included in the above categories. The total cost of the cooperative chick program itself was $77,704.64 for 1952.

Figure 2

Summary of 1952 Propagation Program -- Game Farm



TOTAL BIRDS RELEASED - 223,999

* Hens released after breeding activities have been completed.

Spring vs. Summer Releases

Hens. It has been established that some spring-released hens will survive long enough to nest and raise broods in the first breeding season following their liberation, thus contributing to the fall population. It is also true that a relatively high return of pheasant cocks released in the late summer may be expected during the hunting season. The question therefore arises, is it more economical to hold hens over the winter

and release them in spring than to raise game-farm-hatched birds and liberate these in late summer at about ten weeks of age?

We shall next compare, then, the number and cost of birds in the fall population which come from two sources of stocked birds: The progeny of the spring-released hens raised by the game farm, and the young birds raised by the game farm and released in the late summer. As shown in Part II of this report, 100 hens released in the spring may be expected to contribute 60 to 90 young birds to the fall population of which about 30 to 50 are cocks. In Part III, information was obtained which indicated that out of every 100 summer-released pheasant cocks, 51 are recovered in the hunter's bag. Although the *number* of young cocks in the fall population from the two sources of stocked birds is somewhat similar, the *cost of producing* these birds shows a striking difference. The average cost of propagating young cocks is shown in Table 13. An analysis of the production costs of cocks in the fall population produced by spring-released hens and those released in the late summer is presented in Table 14 for Potter's Marsh in 1948 and for Mazomanie in 1952 and 1953. The cost of the cock in the fall which has been contributed by the spring-released hen averages about four times greater than the cost of the summer-released cock in the fall bag. Since adult cocks are always released with the hens in spring, this cost must also be figured into the cost of the young cock in the fall. A slight compensation is made by the recovery of a few of the spring-released cocks by the hunter. These returns are added to the number of cocks produced by the spring-released hens to arrive at a figure representing total cock "production".

Table 13

Cost of Producing Pheasants*

Month	*Approximate Age*	*1950 Hatch*	*1951 Hatch*	*1952 Hatch*	*1953 Hatch*	*Average*	*Average Hunting Season Return*
March 31	Adults	$2.45	$2.94	$3.29	$----	$2.89	10%
	6 weeks	.53	.75	.73	.70	.68	-------
	10 weeks	.69	.93	1.17	1.08	.97	-------
Approx. Aug. 15–31	12 weeks	.81	1.06	1.39	1.27	1.13	51%
Approx. Sept. 1–15	14 weeks	.93	1.21	1.59	1.44	1.29	-------
Approx. Oct. 1–15	18 weeks	1.17	1.55	1.94	1.75	1.60	-------
Approx. Oct. 15–31	21 weeks	1.34	1.77	2.11	1.98	1.80	20–52% (mid-season)

*Propagation costs obtained from Cost Report for State Game and Fur Farm, 1952 and 1953.

Wisconsin hunters shoot a high proportion of the cock pheasant population annually. Hence the cocks surviving from one year to the next and their subsequent recovery by hunters has not been included

Table 14

Cost Analysis of Putting Cock Pheasants in the Bag for: Spring-Released Hens and Cocks and Summer-Released Cocks

Spring-released Hens (Adults)	*Potter's Marsh 1948*	*Mazomanie 1952*	*Mazomanie 1953*
1) No. adult hens released	316	562	400
2) No. adult cocks released	92	179	179
3) Total birds released ((1)+(2))	408	741	579
4) Cost/adult bird (March release)*	$ 2.89	$ 2.89	$ 2.89
5) Cost adult hen release ((1) x (4))	913.24	1,624.18	1,156.00
6) Cost adult cock release ((2) x (4))	265.88	517.31	517.31
7) Cost total adult release ((5)+(6))	1,179.12	2,141.49	1,673.31
8) No. young produced (From Table 5)	292	412	242
9) Cost/young bird ((7)÷(8))	4.04	5.20	6.91
10) No. young cocks produced (½ of (8))	146	206	121
11) Spring-released adult cocks recovered in fall (from Table 15)	14	8	26
12) Total cock "production" ((10)+(11)	160	214	147
13) Cost/young cock in fall bag ((7) ÷ (12))	7.37	10.01	11.38
Summer-released Cocks (Young)			
No. young cocks released	614	200	600
Cost/cock (August release)**	$ 1.13	$ 1.13	$ 1.13
Total cost cock release	693.82	226.00	678.00
No. young cocks recovered in fall	356	109	297
Cost/young cock in fall bag	1.95	2.07	2.28

*Average cost of propagating young birds and holding until March (Table 13).

**Average cost of propagating young cocks (Table 13).

in the computations in Table 14. Any recovery of cocks by hunters over one year after release would lower the cost of propagation proportionately.

(It should be noted here that the cost of the summer-released cock (10–12 weeks) is based upon the rearing and releasing of both hens and cocks. If only cocks were released, and hens destroyed at the time they were sexed, the additional cost of egg production and incubation for hens which would be destroyed would have to be charged to the cock.)

It therefore appears that a better investment of stocking monies can be made at the present time by the release of young birds at 10–12 weeks of age rather than by the release of adult hen pheasants in the spring for most of the purposes for which game farm birds are stocked directly by the state conservation department.

Cocks. Approximately 10,000 adult cock pheasants are stocked each spring. The philosophy behind this practice is to provide breeders for the approximate 20,000 spring-released hens, and to augment wild breeders in heavily shot areas, since a large share of the cock population is cropped during the previous hunting season. However, there is no evidence to indicate that the need for additional cock breeders exists. In the first place, it is generally conceded that sex ratios obtained following the hunting season are not so distorted as to prevent normal production (Dale, 1951). Sex ratio and brood observations in Milwaukee and Green Counties over the past few years also demonstrate this (Pittman–Robertson Quarterly Progress Reports, 1948–1954). Secondly, the wild population of cocks is so much larger relatively speaking than the numbers of cocks released, that even if additional breeders were needed, the stocked birds could contribute little.

The cocks stocked in spring also contribute little to the shootable cock population available to the hunter in the fall. A summary of the returns in the fall on spring-released cocks obtained during various Wisconsin pheasant studies is presented in Table 15.

Table 15

Hunting Returns on Spring-Released Cocks*

Year	*Area*	*No. Stocked (Spring)*	*Returns (Fall)*
1941	Menomonie	104	3.4%
1948	Potter's Marsh	92	15.2%
1949	Potter's Marsh	60	18.3%
1952	Mazomanie	179	4.5%
1953	Mazomanie	179	14.5%**
	Total	614	Average 10.3%

*Data obtained from Quarterly Progress Reports of the P-R Pheasant Research Project.
**Adjusted to a 100 per cent check on the basis of a 9-day (approximate 90 per cent) check.

The low returns make spring cock stocking a very costly venture from the point of view of augmenting the shootable fall population.

Fall vs. Summer Releases

We will next examine the returns and relative costs of fall releases in relation to summer releases. These consist of releases of immature cocks just prior to the hunting season ("pre-season releases") and during the hunting season ("mid-season releases") for the purpose of directly increasing the shootable population.

Earlier Wisconsin studies have indicated that the closer the release date to the opening day of the season, the higher the hunter return. Data obtained by Buss (1943) comparing the returns of cocks released in summer with those released in fall on the Jefferson area are presented in Table 16.

Table 16

Returns of Cocks Released in Summer and Fall, Jefferson, 1940–42*

Month Released	*Age at Release*	*Returns*
July	8 weeks	32%
August	10 weeks	34%
September	12 weeks	59%

*Buss (1943).

The results of the Dunn county hunter checks made in the fall of 1946 during which there was an open season on both hens and cocks are presented in Table 17. This information also illustrates this trend of higher hunter returns with later season releases and offers a comparison of the returns from spring, summer and fall releases. It should be pointed out, however, that the summer-released cocks were stocked in the county-at-large, while the birds in spring and fall were released on public hunting grounds where hunting pressure was greater. The 13.1 per cent

Table 17

Return on Birds Released in Dunn County, 1946*

Time of Year Release Made	*No. Released*	*Returns*
SPRING (April 5—June 9; adults)		
Hens	627	3.7%
Cocks	218	4.6%
	845	3.9%
SUMMER (September 8 and 14; 10–14 weeks old)		
Hens	1,837	11.8%
Cocks	1,717	14.4%
	3,554	13.1%
PRE-SEASON (October 11 and 17: juvenile birds)		
Hens	50	20.0%
Cocks	47	51.1%
	97	35.1%
DURING SEASON (October 23; juvenile birds)		
Hens	50	22.0%
Cocks	50	32.0%
	100	27.0%

*From Kozlik (1947a) and (1947b).

return of the summer-released birds therefore is a relatively low figure. The data on pheasants shot were obtained on game kill report cards from pheasant hunters who purchased hunting licenses in Dunn county for the 1946 season. The return of cards, after three solicitations, was believed to have been about 90 per cent. It is important to note that while the returns between the various types of releases made are generally comparable in this table, they cannot be compared with those found in other studies reported here since the methods of obtaining the returns were very different.

One follow-up check on a *pre-season release* of banded young cocks was made during the period of intensive study, 1948 to 1954. On the Mazomanie area, 200 pheasant cocks (20–22 weeks old) were released five days before the start of the 1954 hunting season. During the ensuing season, 75 per cent of these birds were bagged by the hunters. During this same season, 68 per cent of the summer-released cocks were bagged on Mazomanie.

In an evaluation of pre-season stocking, consideration should also be given to whether the increased survival of the late-released cocks compares favorably with the increased cost of rearing birds until just before the hunting season. Table 13 shows the cost of raising birds at the game farm up to late October and early November. The cost of propagating each cock up to early October, approximately one week before the hunting season opens in Wisconsin, for the past four years averaged $1.60. This is 42 per cent more than the cost of raising summer releases to late August. Thus, 42 per cent more pre-season releases would have to be shot by hunters than summer releases to get the same dollars and cents return.

On the basis of the Mazomanie study, the returns on the birds released just prior to the hunting season were only 10 per cent higher than the returns on the birds released in late summer. However, compared to the *average return of 51 per cent for summer-released cocks,* the returns of the Mazomanie pre-season release were 47 per cent higher. While the returns from the Jefferson study area (Table 16) show an increase from August to September, they reflect the difference between returns of birds released in early August and late September, and are not strictly comparable as late summer and pre-season releases. Likewise, the data on summer and pre-season releases in the Dunn county study (Table 17) are not comparable, for the summer-releases were made on a county-wide basis, while the pre-season releases were made on public hunting grounds.

No definite answer can be given to the question of pre-season stocking at this time, but current information suggests that pre-season stocking may pay off in birds recovered to equal the increased cost of holding these birds to a period just before the hunting season.

Data on the return of *mid-season releases* show that in the Potter's Marsh area in 1948, 52 per cent of 175 cocks were shot by hunters, while 58 per cent of the 614 summer-released cocks were shot. In 1952, 100 cocks were released on Mazomanie 12 days after the opening of the hunting season; 20 of these later turned up in the hunter's bag, while almost 55 per cent of the summer-released birds were recovered on this area. The Dunn county returns also show a lower return for mid-season releases (Table 17). Thus it is apparent that returns from released birds show a higher recovery rate from spring to early fall, but that the percentage returns on birds released during the hunting season drop off. The lower return of the birds released during the season is due to the reduced hunting pressure of the latter half of the season. This drop-off in hunting pressure may be clearly seen in the number of hunters tallied daily on the various public hunting grounds studied (Appendix Tables I–V).

The average cost of rearing and holding these birds to mid-season is $1.80, which exceeds that of the summer-released cocks by $.67.

Therefore, in view of the lower return, greater cost and the small number of hunters which these birds supply it appears that birds stocked during the hunting season offer a less effective and efficient use of stocking monies than birds stocked in late summer and early fall.

Since the fall releases had a longer time to become more dependent on feed handouts and more reliant on pen walls for predator protection, any of these birds escaping the hunters would likely have a more difficult time surviving throughout the winter. On the other hand, the observed behavior and winter checks show that the summer releases are quite wild during the hunting season and exist in the wild in wintering populations with a display of the "know how" to survive under natural conditions.

Contribution of the Stocked Pheasant

Although Wisconsin investigators have not studied the results of a "stop-stocking" program, we do have some information on the part played by the cock pheasant in the annual kill on public hunting grounds. These areas range from 600 to 9,600 acres in size and average about 3600 acres, and are heavily hunted. Random checks were carried on

from 1946 through 1951 on a variety of public hunting grounds which varied in many habitat characteristics. All of the game-farm-reared birds released on the public hunting grounds during this period were banded at the time of release. A summary of the checks is presented in Table 18 and indicates that 50 to 70 per cent of the total pheasants shot on these public hunting grounds were game farm releases. On these areas of heavy hunting pressure and in these years, then, the stocked bird comprised a half or more of the total kill.

Table 18

Proportion of Game-Farm-Released Pheasant Cocks in the Total Kill on Public Hunting Grounds*

Year	*Number of Hunters Checked*	*Total Cocks Checked*	*Per Cent of Released Birds In Total Kill*
1946	Not known	124	61
1947	2,889	1,510	70
1948	3,877	1,833	65
1949	13,674	4,315	51
1950	5,727	2,365	50
1951	4,276	1,004	54

*Includes summer, pre-season and mid-season releases.

The releases made by the state on public hunting grounds, however, are relatively small in number compared to the county-wide releases made by cooperating sportsmen's clubs, which compose the major portion of the stocking effort. If the county-wide kill of *all* stocked birds were equal to the high returns obtained on the special study areas, and current evidence indicates that this might be the case in some areas, about 50 per cent of the birds stocked annually would end up in the bags of the hunters. With a kill of about 500,000 and an annual stocking of about 200,000 birds, half of which are cocks, 50,000 of the total birds released might be harvested, which would amount to 10 per cent of the total kill. If 100 per cent of the released birds were shot by hunters, a maximum of 20 per cent of the total kill could theoretically be made up of stocked birds. The contribution of the artificially propagated cock to the *total annual kill,* therefore, can be expected to be below 20 per cent, and probably around 10 per cent. The major portion of the kill is contributed by the wild-reared pheasant.

Over the past 15 years, the kill has averaged 487,879 cocks each year, and the number of stocked birds has averaged 202,261. Assuming a return of half of the cocks released, the stocked bird has on the average made up about 10 per cent of the total kill each year. This proportion of stocked bids in the kill would be characteristic of the years in which

the kill was around 500,000 birds. When the kill was lower, as in the late 1940's when about 300,000 cocks were taken, the contribution of the stocked cock to the total annual kill would be greater, whereas in the peak years of the early 1940's when the kill reached 800,000, it would be much less.

The contribution of the hen pheasant released into the wild has not been fully evaluated. Unless the hens released each year survive and produce broods, their contribution is negligible and costly. Assuming that the young hen costs as much as the young cock to rear and release at approximately 12 weeks of age, ($1.13, Table 13), this part of the stocking program alone has cost almost $100,000 each year for the past three years. It is therefore very important to determine the value of hen stocking.

The Wisconsin studies to date have shown that the spring-released hen contributes only a half a cock or less to the fall kill. At the most, the approximately 20,000 hens released in the spring could contribute about 10,000 cocks to the hunters' bags, which would amount to 2 per cent of the total pheasant hunting kill.

Again, however, the major portion of the hens released into the wild are released by cooperating sportsmen's clubs. If these young hens survive to the hunting season as well as did the young cock reported on in this study (evidence from the 1946 pheasant hunting season in Dunn county (Table 10) supports this hypothesis) and their survival through the winter is comparable to the wild bird, then their value to a stocking program is apparent. For example, in 1952 the state through its stocking effort released about 83,000 young hens in summer. If 63.6 per cent survived to the hunting season as did the young cocks on the Brodhead study area in 1950, we would have a total of about 53,000 hens going into the winter period. Then if the hunting season survivors lived at the same rate as do wild birds (70 per cent mortality) we might expect anywhere from a minimum of 16,000 to a maximum of 53,000 potential breeders the next spring from the previous summer's release.

We do know, however, that if the survival and reproduction of these young stocked hens was high, there should have been a tremendous mass of pheasants that would keep increasing in number until the hen itself was made legal hunting game. This has not happened in Wisconsin.

At this date we do not know how many of these approximately 12-week-old hens live up to the hunting season and through the winter. It is possible that young hens released in fall or even after the hunting season might fare as well or better than do adult hens. The only data we have on this comparison were obtained in 1946–47 on Potter's Marsh

when 200 hens were released on December 10, 1946 and 200 released the following spring on March 6, 1947. Brood observations on this area showed that 13 of the December hens were seen with broods while only 5 of the March-released hens were observed with broods. Until studies on this phase of the stocking program are completed, final evaluation of the total pheasant stocking picture in Wisconsin must wait.

A related factor which must be studied further is the possibility that young or adult game farm hens when released into the wild compete with wild hens for feed and places to nest and raise young because our suitable habitat in the state may already be filled with pheasants. In order to get information of this type, it may be necessary to stop stocking in certain counties and observe the resident wild pheasant population to see if there is a downward trend or if the wild pheasant population can hold up without an annual game farm supplement.

It is impractical to use directly the data obtained on stocking from other state investigations for an evaluation of the stocked pheasant in Wisconsin. Although some investigators have attempted to evaluate pheasant stocking returns for their state on the basis of programs conducted in other states, there are very real differences in cost of propagation, stocking procedures and methods used to obtain hunter returns which may not be applicable to another area. For example, the cost of propagating and releasing pheasants at the Wisconsin State Game Farm and the value received is related to the number and type of birds reared, the cost of the farm when it was built, the efficiency of the propagators, the method of releasing and the age of the birds at release time, assistance from cooperators in rearing and stocking, the habitat into which the bird is released, hunting pressure and the intensity of the study which was conducted to get hunter returns.

The remark is often made by persons in this state that Michigan's activities with regard to stocking are proof that stocking is not economical. Michigan has virtually no stocking program, but has a kill of over 1,000,000 birds. This is another example of where interstate comparisons cannot logically be made. In the foregoing discussion, we have suggested that stocked cocks may comprise 10 to 20 per cent of the kill. For Michigan to increase its kill by a similar minor amount, it would have to have more than twice the stocking program that Wisconsin has since they have more than twice the number of pheasants in the wild. The cost of such a program would not be economically feasible for any state. Wisconsin ranks near the top in the number of pheasants released, and if Michigan had a costly program of similar magnitude, it might only increase its kill by a mere 5 or 10 per cent.

Considerations on Habitat Management

In any discussion of stocking, it is essential not to lose sight of the importance of habitat. Without suitable habitat, there can be no flourishing pheasant populations. Since it appears that the bulk of the total statewide kill is made up of wild-reared pheasants, the importance of habitat to pheasant production and the resultant kill is apparent. Even the survival of released birds is dependent on habitat. While the returns on released birds on public hunting grounds is usually high, this is not always the case. The 1949 return of stocked birds on Yellowstone, an example of relatively poor pheasant habitat, was considerably lower than the return the same year on Potter's Marsh, an area of good habitat.

Great changes have taken place in Wisconsin land use in the past two decades, resulting in the rapid deterioration of pheasant habitat. If habitat losses continue, the number of suitable pheasant stocking areas will be reduced to the point where almost any pheasant propagation program will be an extravagant practice. This is particularly true in the case of the release of young and adult hens. The production potential of the released hen will be an all-important factor in the final evaluation of the significance of the general stocking program, and this is dependent to a large extent on the type of habitat available to these birds.

Habitat management, then, is basic to the management of all wildlife, and particularly of pheasants. A considerable amount of money is spent by the Conservation Department on activities which have a direct bearing upon habitat improvement (Table 19)—almost three times as much as is spent on pheasant propagation. All projects listed in Table 19 benefit several species and it is not feasible at this time to separate those having a direct bearing just on pheasant habitat. However, those projects carried on in Areas IV and V affect primarily pheasants and other upland game, while those in Areas I, II, and III affect primarily forest game and waterfowl.

Indirect expenditures for habitat improvement, which are considerable, are not listed here since it is impractical to prorate these for the various species concerned for purposes of this evaluation.

Regardless of the money spent, however, habitat is still deteriorating.

Stocking of cocks is a short-term effort involving an increase of 10 to 20 per cent in the kill each year. We are daily losing the habitat which provides the birds for 80 to 90 per cent of our kill through the years. If we sit by, continue stocking, and let the habitat go, we may end up with an annual kill of only 50,000 stocked cocks, having lost

the 450,000 wild-reared cocks which our habitat produced. If pheasant hunting is to exist in the future in anything more than a highly artificial form, a substantial wild population or wild-reared population must be maintained. This will require continuing large expenditures for habitat management.

SUMMARY AND CONCLUSIONS

1. Studies have been carried out over the past 14 years as a part of a critical evaluation of the potential contribution of the game farm pheasant to the breeding population and shootable fall population. The major approach to this problem reported upon here was the determination of the relative values of stocking adult breeder hens in spring and immature cocks in the late summer and fall by the state on public hunting ground areas.

2. Adult pheasant hens were released in spring on special study areas in order to learn more about their production in the wild. These studies showed that the hens survived and brought off broods during the spring in which they were released. The average size of the brood produced by the spring-released hen (7.1) was smaller than that produced by the wild hen (8.2), a statistically significant difference.

An analysis of the total production of these hens based on the fall kill showed that each two hens contributed less than two young birds, half of which were cocks, to the hunter's bag in the fall. This low production was apparently due to the fact that about two-thirds of the spring releases failed to survive to bring off broods.

3. Studies were made for 10 years on immature pheasant cocks raised at the State Experimental Game and Fur Farm and released in late summer and early fall at approximately 10–12 weeks of age by conservation department personnel on 21 different public hunting grounds. Close to 100 per cent "personal contact" checks of hunters were carried out from 1948–1954 on four of the public hunting grounds. On these areas an average of 51 per cent of the summer-released cocks were recovered by hunters. This return is considerably higher than returns reported in past studies in Wisconsin and elsewhere. A comparison of different methods used to check the kill of hunters indicated that an intensive "personal contact" check is absolutely essential in order to obtain a true representation of the proportion of released birds in the kill.

4. A comparison was made of the returns and cost of cocks in the fall from the following sources: Young birds produced by spring-released hens, adult cocks released in the spring as breeders, and young cocks raised at the game farm and released during late summer, just before the hunting season and during the hunting season.

(1) The *number* of young cocks contributed to the hunter's bag by the spring-released hen and by the release of 10–12 week-old cocks raised at the game farm is somewhat similar, but the *cost of producing* these birds is quite different. The cost of the cock in the fall produced by the spring-released hen is about four times greater than the cost of the summer-released cock.

(2) Adult cocks released in the spring fulfill a questionable function as additional breeders for spring-released and wild hens. Further, considering the high costs involved, they contribute little to the shootable cock population available to the hunter in the fall (an average of 10 per cent of those stocked in spring are bagged).

(3) Current information on pre-season stocking suggests that the higher returns on birds released shortly before the season may be proportionate to the increased cost of raising these birds to early October.

(4) The return on cocks released during the hunting season, which ranged from 20 to 52 per cent on two areas studies, was lower than the return of summer-released cocks on these same areas, due to reduced hunting pressure during the latter half of the season. The average cost of rearing and holding birds until mid-season was almost two-thirds higher than that of the summer-released cock.

A comparison of the returns and costs of releases made at different seasons shows that the closer to the hunting season the release is made, the higher the recovery rate. However, the cost of rearing and holding birds increases through the summer and fall disproportionately. On the basis of current information the release during late summer of young pheasant cocks raised and reared by the game farm to approximately 10–12 weeks of age offers the most effective and efficient use of present stocking monies.

The stocking of adult hens in spring has been shown to be an overly costly venture for the value received. Since the number of young produced by spring-released hens is small and the cost of putting a young cock in the bag of a hunter is relatively high, clubs buying feed to hold hen pheasants through the winter are incurring a very large and unwarranted expense.

Table 19

Expenditures by the Wisconsin Conservation Department for Wildlife Management Activities Which Have a Direct Effect on Habitat Improvement (1952–53)

FEDERAL AID—PITTMAN-ROBERTSON	AREAS I	II	III	IV	V	Total
Maintenance						40,467.30
Horicon Marsh				19,259.43		
Rock County					2,334.10	
CWCA—BRF			4,198.45			
CWCA—MV			4,547.16			
Crex Meadows	10,128.16					
Development						219,931.73
Regional	3,135.46	4,680.81	4,522.38	15,129.99	42,306.38	
Forest Habitat	21,108.49	30,264.37				
CWCA—BRF			19,693.07			
CWCA—MV			13,260.47			
Ackley	856.81					
Browntown					8,707.55	
Crex Meadows	14,600.08					
Totogatic	14,989.85					
Yellowstone					9,041.95	
Yellowstone Dam					11,573.57	
Wood County			6,060.50			
Acquisition						62,458.57
Crex Meadows	2,043.54					
Eldorado				23,471.96		
Fish Lake	780.94					
French Creek					3,110.32	
Jackson Marsh				2,985.33		
Keizer Lake	2,881.37					
Little Rice	4,518.77					
Navarino Marsh		77.17				
New Munster					81.38	
Peshtigo Brook		3,472.75				
Pine Island					5,581.55	
Princess Point					3,287.04	
Rice Bed Creek	371.98					
Thunder Lake		1,643.95				
Tiffany			5,335.70			
Vernon					2,814.82	
Boscobel Nursery					56,649.32	56,649.32

Table 19 (Cont.)

	AREAS I	II	III	IV	V	Total
FEDERAL AID—DINGELL-JOHNSON						
Watershed stabilization	17,593.36	21,943.42	18,289.61	18,025.39	38,716.20	114,567.98
NON-FEDERAL AID						
State watershed management	8,891.30	14,065.91	10,763.80	8,588.27	14,083.29	56,392.57
PHG program	13,860.66	16,758.37	37,549.40	42,082.90	56,167.23	166,418.56
CWCA—BRF revolving fund	----------	----------	8,796.52	----------	----------	8,796.52
CWCA—MV revolving fund	----------	----------	4,386.76	----------	----------	4,386.76
Nursery (Griffith)	----------	----------	3,187.15	----------	----------	3,187.15
Deer yard acquisition and management	6,567.50	3,527.64	6,764.62	----------	----------	16,859.76
TOTAL	122,328.27	96,434.39	147,355.59	129,543.27	254,454.70	750,116.22

5. Young pheasant cocks stocked in late summer by the state on public hunting grounds constituted from 50 to 70 per cent of the total kill on these heavily hunted areas during the years studied.

The contribution of the pheasants released by cooperating sportsmen's clubs in the counties-at-large is still being evaluated. Inasmuch as approximately 100,000 cocks are stocked and approximately 500,000 birds are shot annually, the kill of stocked birds cannot exceed 20 per cent of the total kill. Based on current information, the contribution of stocked cocks to the total annual kill may not be more than 10 per cent.

6. The contribution of young pheasant hens released in late summer is also being evaluated. Until information on their survival and production is known, the final evaluation of the entire stocking program cannot be made.

7. Regardless of how high the returns of stocked birds are, the wild-reared pheasant still produces the bulk of the annual kill. Therefore, in evaluating stocking as a game management technique the importance of maintaining habitat for the wild breeding population must be considered. Under certain conditions stocking can be an important practice, but under no circumstance can it be a substitute for habitat development and management.

LITERATURE CITED

Buss, Irven O. 1943. Pittman–Robertson Pheasant Management Research Project 9–R, *Wisconsin Wildlife Research* 2(4):36–61.

————. 1946. Wisconsin Pheasant Populations. Pub. 326, A–46, Wisconsin Conservation Department, 184pp.

————. Roland K. Meyer and Cyril Kabat. 1951. Wisconsin pheasant reproduction studies based on ovulated follicle technique. *Jour. Wildl. Mgt.* 15(1):32–46.

Dale, Fred H. 1951. The refuge in pheasant mangement. *Jour. Wildl. Mgt.* 15(4):337–346.

Kabat, Cyril, Donald R. Thompson and Frank M. Kozlik. 1950. Pheasant weights and wing molt in relation to reproduction with survival implications. Technical Wildlife Bulletin No. 2, Game Management Division, Wis. Conservation Dept., Madison. 26 pp.

Kellogg, H. B., 1939. Pheasant banding statistics. *Wis. Conservation Bull.* 4(12):49–51.

Kozlik, Frank M. 1947a. Pittman–Robertson Pheasant Management Research Project 9–R, *Wisconsin Wildlife Research* 5(4):34–43.

————. 1947b. Pittman–Robertson Pheasant Management Research Project 9–R, *Wisconsin Wildlife Research* 6(3):51–76.

————. 1948. Gentle release method of stocking pheasants. *Wis. Conservation Bull.* 13(5):12–14.

Ledin, Donald H. and Gerald T. Bue. 1953. Pheasant population trends. *Conservation Volunteer* XVI (95):8–11.

Meyer, Roland K., Cyril Kabat and Irven O. Buss. 1947. Early involuntionary changes in the post-ovulatory follicles of the ring-necked pheasant. *Jour. Wildl. Mgt.* 11(1):43–49.

APPENDIX

Table I

Daily Summary of Hunters Checked on the Potter's Marsh Public Hunting Grounds in 1948

Date	*No. of Hunters*	*Man-Hours*	*No. of Dogs*	*Birds Crippled*	*Summer-Released Cocks Shot*	*Spring-Released Cocks Shot*	*Cocks Released in Previous Years*	*Cocks Released During Hunting Season*	*Wild Juvenile Cocks*	*Wild Adult Cocks*	*Total Birds Shot*
10/23	574	1,257	123	82	241	6	1	--	112	8	368
10/24	508	1,327	140	20	64	4	1	--	40	5	114
10/25	31	70	16	2	5	1	0	--	0	1	7
10/26	40	100	11	1	7	0	0	--	3	2	12
10/27	14	21	5	0	3	0	0	--	2	0	5
10/28	56	130	26	0	4	0	0	5*	9	1	19
10/29	28	79	15	5	4	0	0	11	5	2	22
10/30	107	297	35	4	13	1	1	14	8	1	38
10/31	83	253	41	0	7	0	0	5	7	1	20
11/1	14	37	14	1	1	0	0	4**	1	0	6
11/2	29	63	15	2	2	0	0	25	0	0	27
11/3	4	8	3	0	2	0	0	6	0	0	8
11/4	34	100	18	1	3	1	0	19	3	1	27
11/5	12	33	6	0	3	1	0	2	0	0	6
Total	1,534	3,775	468	118	359	14	3	91	190	22	679

*Date of first season release (75 cocks).
**Date of second season release (100 cocks).

Table II

Daily Summary of Hunters Checked on the Potter's Marsh Public Hunting Grounds in 1949

Date	*No. of Hunters*	*Man-Hours*	*No. of Dogs*	*Birds Crippled*	*Summer-Released Cocks Shot*	*Spring-Released Cocks Shot*	*Cocks Released in Previous Years*	*Wild Juvenile Cocks*	*Wild Adult Cocks*	*Total Birds Shot*	*Per Cent of Total Kill*
10/22	**666**	1,470	**113**	51	232	5	2	101	12	352	68
10/23	498	1,126	119	13	60	5	0	37	7	109	21
10/24	34	80	19	1	2	0	0	2	0	4	1
10/25	21	60	6	2	3	0	0	1	1	5	1
10/26	32	60	15	1	7	0	0	2	1	10	2
10/27	40	86	16	2	7	0	0	4	0	11	2
10/28	33	51	21	1	2	0	0	3	0	5	1
10/29	46	95	13	1	2	0	0	4	0	6	1
10/30	62	192	20	2	3	0	0	1	1	5	1
10/31	8	12	3	0	0	0	0	1	0	1	---
11/1	9	14	5	1	0	0	0	0	0	0	---
11/2	1	8	0	0	0	0	0	0	0	0	---
11/3	15	14	6	1	1	1	0	2	0	4	1
11/4	13	27	8	2	2	0	0	2	0	4	1
Totals	1,478	3,295	364	78	321	11	2	160	22	516	100

Table III

Daily Summary of Hunters Checked on the Yellowstone Public Hunting Grounds in 1949

Date	*No. of Hunters*	*Man-Hours*	*No. of Dogs*	*Birds Crippled*	*Summer-Released Cocks Shot*	*Cocks Released in Previous Years*	*Wild Juvenile Cocks*	*Wild Adult Cocks*	*Total Birds Shot*	*Per Cent of Total Kill*
10/22	152	265	24	8	22	2	2	0	26	25
10/23	213	555	29	7	41	0	3	2	46	44
10/24	9	22	5	1	3	1	0	0	4	4
10/25	24	43	10	1	6	0	4	0	10	9
10/26	4	9	1	0	1	0	0	1	2	2
10/27	0	0	0	0	0	0	0	0	0	---
10/28	3	6	1	0	1	0	0	0	1	1
10/29	18	34	9	2	4	0	2	0	6	6
10/30	4	8	1	0	2	0	0	0	2	2
10/31	0	0	0	0	0	0	0	0	0	---
11/1	0	0	0	0	0	0	0	0	0	---
11/2	3	12	2	0	0	1	1	1	3	3
11/3	11	18	5	0	1	0	0	0	1	1
11/4	5	5	4	0	3	0	1	0	4	4
Total	446	977	91	19	84	4	13	4	105	101

Table IV

Hunter Check Statistics, Brodhead Public Hunting Ground 1950

Date	No. of Hunters	Man-Hours	No. of Dogs	Birds Crippled	Summer Release Recoveries	Wild Juvenile	Wild Adult	Total Birds	Per Cent Banded
10/14	627	1,659	62	76	134	141	22	297	45
10/15	540	1,563	54	33	69	97	7	173	40
10/16	46	124	9	2	9	6	2	17	53
10/17	76	161	19	2	7	5	2	14	50
10/18	29	68	5	0	0	4	0	4	0
10/19	51	96	13	0	3	5	0	8	38
10/20	56	115	18	4	5	8	0	13	38
10/21	225	588	44	2	9	24	5	38	24
10/22	154	347	45	5	15	13	0	28	54
10/23	12	28	4	0	0	3	0	3	0
10/24	10	28	5	1	2	5	1	8	25
10/25	14	26	7	0	0	0	1	1	0
10/26	11	88	1	1	4	1	0	5	80
10/27	3	8	1	0	0	3	0	3	0
10/28	63	170	25	5	6	9	2	17	35
10/29	90	253	19	7	9	17	2	28	32
Total	2,007	5,322*	331	138	272*	341	44	657	41.4

*Seven additional bands were recovered on which the date of taking was not available and the accompanying data were not available.

Table V

Daily Summary of Hunters Checked on the Mazomanie Public Hunting Grounds in 1952

Date	No. of Hunters	Summer-Released Cocks Shot	Spring-Released Cocks Shot	Cocks Released During Hunting Season	Wild Juvenile Cocks	Wild Adult Cocks	Un-known	Total Birds Shot
10/18	660	51	4	--	131	8	17	211
10/19	475	20	3	--	53	3	1	80
10/20	69	2	--	--	15	1	--	18
10/21	69	6	--	--	11	2	2	21
10/22	57	4	--	--	9	1	2	16
10/23	41	4	--	--	8	--	--	12
10/24	40	1	1	--	8	3	--	13
10/25	145	5	--	--	12	--	--	17
10/26	154	5	--	--	10	1	1	17
10/27	13	1	--	--	---	--	--	1
10/28	18	---	--	--	2	1	--	3
10/29	22	1	--	--	5	--	3	9
10/30	10	---	--	--	1	--	2	3
10/31	17	---	--	--	4	1	2	7
11/1	35	---	--	2	---	1	--	3
11/2	73	---	--	6	8	4	1	19
11/3	3	---	--	1	1	--	1	3
11/4	9	1	--	3	2	--	--	6
11/5	6	---	--	--	1	1	--	2
11/6	6	---	--	1	---	--	--	1
11/7	9	---	--	2	1	1	1	5
11/8	14	---	--	4	---	--	--	4
11/9	11	1	--	--	---	--	2	3
11/10	2	1	--	--	---	--	9	10
11/11	9	---	--	--	---	--	--	0
Total	1,967	110*	8	19	282	28	44	484

*Total includes 7 birds not tallied according to date shot.

Table VI

Returns on Pheasant Cocks Stocked by Sportsmen's Clubs

County	*Year*	*No. Banded*	*Age*	*Time of Release*	*Per Cent Returned*
Wood County*	1951	10	16 weeks	Sept. 30	70
	1952	25	12 weeks	Aug. 25	44
	1953	20	11 weeks	Sept. 19	45
	1954	15	14–15 weeks	Oct. 5	80
Brown County**	1952	572	----------	--------	26

*A1 Krzykowski, of Heart of Wisconsin Conservation League (reward bands).

**Brown County Conservation Club (cash prize offe red; only club members eligible).