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AN EVALUATION OF PHEASANT STOCKING
Through the Day-old-chick Program in Wisconsin

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AN EVALUATION OF PHEASANT STOCKING THROUGH THE DAY-OLD-CHICK PROGRAM IN WISCONSIN

by

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CONTENTS

ABSTRACT

Pheasant stocking in Wisconsin is centered on a day-old-chick program. Pheasant chicks are given by the Wisconsin Conservation Department to sportsmen's clubs which rear the birds for release on lands open to public hunting. In recent years about 175,000 pheasants have been stocked annually through this program.

From 1953 to 1955 studies in 23 counties evaluated the contribution of pheasant cocks stocked by sportsmen's clubs. In marginal pheasant range the percentage of club-stocked cocks in the kill ranged from 16 to 64 and averaged 38. In mediocre range between 13 and 38 per cent of the kill was of club-stocked cocks, averaging 27 per cent. Less than 10 per cent of the kill in better pheasant range was of club-stocked cocks, averaging 5 per cent. Club-stocked cocks are an important source of shooting in counties with marginal pheasant range, but they add little to the kill in good range where the pheasant kill in individual counties is between 12,000 and 45,000 cocks annually.

Club members bagged a higher percentage of stocked cocks than nonclub members. The proportion of stocked cocks in the kill of both club and nonclub members was high in marginal range and low in good range.

The percentage of stocked birds in the bag decreased from the beginning to the end of the pheasant hunting season. Stocked cocks may be more vulnerable to hunting than wild birds and therefore may be harvested at a higher rate than wild birds early in the season. Another possibility is heavier hunting by club members on release areas early in the season. When hunting success drops off on these areas, club members may move to areas where no birds were stocked.

The percentage of club-stocked cocks recovered ranged between 42 and 75 per cent. The returns tended to be higher on birds stocked in areas containing high native populations than in areas where the native populations were low. For maximum returns, club-stocked birds should be released in good habitat where native pheasant populations and hunting pressure are high.

From 1955 through 1958 an evaluation was made of the contribution of hens stocked in fall by sportsmen's clubs in 12 marginal pheasant counties. Stocked hens contribute some young cocks to the shootable fall pheasant populations. The estimated average production was 0.2 to 0.4 young cocks per stocked hen. This low production figure resulted because few hens survived to the following breeding season. Because of low survival there is no long-term effect on the pheasant populations. Data suggest a continual differential loss of stocked birds from the hunting season to the following spring breeding season.

Stocking cocks in late summer and early fall will contribute more cocks to the shootable fall populations than stocking hens in fall and relying upon their production of young cocks for the following fall. Native pheasant populations have maintained themselves fairly well without the aid of hen stocking in most counties in marginal pheasant range.

Stocking through the day-old-chick

program adds about 15 per cent to the annual kill in years when the kill approaches 500,000 cocks. As the wild population decreases the percentage of stocked birds in the kill will increase.

The cost of a bird stocked through the day-old-chick program is $1.03. This is a minimum figure as some clubs donate feed and services and these costs are not figured in the total. The estimated cost of a stocked cock in the bag through direct cock stocking and from production of stocked hens ranges between $1.79 and $3.32.

Wisconsin's pheasant stocking program is not the ultimate answer to quality hunting and is strictly a put-and-take program. However, with various improvements this program should continue to be an important game management tool under certain conditions. It will furnish additional hunting for sportsmen on heavily hunted public hunting grounds. Cock stocking through the day-old-chick program will provide the hunter in marginal pheasant range with some pheasant shooting he could not expect to get entirely from sparse native populations.

INTRODUCTION

One of the objectives of game management is to provide hunting opportunities for the increasing number of small game hunters. One phase of the game management program of the Wisconsin Conservation Department is the artificial propagation of pheasants for release in suitable cover to supplement the shootable fall populations.

Wisconsin has developed one of the largest pheasant propagation programs in the United States. This program may by divided into two major facets: (1) the stocking of subadult and adult birds reared at the State Game Farm on state-owned public hunting grounds; and (2) the stocking of birds by sportsmen's clubs which participate in the cooperative day-old-chick program. All stocked pheasants are reared for release on lands open to the public for hunting. A minor segment of the State's propagation effort is the pheasant-egg-distribution program through which a small number of pheasants are stocked annually by interested cooperators including 4-H clubs.

Many other states have evaluated their pheasant stocking programs. The studies have produced a variety of results (Pushee, 1948), but the trend has been toward a reduction in the stocking effort in many of the states (Wandell, 1949). Michigan greatly curtailed its stocking program when pheasant releases no longer increased pheasant numbers (McCabe, MacMullen and Dustman, 1956). Even without pheasant stocking, Michigan hunters harvest around a million birds annually. South Dakota has never had a game farm (Gabrielson, 1951) and is recognized by everyone for its excellent pheasant hunting and its annual harvest of several million birds. Investigators in Oregon (McKean, 1951) and Colorado (Figge, 1951) have evaluated their pheasant stocking programs and found that the expenditures were

not justified. As a result, there have been revisions in the stocking policies in these states.

There are, however, a number of states actively operating game farms principally for propagating pheasants. In a recent survey in which 45 states replied to a questionnaire, Mahaffey (1958) found that 25 were raising pheasants. Several states reported raising only a few thousand birds (Iowa, 15,000; New Hampshire, 12,900; New Mexico, 5,715; North Dakota, "few"; and Rhode Island, 2,000), while other states had relatively large programs (Illinois, 120,000; Indiana, 139,990; and New York, 165,000). Pennsylvania reported producing 271,550 pheasants in the year of the survey (1956) which is comparable to Wisconsin's program.

Studies to evaluate the success of pheasant stocking in Wisconsin began in 1940. Intensive studies were conducted from 1946 through 1954 on Wisconsin Conservation Department public hunting grounds to gather information on the hunting returns from stocked birds. When season-long checks were made to record every bird shot on certain release areas, biologists found that an average of 51 per cent of the stocked male birds were taken by hunters in the same year as the release (Kabat, Kozlik, Thompson and Wagner, 1955). This percentage applies to the return of 10- to 12-week-old birds stocked in late August and early September on areas with good habitat and heavier-than-average hunting pressure. We could not assume that similar returns would necessarily be obtained on the cooperator-club (day-old-chick) birds which are stocked in a variety of habitats over the counties at large.

There was little factual information available on the day-old-chick program which would indicate either the success or desirability of continuing the release of pheasants under this program. Many members of sportsmen's clubs were under the impression that most of their shooting was coming only from birds stocked through the day-old-chick program. Other sportsmen believed that survival of club-stocked birds was poor and most of their shooting was coming from native birds. Therefore, studies were initiated by the Pheasant Management Research project (now the Farm Game and Range Research project) in 1953 to evaluate intensively this program and its contribution to pheasant hunting opportunity in Wisconsin. The objectives were (1) to determine what proportion of the pheasant kill was made up of cocks stocked each fall by clubs cooperating in the day-old-chick program, and (2) to obtain information on the survival of these birds to the fall hunting season. From 1955 through 1958 emphasis was placed on evaluating the contribution of the club-stocked hen to the huntable pheasant population through its reproductive efforts. Objectives were (1) to determine what proportion of the fall kill was made up of cocks produced by club-stocked hens, and (2) to obtain information on the contribution of stocked hens to future pheasant populations.

THE DAY-OLD-CHICK PROGRAM

Pheasant stocking by the Wisconsin Conservation Department began on a small scale in 1929 with the release of 3,053 birds. In 1936 the day-old-chick program was introduced by the Department to increase the annual output of pheasants to meet the demands of the hunting public. In this cooperative program, sportsmen's clubs throughout the state are encouraged to carry out the bulk of the pheasant rearing and stocking activities. Pheasant eggs are hatched at the State Game Farm and day-old-chicks are distributed to interested clubs upon request. Feed is provided by the Conservation Department to raise each chick to about 10 weeks of age.

In order to qualify for these chicks without cost, the clubs must meet certain requirements. Each club must supply and maintain standard chick brooders and brooder houses. There must be a minimum of 50 square feet of ground space available in outdoor runs for each bird. The club supplies its own caretaker and must comply with various Department regulations necessary for the successful propagation of pheasants.

The number of day-old chicks a club may receive is determined by the size of the club's facilities and financial abilities. There are many sportsmen's organizations in the state which are able to finance and maintain only one standard brooder set-up and thus receive 350 chicks which is considered a normal capacity for such facilities. Several club associations have been formed to pool the financial resources of a number of small clubs, and as a result they have large cooperative pheasant propagation programs. It is not uncommon to find 5,000 to 8,000 chicks being reared by one of these club associations.

The Conservation Department recommends that the cooperating clubs rear the pheasants to at least 10 weeks of age at which time the birds are usually fully feathered and are old enough to care for themselves. At this age the feed supplied by the state normally is all used up. A few clubs buy additional feed and hold the birds until a few weeks before the hunting season. Some clubs hold a portion of the hens, and a few cocks (recommended ratio of 1 cock to 10 hens) over winter for release in the spring. All birds must be released on lands open to the public for hunting. Clubs are requested to contact the district game manager or conservation warden

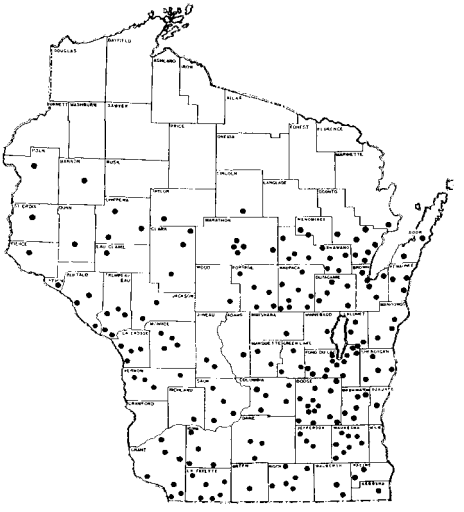
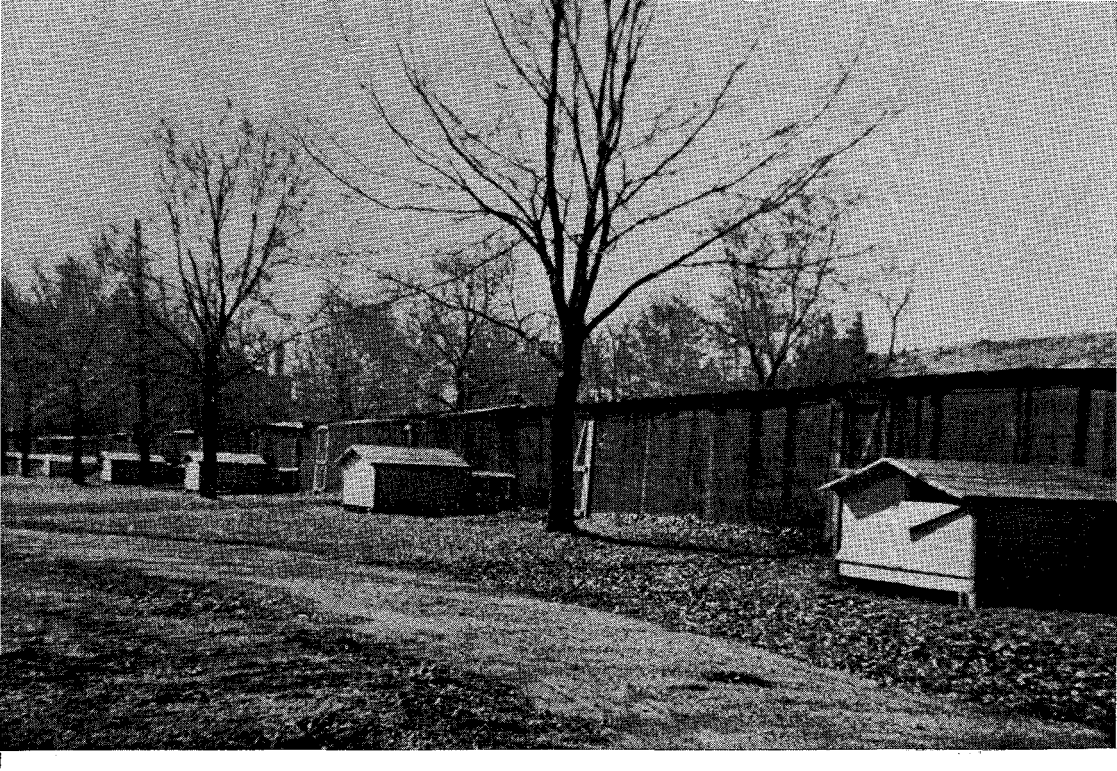


Figure 1. Location of sportsmen's clubs participating in the day-old-chick program in 1958.



Several club associations maintain large brooder facilities and thus are able to raise several thousand pheasants.

to aid in releasing the birds in good habitat.

The day-old-chick program has grown immensely since its inception. In recent years about 175,000 pheasants of both sexes have been stocked annually through the cooperative efforts of sportsmen's organizations. The number of clubs cooperating in the program has also grown. In 1958 there were 198 clubs in 55 counties rearing pheasants through the day-old-chick program. The locations of clubs participating in the program in 1958 are shown in Figure 1.

Table 1 shows the relationship between the number of pheasants stocked from the egg program and the day-old-chick program, and directly from the State Game Farm. The majority of the pheasant stocking effort in Wisconsin is centered on the cooperative day-old-chick program. The number of pheasants hatched from the egg program is a very small part of the total propagation program.

COCK STOCKING EVALUATION

Methods

Previous studies by Kabat *et al.* (1955), have shown that reliance on voluntary return of pheasant leg bands (by sportsmen) from birds stocked on Wisconsin public hunting grounds produces misleading results. Many sportsmen forget to return bands or have little interest in returning bands since they usually know the birds were reared and released by the Depart-

TABLE 1

Pheasants Stocked in Wisconsin, 1929-58

Year	Stocked From Egg Program	Stocked From Day-old Chick Program	Stocked From Game Farm*	Total Pheasants Stocked
1929	1,336	—	1,717	3,053
1930	4,410	—	8,799	13,209
1931	6,683	—	7,439	14,122
1932	4,680	—	7,360	12,040
1933	18,612	—	4,131	22,743
1934	12,163	—	12,126	24,289
1935	26,910	—	2,791	29,701
1936	19,453	4,427	11,050	34,930
1937	15,869	33,393	28,250	77,512
1938	19,731	65,792	69,671	155,194
1939	10,947	93,477	97,423	201,847
1940	14,249	115,390	96,486	226,125
1941	15,500	194,143	36,525	246,168
1942	11,827	141,247	39,865	192,939
1943	8,475	129,524	29,333	167,332
1944	8,965	123,227	30,345	162,537
1945	4,788	132,333	36,592	173,713
1946	4,645	117,259	49,621	171,525
1947	5,146	114,144	46,432	165,722
1948	5,783	146,294	50,206	202,283
1949	10,585	150,703	55,657	216,944
1950	9,608	165,990	51,527	227,125
1951	8,666	162,206	68,723	239,595
1952	10,282	165,692	61,819	237,793
1953	10,905	171,166	67,007	249,078
1954	10,340	154,904	62,892	228,136
1955	12,621	176,220	78,301	267,142
1956	16,928	177,026	70,853	264,807
1957	10,949	180,831	78,696	270,476
1958	9,432	191,497	65,480	266,409
Total	330,488	3,106,885	1,327,117	4,764,490
Per Cent of Total	6.9	65.2	27.9	100.0

* These figures include immature birds (10 to 20 weeks) stocked in late summer and early fall, plus mature birds stocked in fall and early spring.

ment. The conclusion, therefore, that the number of bands returned voluntarily represents the total number of banded birds bagged is entirely erroneous. In order to get reliable information on the harvest of banded pheasants, it is necessary to conduct an intensive hunter check on a well-defined area and examine every bird harvested for leg bands. This intensified checking method has consistently produced leg band returns approaching 50 per cent on 10- to 12-week-old cocks released in late August.

In this study an intensive hunter check to obtain information on county-

wide releases was impossible and another approach had to be used. A method was selected whereby legs of the stocked birds were branded at an early age, then recovered and identified during the fall hunting season.

Shortly before the opening of the 1953, 1954 and 1955 pheasant hunting seasons, a sample of hunters in selected counties was requested by the pheasant research project to return legs of shot pheasants via postage-free envelopes provided by the research project. From this sample of the fall kill, we determined what proportion of the pheasant kill was stocked cocks and estimated the number of stocked cocks shot. A comparison of this estimate with the number of cocks released gave an indication of survival to the fall hunting season.

Location of Study Counties

A series of counties with varying levels of native pheasant populations and stocking intensities was selected for study because of a possible relationship between the density of the native pheasant population and the intensity of stocking. The distribution of Wisconsin's native pheasant population is shown in Figure 2. The better pheasant areas are represented by classes 1 and 2; class 3 represents mediocre range, while class 4 represents the marginal and submarginal pheasant range. Pheasants are generally lacking in class 5 range. This population distribution, previously published by Wagner and Besadny (1958), is based on a combination of pheasant harvest data, crowing-count surveys and game managers' appraisals. The number of pheasant cocks killed per cock stocked is shown in Figure 3.

In 1953, Dane and Jefferson Counties, located in some of Wisconsin's better pheasant range, and Dunn and Barron Counties, in marginal range, were selected for study. In 1954, thirteen counties were studied: Dodge, Green, Racine, Rock and Walworth Counties in the better pheasant range; Jackson and Manitowoc Counties in mediocre pheasant range; and Clark, Iowa, Kewaunee, Richland, Shawano and Vernon Counties in the marginal and submarginal pheasant range. Six counties were studied in 1955: Kenosha, Ozaukee, Racine, Walworth, Waushara and Winnebago. (Racine and Walworth Counties were resampled to check on sampling biases). Each county sampled in 1955 contained good native pheasant populations and stocked relatively few birds through the day-old-chick program. Each of these counties received heavier-than-average hunting pressure because of the proximity to large urban populations.

Marking Birds for Identification

A marking technique was needed which was easy to apply and which would leave a discernable, but inconspicuous mark. This latter criterion was desired so hunters would not realize that stocked birds were marked and bias the results by sending in marked or unmarked legs preferentially. The technique also had to be a type requiring little time as a large number of birds were involved.

A branding technique described by Wandell (1943) was used. This technique involved applying an electric wood-burning pencil to one scute

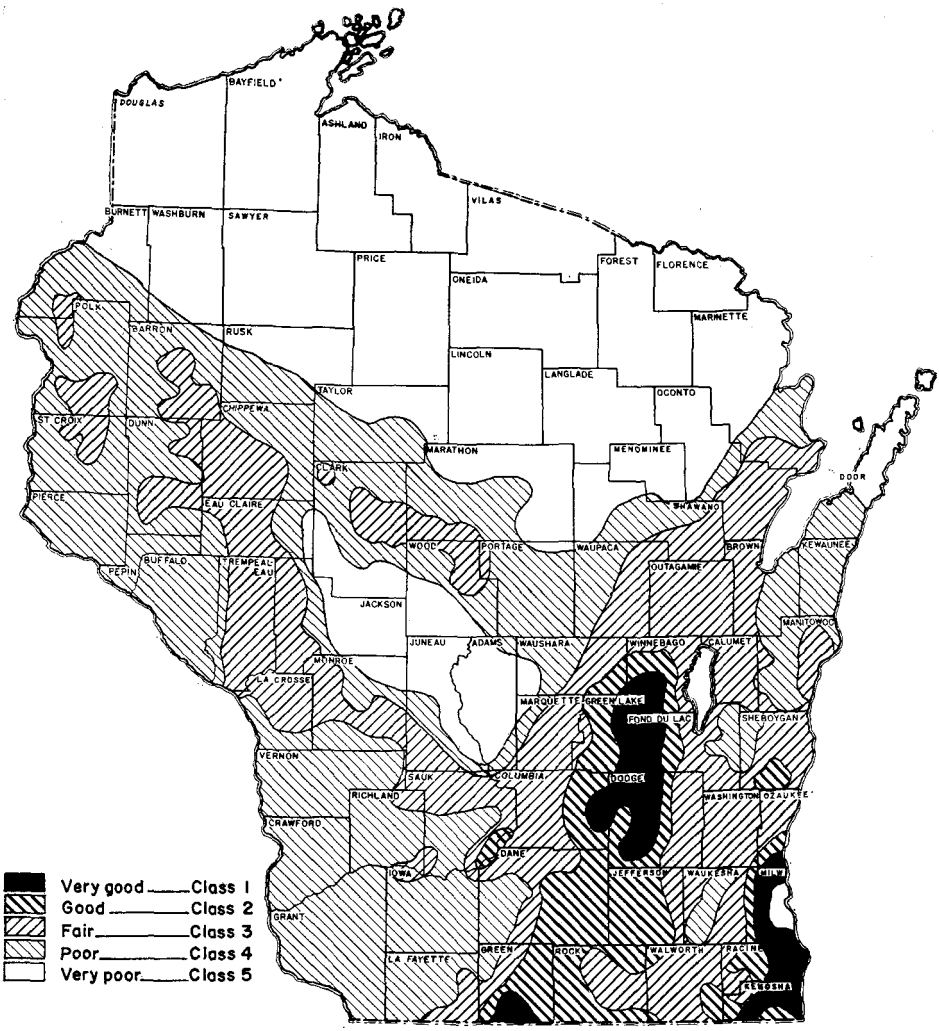


Figure 2. Pheasant population distribution in Wisconsin.

(scale) on the front surface of each leg of a pheasant chick. It proved to be a simple and efficient way of marking a large number of birds for identification. The mark, a deformed scute, is quite inconspicuous and unless the observer knows exactly what to look for, will go unnoticed. Two people, working together, can mark about five birds a minute.

Club officials at each club participating in the study were contacted in spring before the delivery of the pheasant chicks by either research personnel, the district game manager or conservation warden. Objectives of the study were explained at this time. Many of the club officials expressed their desire for such a study. Clubs participating in the cock-stocking study are listed in Tables 19, 20 and 21, Appendix A.

The first day-old chicks to be delivered to cooperators by the State

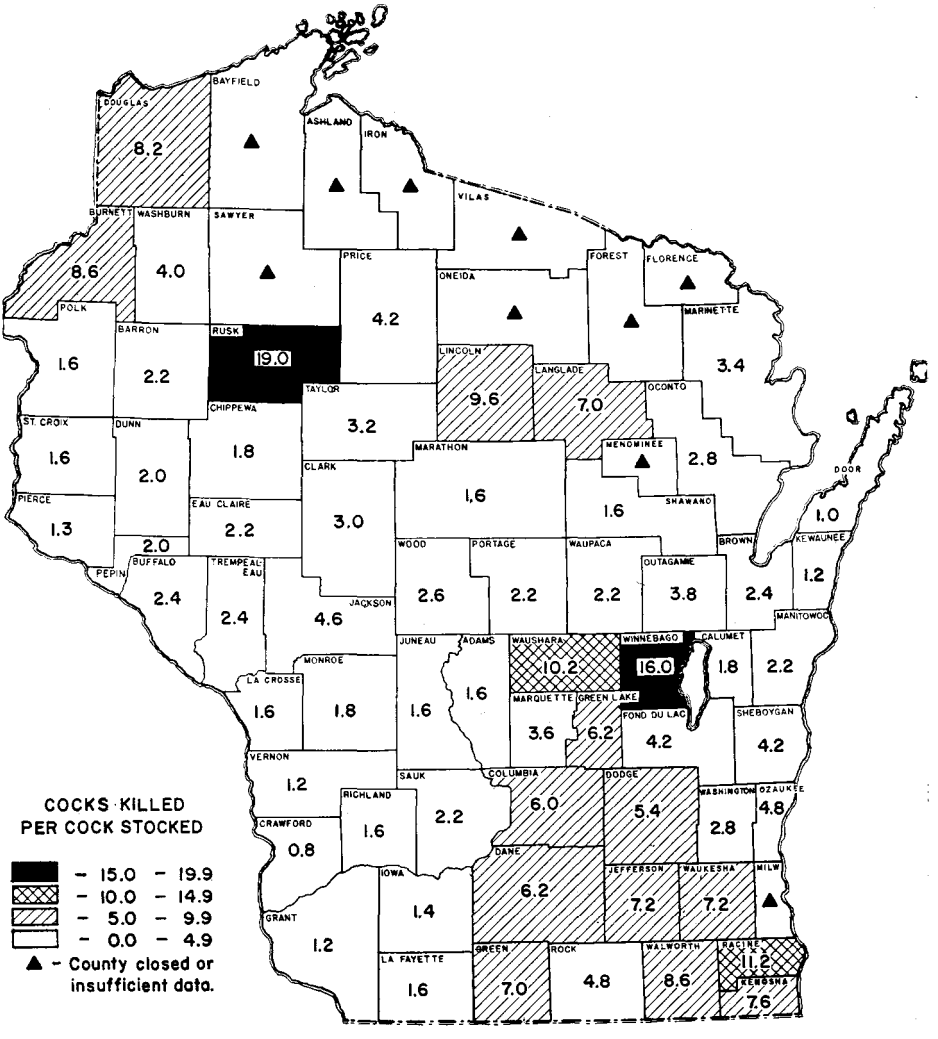
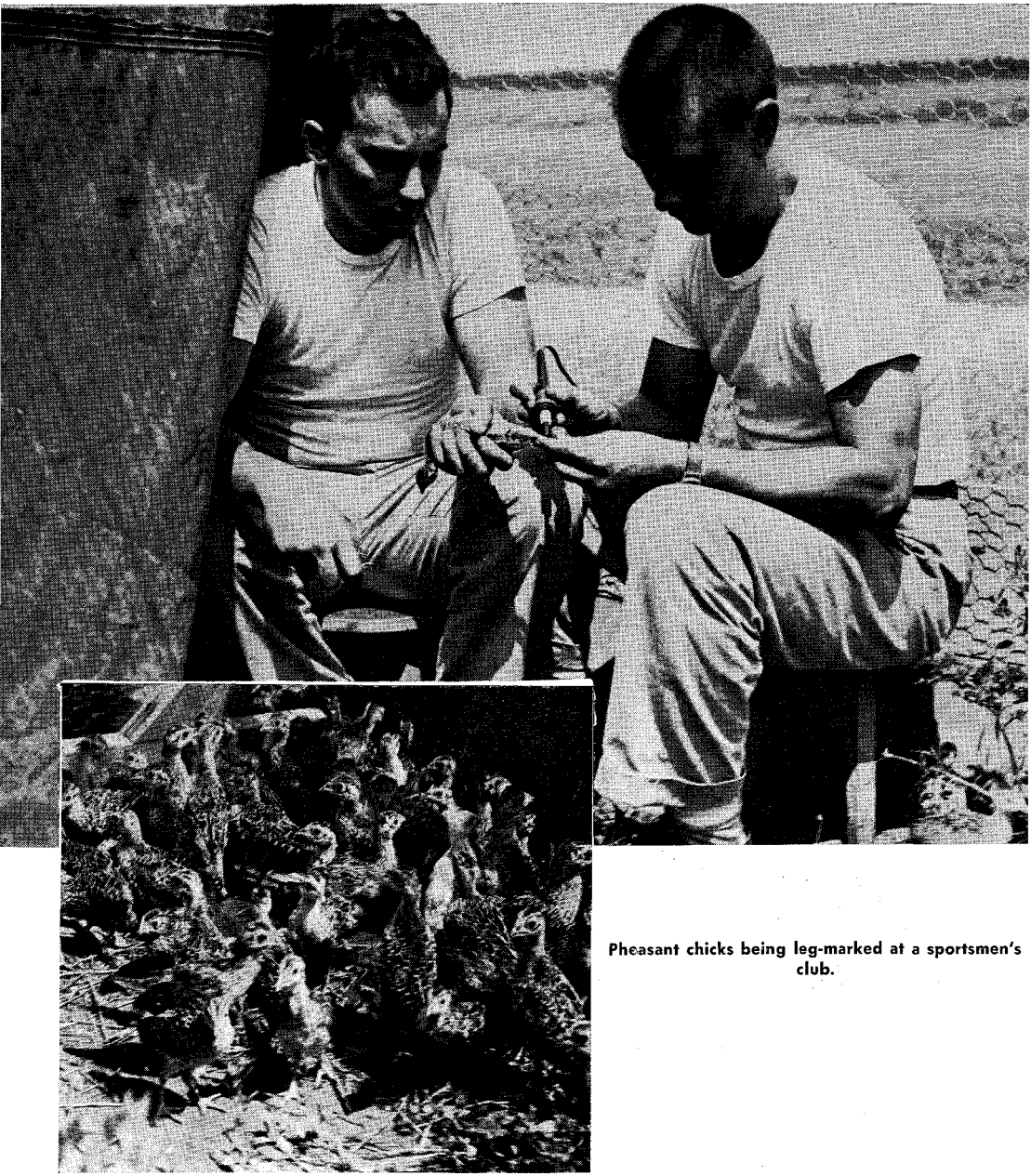


Figure 3. Pheasant cocks killed per pheasant cock stocked based on a three-year average, 1950-52.

Game Farm each spring are usually distributed to clubs in the southern part of the state because of more favorable weather conditions for artificially propagating pheasant chicks at this time. Later-hatched chicks are delivered to clubs in the northern sections of the state when the weather becomes more favorable in these areas. About 12 different hatches, produced at four-day intervals, are delivered to the cooperating clubs between the middle of May and the end of June.

When the pheasant chicks were between 11 and 20 days old (the best age we found for marking them), pheasant project personnel visited each club and leg-marked the birds. Both sexes were marked as it is difficult to rapidly separate the sexes at this early age. Over 78,000 chicks were marked during the three years of the cock-stocking study.

Periodically during the summer of



Pheasant chicks being leg-marked at a sportsmen's club.

each year of this study spot checks were carried out to make certain that the marks were clearly visible on the birds. Checks were also made prior to release. Legs of 5,000 birds were re-examined and the marks were identifiable on *every* bird. Several clubs participating in the 1953 study held birds, largely hens, over winter for release in the spring. These clubs were visited in late November after the close of the hunting season and legs of 250 birds were examined for persistence of marks. Marks were again clearly visible on every bird. Six pheasant hens were leg-marked when two weeks

of age and held in a pen at the State Game Farm for three years. Even after this length of time the leg marks were still visible on each of the hens. This indicates no loss of marks during the course of the study and, therefore, no bias in this respect.

Leg-branding had no noticeable effect on the birds. Survival of branded birds from time of marking to release was high and comparable to survival of unbranded birds reared at the State Game Farm. This technique can, however, cause damage to the birds if improperly applied. During the first year of the study about 300 pheasant chicks out of a total of 21,000 were accidentally crippled when the wood-burning pencil was applied too hard to the surface of the leg and the leg tendons were seared. This caused the toes to curl back and the birds walked on stubs. The majority of these crippled birds were replaced, but a few were released. During the hunting season several of these crippled birds were shot and returned to us in the wing and leg envelopes indicating that even with this walking difficulty the birds managed to survive in the wild. A little experience with the branding technique soon remedied this difficulty and in later years no crippling was observed from the branding.

In 1954, an additional approach was used to identify club-reared pheasants. One method used to estimate returns of club-stocked cocks in this study was based on Department kill figures which were subjected to sampling error and various biases. In order to obtain a set of return estimates independent of kill figures, two-dollar

The wood-burning pencil left a small mark on a scale on the front surface of each leg of a chick. The marks appear as small white spots shortly after branding (see arrows), but disappear in a few days when they become well camouflaged in the leg scales.

reward bands were used. A reward band was placed on a leg of a random sample of 100 club-reared cock pheasants in each of five study counties (Jackson, Manitowoc, Rock, Shawano and Vernon) at the time of stocking. Each of these counties represented a different pheasant population level and a high rate of stocking.

The reward was used as an incentive to return the leg band. Each band bore the inscription "$2.00 reward for return to Wisconsin Conservation Department, Madison, Wisconsin" along with a serial band number. Publicity was given to this banding method after the birds were released. These reward bands were placed on pheasant cocks by pheasant project personnel and the birds were released along with the others by club officials.

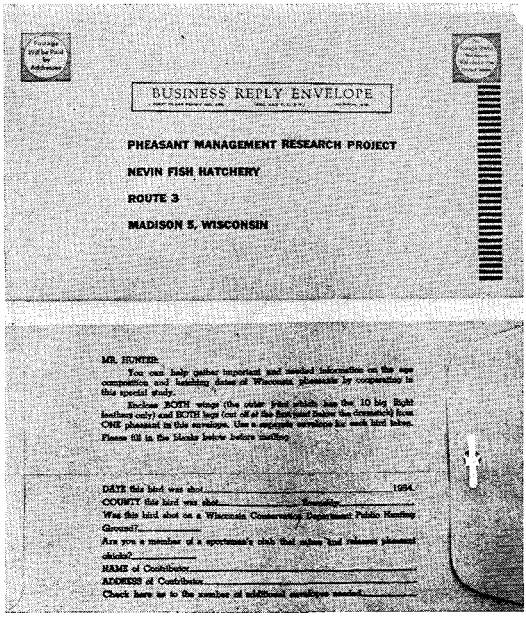
Collecting Data

A mailing list of pheasant hunters was compiled by obtaining names and addresses from kill report cards. All hunters were required by law to submit a report of game they killed on a form attached to their hunting license. Although the return of these kill reports represented less than 15 per cent of the small game hunters during the years of this study, they were a ready source of hunter names. Names and addresses were gathered from the 1952, 1953, and 1954 kill report cards for the 1953, 1954, and 1955 studies. Every hunter who reported shooting one or more pheasants in any one of the study counties was sent a number of postage-free return envelopes and a set of instructions. The instructions requested the hunter to send us both wings and both legs from each pheasant rooster shot during the hunting season. The wings of wild birds were used to obtain hatching-date information in connection with another study.

Hunters sending in envelopes were requested to record on the back of each envelope (1) date the pheasant rooster was shot, (2) county and township where it was shot, (3) whether or not the bird was shot on a Wisconsin Conservation Department public hunting ground, (4) whether or not the hunter was a member of a sportsmen's club that raised and released pheasants, and (5) the hunter's name and address. A space was provided where the contributor could indicate how many additional envelopes he needed (Fig. 4).

The number of envelopes sent to each hunter on the mailing list depended on his hunting success the previous year as determined from his kill report card. With two exceptions, each hunter received the same number of envelopes as the number of pheas-

Figure 4. Postage-free envelopes were sent to a sample of pheasant hunters for the return of pheasant wings and legs.



Sorting wing and leg envelopes.

ants he reported shooting the previous year. Anyone who reported shooting only one pheasant was sent two envelopes. A maximum of 12 envelopes was sent to hunters reporting shooting more than ten pheasants. Later requests for additional envelopes were filled immediately. District game managers and conservation wardens in some of the study counties also distributed envelopes to hunters they met in the field.

In 1954, an additional method was used to distribute envelopes in nine counties. County clerks in Wisconsin aid in selling hunting licenses, both directly through their office and through cooperative agents in their counties. County clerks in Clark, Iowa, Jackson, Kewaunee, Manitowoc, Richland, Shawano, Vernon and Walworth Counties were each sent 1,000 envelopes with instructions to distribute two envelopes with each small game license sold. Excellent cooperation was obtained from most of the county clerks and their agents in distributing envelopes and several county clerks requested additional envelopes for distribution.

About 69,000 envelopes were distributed (via all methods) to hunters during the study. Over 12,000 envelopes containing pheasant wings and legs were returned to us which represented about 5 per cent of the estimated pheasant kill in the study counties.

Findings

Proportion of Club-Stocked Cocks in the Harvest

The assumption is made that the leg sample in this study constitutes a reasonably random sample of the county-wide pheasant kill, and therefore, the percentage of marked birds in the sample from each county approximates the percentage of club-stocked cocks in the county kill.

In a study of Wisconsin kill estimates, Thompson (1951, 1952, 1953) found that the state-wide pheasant kill estimates based on voluntary reports averaged about 10 per cent higher than in his hunter poll which was based on direct solicitation. Thus, the county kill figures used in the cock stocking phase of this report have been reduced by 10 per cent to compensate for the bias resulting from over-estimating the county pheasant kill.

County Variations

The percentage of club-stocked cocks in the kill in each county studied is shown in Table 2 along with the estimated kill for each county. In Figure 5, the percentages are superimposed on a map showing wild pheasant population levels. In marginal pheasant range (Class 4) the percentage of club-stocked cocks in the county kill ranged from 16 to 64 and averaged 38. In mediocre pheasant range (Class 3) between 13 and 38 per cent of the county kill contained club-stocked cocks, averaging 27 per cent. Less than 10 per cent of the kill in the better southeastern counties (Classes 1 and 2) contained club-stocked cocks, averaging 5 per cent.

These data suggest that club-stocked cocks constitute a large proportion of the kill in marginal pheasant range where the county kill ranges from 1,000 to 8,000 cocks annually. In the better pheasant range, where hunters in individual counties annually harvest between 12,000 and 45,000 birds, club-stocked cocks make up a very small percentage of the total kill

The percentage of club-stocked cocks in the county kill is related to the wild pheasant population level and the number of cocks stocked. The rate of stocking in most marginal pheasant counties where a high percentage of the kill is composed of stocked birds is not especially heavier than in the better pheasant counties. The available habitat in the marginal counties generally is of poor quality and wild population levels are so low that stocked birds make up a high proportion of the shootable fall populations. In the better pheasant counties where habitat conditions are more favorable, wild pheasant populations far out-number stocked birds.

Similar findings were obtained in New York by Skiff (1948). By means of voluntary band returns he found that between 25 and 50 per cent of the kill on certain release areas was composed of stocked cocks. On two intensively checked areas, 57 and 80 per cent of the kill was stocked cocks.

Hart, Jones and Shaffer (1951) found that 28 per cent of the total kill was composed of stocked birds in good pheasant range in California; in marginal range 82-93 per cent of the kill contained stocked cocks. Harper (1956) obtained similar information in Idaho: opening week-end hunter checks revealed that 65-78 per cent

TABLE 2

Estimated Pheasant Harvest and Percentage of Stocked Birds in the Harvest

County and Year	Estimated Pheasant Harvest	Total Birds in Sample	Per Cent Stocked
1953			
Barron	4,709	241	51
Dane	26,440	1,254	6
Dunn	5,255	429	38
Jefferson	28,272	1,221	5
1954			
Clark	3,261	148	34
Dodge	44,240	1,167	8
Green	13,842	778	3
Iowa	2,136	195	29
Jackson	5,989	366	13
Kewaunee	2,251	215	44
Manitowoc	8,623	414	32
Racine	17,301	708	2
Richland	1,692	139	32
Rock	20,691	841	7
Shawano	5,021	280	40
Walworth	13,480	591	3
Vernon	1,446	81	64
1955			
Kenosha	13,107	567	5
Ozaukee	6,384	300	9
Racine	18,040	751	3
Walworth	14,930	568	3
Waushara	8,227	338	3
Winnebago	22,183	779	2

of the pheasant kill in poor range was made up of stocked birds while 3-15 per cent of the kill in good pheasant range contained stocked birds. Parts of the New England States have considerable marginal pheasant range and studies by Pushee (1948) and Dorr (1952) showed that the annual kill for Connecticut, Maine, and New Hampshire contains 59-80 per cent stocked birds; New York which stocks from 100,000 to 200,000 birds annually has an annual kill composed of about 32 per cent stocked birds.

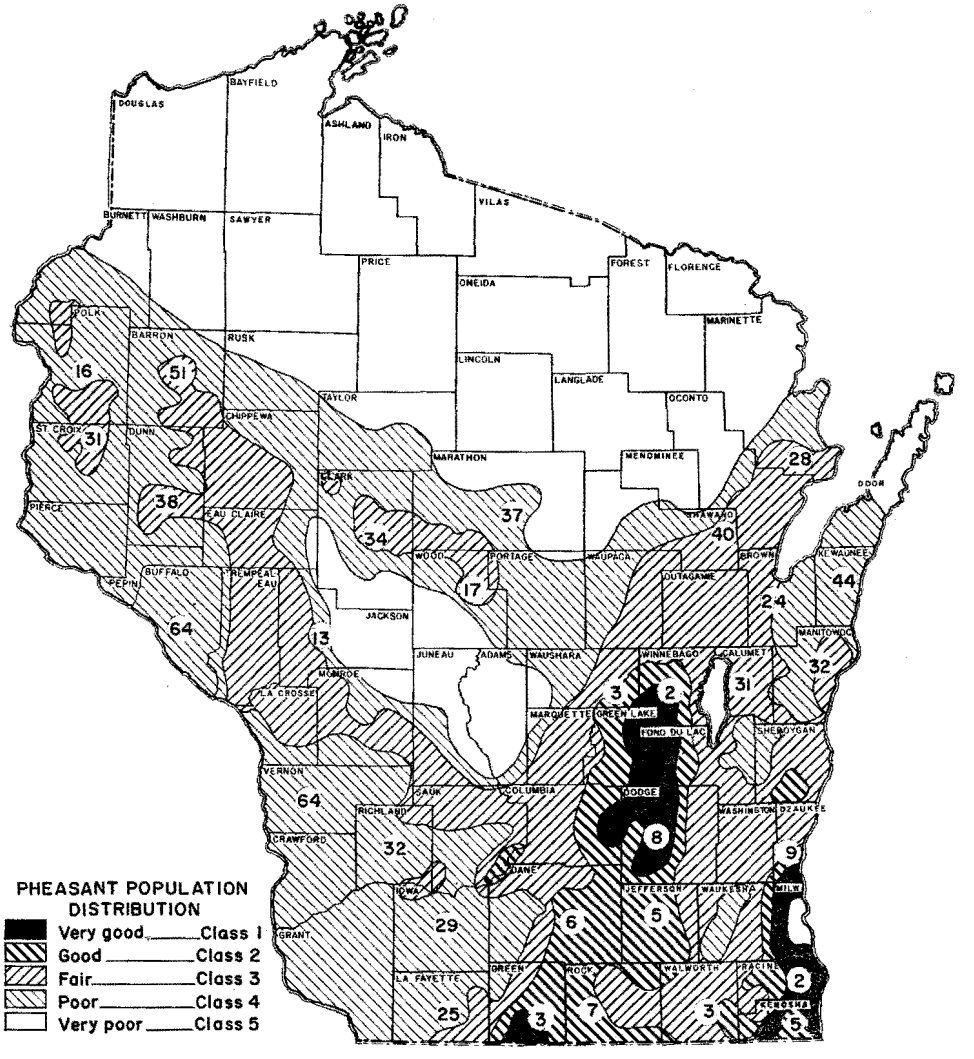


Figure 5. Percentage of club-stocked cocks in the county kill in relation to population levels of wild pheasants. (Percentages obtained from the first year of the hen stocking evaluation study are included.)

Harvest by Club and Nonclub Members

On the back of each return envelope the contributor was asked to indicate whether or not he was a member of a sportsmen's club which raised and released pheasants. From this information we were able to analyze the returns of club and nonclub members. The proportion of club-stocked cocks shot by hunters who belong to sportsmen's clubs raising day-old-chicks is higher than for nonclub members (Table 3). These data suggest that most club members have a knowledge of the release sites and tend to hunt in the vicinity of these areas.

Sportsmen's clubs publicize the stocking of pheasants reared under the day-old-chick program in several ways. Stocking is sometimes done by a com-

mittee of several men appointed by the club membership. When this method is used, a map is often circulated at a later date to the membership showing the release areas. Another stocking method provides each club member with a portion (usually 3 or 4) of the birds for release in an area he feels is suitable. Sometimes the pheasants are stocked by one or two club members and no publicity is given.

Clubs which raise only a few hundred pheasants usually stock these birds within a few miles of the town in which the majority of club members live. Large sportsmen's organizations raising several thousand pheasants normally scatter them over several townships or at times equally divide the birds among each township in the county.

By the time the pheasant hunting season begins in mid-October most club members know where the cooperatively reared birds were stocked. Some nonclub members also gain knowledge of these release sites through acquaintance with club members. The data in Table 3 indicate that while the proportion of stocked cocks in the bag of club members is higher, stocked cocks are also being harvested by nonclub members. In a few counties nonclub members harvest more club-reared pheasants than club members. This is probably the result of wide-spread publicity or stocking of pheasants over large segments of the county allowing more hunters to come into contact with the stocked birds. The proportion of stocked cocks in the kill of both club and nonclub members remains high in marginal counties and low in good pheasant counties.

Vulnerability of the Club-Stocked Cock

The percentages of the total season harvest taken each week of the season for both stocked and wild birds are shown in Figure 6. There is a differential rate of harvest between the two groups, with the stocked birds displaying a greater vulnerability during the first week of the hunting season. To statistically analyze this effect, the individual groups of counties representing varying native pheasant population levels were separately examined. Harvest data were partitioned into periods covering the opening week end, the next 14-day period (first two weeks) and the remainder of the season (Table 4). Chi-square tests indicate that for all county groupings the stocked birds suffered a significantly higher exploitation rate than the wild birds in the early part of the season.

The percentage decrease in stocked birds appears to be greater throughout the season in good and mediocre pheasant range (Classes 1-3). This may result from heavier hunting pressure which takes place in better pheasant range. In poor pheasant

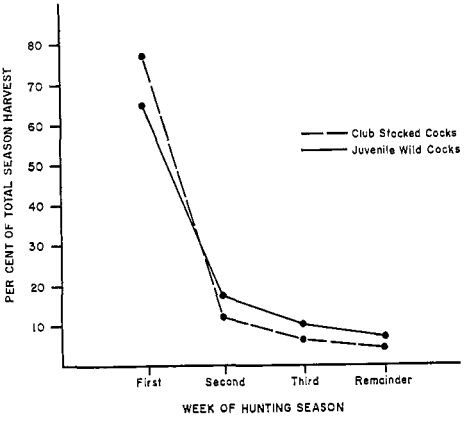


Figure 6. Weekly distribution of juvenile wild and club-stocked cocks shot during the hunting season.

TABLE 3

Proportion of Stocked Birds in the Bag of Club and Nonclub Members

County	Total Birds Shot		Per Cent Stocked Birds in Bag	
	Club Members	Nonclub Members	Club Members	Nonclub Members
Dane	368	808	7.9	4.8
Dodge	388	757	9.0	7.1
Green	306	445	2.9	2.7
Jefferson	432	740	6.0	4.3
Racine – 1954	94	591	0	2.0
Rock	210	572	8.6	5.9
Walworth – 1954	88	482	9.1	2.1
Kenosha	258	304	6.2	3.9
Ozaukee	101	195	10.9	8.7
Racine – 1955	93	647	5.4	2.3
Walworth – 1955	136	409	8.1	1.7
Waushara	55	280	1.8	3.6
Winnebago	135	621	2.2	1.6
Total	2,664	6,851		
Weighted Avg.			6.5	3.9**
Jackson	180	178	13.9	11.8
Manitowoc	181	218	33.7	32.1
Total	361	396		
Weighted Avg.			23.8	23.0
Barron	90	129	50.0	54.3
Clark	69	77	31.9	35.1
Dunn	205	210	40.5	34.3
Kewaunee	152	59	48.7	35.6
Shawano	162	116	43.2	36.2
Vernon	48	32	70.8	53.1
Richland	76	60	44.7	15.0
Iowa	130	58	31.5	22.4
Total	932	741		
Weighted Avg.			43.2	36.6**
Grand Total	3,957	7,988	16.7	7.8**

** The percentages of stocked birds between club and nonclub members differ at the 1 per cent level of probability.

range (Class 4) where hunting pressure is lighter, the seasonal harvest of both stocked and wild birds is prolonged.

Similar trends have been found in pheasant studies in New Zealand by Westerskov (1956:33). He believes that game farm birds are not as wild

TABLE 4

Comparison of Early Season vs. Late Season Harvest of Stocked and Wild Birds

Pheasant Population Level	Total Season Sample		Per Cent of Season Harvest: Opening Week End	First Two Weeks	Remainder of Season	Chi-Square
Class 1-2 (Good)	Stocked	281	52.3	39.5	8.2	
	Wild ..	4,054	43.4	44.1	12.5	10.05**
Class 3 (Mediocre)	Stocked	182	67.6	29.1	3.3	
	Wild ..	558	53.6	36.4	10.0	13.83**
Class 4 (Poor)	Stocked	580	42.9	43.5	13.6	
	Wild ..	826	39.3	40.2	20.5	10.70**

** Different at 1 per cent level of probability.

and alert as birds reared in the wild and, therefore, stocked birds are easier targets for the hunter. Westerskov found that 33 per cent of the stocked pheasants were bagged the first week end of the hunting season. Only 24 per cent of the season kill of wild birds occurred during this period.

Kabat *et al.* (1955), trapped, banded and liberated wild cocks at the time of release of game-farm-reared cocks on a Wisconsin study area in 1948 and 1949. In these two years, 30 and 64 wild cocks, respectively, were released; 73 and 56 per cent of the wild cocks were recovered. A comparison was also made of the proportion of stocked cocks in the kill on opening week end and the remainder of the season on various study areas. Their data indicated that stocked cocks were not too disproportionately reduced in numbers during the first few days of hunting. They concluded that there was little difference in superiority of wild cocks over game farm cocks in either survival or vulnerability to the gun.

Harper, Hart and Shaffer (1951) in California found that game farm pheasants stocked a month or more before the hunting season opened were killed in about the same proportions throughout the season as wild birds on a heavily hunted area. However, they found that birds stocked only a few days before the opening of the hunting season or birds stocked in season were harvested more readily than wild birds.

The majority of club-reared pheasants in Wisconsin are stocked at least a month before the opening of the hunting season and these birds are being harvested at a higher rate than wild birds. Part of this higher rate of harvest may result from the way some clubs cooperatively raise pheasants. Many clubs do an excellent job of raising pheasants but some raise them

under adverse conditions. By release time some of these birds are in poor physical condition and can hardly fly to escape the gun. Part of this trouble can be attributed to poor rearing facilities, lack of adequate feed and inexperienced caretaker help. Some clubs treat the pheasants as domestic poultry and end up with a flock of very tame birds.

The differential harvest of stocked birds seems to be analogous to the widely recognized seasonal change in age ratios in the bag. This is generally assumed to be due to a differential vulnerability between juveniles and adults (Eberhardt and Blouch, 1955; Kimball, 1948).

Another possible cause for the decline in percentage of stocked cocks in the bag is that as soon as the hunting season opens, club members may hunt the release areas quite heavily. In most areas club members are getting a higher percentage of stocked birds than nonclub members (Table 3). The shrinkage of club-stocked cocks during the season may well result from this selective hunting.

Survival of the Club-Stocked Cock

The second objective of this study was to obtain information on the survival of the club-stocked cock to the fall hunting season. Our only approach was to measure the percentage of club-stocked cocks shot by hunters as indicated by the leg-sample data. This "percentage return" provided an index of survival. The accuracy with which it reflects survival depends upon the percentage of surviving birds shot by hunters. Survival here covers the period from the day of release to recovery during the hunting season.

Age of the stocked pheasant and its release date have a direct effect on survival and return to the hunter. The older the birds and the closer they are stocked to the hunting season opening, the higher the return (Buss, 1946; McNamara and Kozicky, 1949; Harper *et al.*, 1951; Kabat *et al.*, 1955). In this study, club-reared birds averaged 12 weeks of age at release.

The time of release of club-stocked birds in Wisconsin has varied because of staggered delivery dates of chicks in spring. In this study stocking varied from mid-July to mid-September, with the majority of the birds being stocked in late August. Thus, birds were stocked six to eight weeks before the beginning of the hunting season in mid-October. The age and time of release of these birds are comparable to the age and time of release of birds stocked on public hunting grounds.

The quality of the stocked bird is also an important factor in its survival. Disease and improper nutrition can be a problem where many birds are raised in close captivity. These problems have been relatively minor in Wisconsin's day-old-chick program as the average survival rate (from day of delivery of chicks to day of release) has been about 85 per cent. Minor outbreaks of disease have occurred at cooperator clubs mostly because of unsanitary conditions in the brooder houses. The feed rations supplied by the state have been developed by the Department and are of exceptionally high quality (Stanz, 1952).

Returns of Club-Stocked Cocks Using Estimated Kill Figures

An estimate of the number of stocked cocks shot in each county was ob-

TABLE 5

Implied Percentage Return of Club-stocked Cocks According to County-wide Estimates of the Total Kill

Pheasant Population Level	Per Cent Return	
	Based on the Total Bag Sampled	Based on Bag Sample From Non-Club Members
Class 1-2 (Good)	82	71
Class 3 (Mediocre)	72	70
Class 4 (Poor)	76	69
Weighted Avg.	78	70

tained by multiplying the percentage of stocked cocks in the bag by the estimated county pheasant kill. Since the number of cocks stocked was known, it was possible to estimate the percentage return (Table 5). These data indicate an average return of 78 per cent of club-stocked cocks. This implied return seems high and may result from overestimating individual county pheasant kill figures (in spite of a 10 per cent reduction) because of harvest sampling procedures. Bias may also result from club members sending in more marked legs of stocked pheasants. Since our sample kill of pheasants by club members contains a higher proportion of stocked birds than that of nonclub members, greater cooperation in sending in legs could bias the sample and contribute to the higher returns.

By using only data from nonclub members, a minimum estimate can be obtained by using the same procedures. The average return for all counties studied was 70 per cent.

The bias may or may not be offset by using only data from nonclub members. However, this method of estimating returns gives a maximum return of stocked cocks ranging from 70 to 78 per cent, and probably approaches a return of 75 per cent.

This estimated return is high for pheasants stocked in various types of habitat throughout Wisconsin's pheasant range 6 to 8 weeks before the hunting season opened. High return estimates have been obtained on stocked birds released shortly before the season opened during the hunting season. Stokes (1957) cited harvest figures of 75 per cent for cocks liberated in season in California. He calculated that with an estimated crippling loss of 20 per cent, this would give a 90 per cent kill of stocked birds. Stokes also quoted an 85 per cent harvest of inseason releases of stocked birds in Ohio. Studies by Low (1954) in Utah showed a return of 75 per cent on birds released within a week of the hunting season. Returns of

60-65 per cent have been obtained on birds stocked 2 to 7 days before the hunting season on Wisconsin public hunting grounds in recent years. However, returns were much lower on in-season releases made 10-15 days after the season opened, averaging 30-40 per cent. This was attributed to lower hunting pressure later in the season on public hunting areas (unpubl. data).

Reward Band Returns

Of the 500 two-dollar reward bands put on club-stocked cocks at the time of release in five study counties, 199 were returned in the same year as the release (Table 6). This represents a 40 per cent return on pheasants stocked 6 to 8 weeks before the hunting season opened. In subsequent years an additional 11 bands were recovered. This percentage serves as a minimum for the range of return estimates presented in this study since some hunters may never closely examine the leg bands on the birds they shoot. We know of three banded birds which were shot with no effort made on the part of the three individual hunters to send the bands in and claim the reward.

Bellrose (1955) found that two-dollar reward bands placed on mallards in Illinois increased the prcentage of reported recoveries 2.2 times the number reported by using standard leg bands. In his study, 5 reward bands (from a total of 896 reward bands) were known to have been recovered but not reported. With this knowledge of unreported reward bands, Bellrose suggested that the returns on mallards in the Mississippi Valley would be at least 2.5 and possibly 3 times greater than indicated by standard bands.

This system of reward banding indicates that at least 42 per cent of the club-stocked cocks in Wisconsin survived until the fall hunting season. The small number of bands returned in later years shows that stocked cocks not harvested the first year contribute very little to future harvests.

Since we were dealing with early- and late-hatched birds in this study, we obtained information on differential returns on these hatches. Club associations in Jackson and Rock Counties each received two different hatches of pheasant chicks in 1954. The birds were released at two different times that fall. We leg-banded,

TABLE 6

Reward Band Returns, 1954-58

County	Pheasant Population Level	Number of Birds Banded	Number of Bands Returned				
			1954	1955	1956	1957	1958
Rock	Good	100	44	0	1	0	0
Manitowoc	Mediocre	100	50	0	1	0	1
Jackson	Mediocre	100	32	3	1	0	0
Shawano	Poor	100	36	1	0	0	0
Vernon	Poor	100	37	2	1	0	0
Total		500	199	6	4	0	1
Per cent return			40.0	1.2	0.8	0	0.2

TABLE 7

Reward-band Returns — Early vs. Late Releases

County	Release Date (1954)	Age at Release	Number of Bands Returned		Total Returned
			1954	Subsequent Years	
Jackson	Aug. 8	11 wks.	15	3	18
Jackson	Sept. 15	11 wks.	17	1	18
Rock	Sept. 5	14 wks.	24	1	25
Rock	Sept. 12	11 wks.	20	0	20

with two-dollar reward bands, 50 birds from each hatch in each of the two counties. The first release in Jackson County was made on August 8, 1954; the second was made on September 15, 1954. The birds were 11 weeks old at release time. Hunters eventually returned 18 leg bands from each release indicating no difference in survival of birds (Table 7). In Rock County 25 bands were returned from the early-hatched birds released on September 5, 1954. Twenty bands were returned from the late-hatched birds released one week later. A few more bands were returned from the earlier release. These birds were three weeks older when released which might have contributed to the higher return. However, there is no statistical difference between the number of bands returned from the two Rock County releases.

Returns as Shown by Other Wisconsin Studies

Occasionally a few sportsmen's clubs band pheasants and offer prizes for return of bands. For several years one club (Heart of Wisconsin Conservation League, Wood County) offered two dollars in sporting merchandise for the return of club bands. These birds were released at random by one of the club officials in undisclosed locations. The birds ranged from 10- to 16-weeks of age and were released between 2 and 6 weeks before the opening of the pheasant season. The average return for four years was 56 per cent (Kabat *et al.*, 1955).

Buss (1946:118-122) obtained estimates on the county-wide returns of stocked cocks in a marginal pheasant county (Dunn) in 1941 and 1942 using a postcard survey to get information on banded birds. Hunters returned 11 per cent of the 2,550 postcards distributed. Correcting for a complete return for the unanswered cards, Buss obtained estimates of 77 and 84 per cent on the released birds for the two years. He believed that only the more successful hunters reported their kill which exaggerated the returns.

Relationship Between Survival and Habitat

Some investigators (MacMullen, 1954; Allen, 1956) have suggested that stocking game farm pheasants in areas containing good pheasant habitat and high wild populations may result in the eviction of the stocked birds, thus decreasing survival. In order to obtain information on the relationship between survival of the club-stocked cocks, pheasant densities and habitat

in Wisconsin, two indices were used: (1) an index of habitat based on native pheasant population densities; and (2) an index of survival of club-stocked cocks based on leg returns from wild birds. The procedures used in making these calculations are described below:

(1) *Index of Habitat*

Native pheasant population density was used as an index of habitat as high pheasant populations are associated with good habitat and low populations are associated with poorer habitats.

(a) To obtain this habitat index, the number of legs of wild birds sent in by hunters was tabulated from each township from several representative counties studied.

(b) The return by township then was divided by the total return of wild pheasants in the county. This procedure gave the percentages of legs from the county total received from each township within that county. These percentages were assumed to reflect the percentage of the total wild kill occurring in each of the townships within a county, and consequently to reflect the wild population distribution in the county.

(c) The total wild pheasant kill in each township was obtained from the product of the percentage kill in each township (*b* above) and the county kill estimates.

(d) The total wild pheasant kill for each township was then reduced to pheasant kill per square mile for each township by dividing *c* (above) by the area of the township. The pheasant kill per square mile provided an index of the pheasant population density by townships in each of the counties studied.

(e) To minimize sampling error, the townships in each county were divided into four equal groups: the first group with the highest kill per square mile, the second group with the next highest kill, the third with the second lowest kill, and finally those townships with the lowest kill.

(2) *Index of Survival*

The following procedures were used to obtain an index of survival of club-stocked cocks: The number of marked legs returned for each of these four pheasant population density groups of townships for each county was divided by the number of cocks released in each of the density groups. The resulting percentages are index values of the cocks shot and returned for each density group.

The index percentages of stocked cocks recovered were then correlated with the wild kill per square mile (Fig. 7). In Barron and Dunn Counties more intensive sampling efforts were undertaken through added cooperation (distribution of wing and leg envelopes) by the local sportsmen's clubs. This accounts for the higher percentage of marked birds returned as shown on the "Y" axis for these two counties.

The data in Figure 7 suggest that the rate of recovery of stocked cocks is higher in areas containing good habitat and high wild pheasant populations *within* the respective counties studied than from areas containing poor habitat and low wild populations within these counties. This difference in rate of recovery may or may not represent differences in survival or hunting pressure or a combination of both factors. Gower (1942) and Wag-

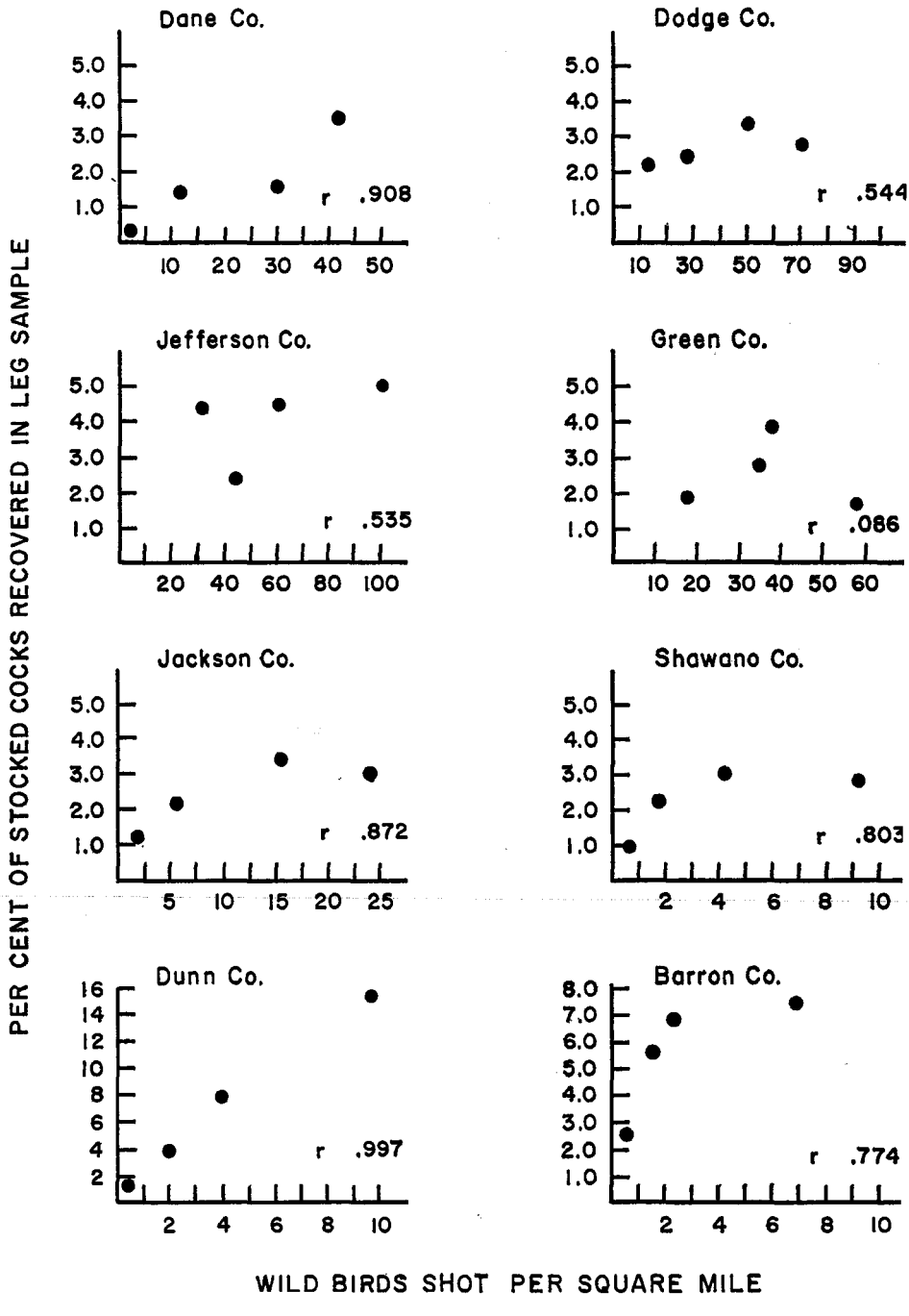


Figure 7. Relationship between rate of recovery of stocked cocks and native pheasant population levels.

ner (1953) have shown that hunting pressure tends to be lighter in marginal pheasant range.

The trends are more clearly shown in the mediocre and poor pheasant counties (Barron, Jackson, Dunn and Shawano) than in the better pheasant counties (Dane, Dodge, Green and Jefferson). One possible explanation is that, although hunting pressure is lighter in the poorer areas of the better counties, it is still heavy enough to harvest the birds. In the poorer townships in the marginal counties hunting pressure may be so low that the birds are inadequately harvested. While the trends are not statistically significant for all counties, the positive values obtained for each county indicate that a relationship between rate of recovery of stocked birds and quality of habitat (as reflected by wild population densities) exists.

Although not statistically significant, there is a trend in the return of reward-banded cocks (Table 6) between counties with varying pheasant population levels. Reward-band returns from Rock County (high pheasant population level) are higher than the combined average reward-band returns from Shawano and Vernon Counties which have low pheasant population levels. Combined average reward-band returns from Manitowoc and Jackson Counties (medium pheasant levels) lie between the returns from Shawano, Vernon and Rock Counties. Lower survival or lower hunting pressure or both in marginal pheasant range probably account for these trends.

Gerstell (1938) liberated 3,000 banded cocks 6 weeks before the beginning of the hunting season in three different classes of pheasant range in Pennsylvania. A noticeable difference was found in the returns from good- and poor-quality range. In the first-class (good) pheasant range, Gerstell obtained a 35 per cent return, in the second class (mediocre) range a 16 per cent return, and in the third class (poor) pheasant range only 11 per cent of the stocked birds were returned.

Stokes (1954:65) found a 24 per cent mortality of wild juvenile birds from 9 weeks of age to the beginning of the fall hunting season (a period of about 8 weeks) in good pheasant habitat. On the basis of the high returns obtained in our study, survival of club-stocked cocks was probably similar to that found for wild birds by Stokes.

Possible Sources of Bias

(1)*Possible bias in the method of obtaining county kill estimates.* During our study Wisconsin hunters were required by state law to make an annual report to the Conservation Department of all game shot during the hunting season. A convenient report form was attached to each game license sold. With a few exceptions this law was not enforced because of the extreme difficulty in enforcing it. As a result the number of reports returned decreased yearly. A new method of obtaining kill estimates for Wisconsin game species has been devised and is now being used with better success.

In 1953 a total of 396,944 small game licenses was sold. This included 40,227 sportsmen's licenses, which also entitled the purchaser to hunt big game and to fish. Only 53,657 report cards were returned by hunting lic-

Good cover in which to stock birds in fall.

encees at the end of the 1953 hunting period. This represented a 14 per cent return of report cards. County pheasant kill estimates were obtained from this sample.

Analysis of the report card returns shows that a higher percentage of sportsmen license holders return their reports than do regular license holders. Sondrini (1950) found that the more successful hunters reported their kill of game in Connecticut. Many unsuccessful hunters probably see no reason for reporting since no game was shot. We are not certain just how these kill estimates are biased, but we conclude that of those hunters sending in annual kill reports, a greater percentage of the successful hunters are inclined to report their kill. Thus, a bias results leading to the calculation of higher kills because of the reporting of the more successful hunters.

(2) *Possible bias in the pheasant hunter mailing list.* Our mailing list included all hunters who sent in their annual kill report and reported shooting one or more pheasant roosters during the previous year. The mailing list was not a true random sample, but included only successful hunters who reported shooting pheasants. Although the mailing list was large enough and our leg sample represented about 5 per cent of the estimated kill, we were undoubtedly sampling a rather select (successful) group of hunters. We are not certain just how this factor influenced the return estimates.

HEN STOCKING EVALUATION

Objectives

There is limited information on the contribution of stocked hens in Wisconsin and this applies largely to adult hens stocked in spring by the Conservation Department (about 25,000 to 30,000 surplus and "spent" breeder hens are released annually). Studies by Kabat *et al.* (1955) showed that every two spring-released hens contributed less than two young birds, half of which were cocks, to the hunters' bag in fall. This low production resulted because about two-thirds of the spring-released hens failed to survive to bring off broods.

The major stocking effort of hen pheasants in Wisconsin is through the day-old-chick program. The majority of these hens are stocked in late summer and early fall along with club-reared cocks. Each year approximately 100,000 hens are stocked throughout the state's pheasant range under this program.

The objective of this phase of the study was to evaluate the contribution of the club-stocked hen to the shootable fall pheasant populations through its reproductive efforts. Two approaches were used: (1) Experimental manipulation of hen stocking intensities – manipulate hen stocking (eliminate, hold constant, double) by clubs in several selected groups of counties and observe any changes by following pheasant population trends in these counties, and (2) Intensive studies of production by stocked hens – obtain information on production of spring- and fall-stocked hens on certain release areas and determine whether or not there is any differential loss of hens between time of release and the following breeding season.

Stocking manipulations were used to establish the validity of one or more alternative hypotheses. These hypotheses were:

(1) Fall-stocked hens contribute no birds to pheasant populations the next fall either because few or none survive to the breeding season, or they produce too few young, or both, and therefore do not maintain their own numbers. If this hypothesis is true, no changes will be observed in the fall pheasant populations during the time stocking manipulations are carried on regardless of whether hen stocking is eliminated, held constant or doubled.

(2) The fall pheasant populations in any county in any year are a product of what the available habitat in that county can support. Stocking of hens adds birds in excess of this carrying capacity and either they or a like number of native birds will be lost. If this is the case, the result will probably be the same as in the first hypothesis with no observable change in either group of counties. It will be difficult to distinguish which of the first two hypotheses actually is occurring, but the findings from the intensive production studies should shed some light on the problem.

(3) Hen stocking contributes a constant, perhaps minor, increment above a population level that would be self-sustaining if no hens are stocked. If this hypothesis is true, the fall pheasant populations in counties where hen-stocking rates are doubled should increase a certain amount over

previous years, then hold fairly constant at this level throughout the study period. Fall populations in counties where hen stocking is eliminated should drop the year following hen removal, then hold fairly constant for the remainder of the study. If native pheasant population fluctuations occur throughout the period of manipulation, these relationships will not be quite so simple. However, manipulation effects should be observable when population trends in all study counties are viewed together.

(4) In marginal pheasant counties the net balance between mortality and productivity is so unfavorable that, without hen stocking, the counties can support only very low pheasant populations and in some cases no populations. The role of stocking is one of bolstering the populations to a point where they can maintain themselves at fair levels. With added hen stocking, the pheasant populations might increase for a time until environmental resistance intercedes to control the population at a somewhat higher level. If this hypothesis is true, there should be a population decrease throughout the study period in counties where hen stocking is eliminated; no change should occur in counties where stocking rates are held constant; increases might occur throughout the period in counties where hen-stocking rates are doubled. These effects again will be somewhat complicated by natural population fluctuations.

Methods

Experimental Manipulation of Hen Stocking Intensities

Field work for this phase of the study began in 1955 and continued through 1958. Twelve counties were selected for study. Three treatments, repeated over a three-year period, were used to evaluate the contribution of club-stocked hens. These were: (1) elimination of hen stocking in four counties; (2) stocking twice as many hens as are usually stocked in four counties; and (3) maintaining a *status quo* in four counties.

Location of Study Counties

Results obtained in the cock-stocking phase of this study determined the choice of study counties. Our research showed that the proportion of stocked cocks in the fall pheasant kill varied from county to county, depending upon both the number of pheasants occurring naturally in the counties, and the number of cocks stocked. We selected counties where the proportion of stocked cocks in the fall population would be relatively high (20 per cent or more). This choice was made on the premise that if stocked hens produce significantly, the effect of major changes in the number of hens stocked would be most noticeable in counties where they also comprise a large proportion of the fall population.

The 12 counties were divided into four blocks of counties in different parts of the state so that the three experimental treatments could be replicated under varying ecological conditions. These four blocks were chosen in: (1) the southwest unglaciated

quarter of the state (Iowa, Lafayette and Richland Counties); (2) the northwest prairie-edge part of the state (Buffalo, Polk and St. Croix Counties); (3) the north central forest-fringe zone (Clark, Marathon and Wood Counties); and (4) the northeast part of the state in the lacustrine soils along Lake Michigan (Brown, Calumet and Kewaunee Counties). The location of the counties and type of treatment each received is shown in Figure 8.

These 12 counties represented the major ecological zones in the state which had mediocre pheasant populations and which had fairly large pheasant stocking programs. The southeast quarter of the state – the primary pheasant range – was not represented because of the high native pheasant populations and low proportion of stocked birds in the fall kill. The nearly pheasantless far north and the central sandy zone with very low pheasant populations and low stocking rates also were not represented in this study.

Hunting season regulations (daily bag limits and season length) were the same in each county studied within any one year, with two exceptions. Season length was reduced in northern St. Croix and Polk Counties in 1957 and 1958 to 25 days. Length of season in other counties was 37 days in 1957 and 44 days in 1958. We believe that the shorter seasons in these two counties had little effect on results obtained in this study. Data from the cock-stocking phase indicated that 80 per cent of the season's kill of pheasants occurred within the first 14 days.

Stocking Manipulations

In one county in each of the four groups, all hens raised by the cooperating sportsmen's clubs were caught up in late summer when they were about 10 weeks of age and crated by research personnel. These counties (designated as 1 on Fig. 8) in which hens were removed were thereafter called "cock counties." The hens were then loaded on Department trucks, hauled to an adjacent or nearby county which was to receive a double hen stocking quota ("hen counties", 2 on Fig. 8) and stocked at those sites at which club officials indicated the birds they were raising were stocked. In those counties where the number of hens introduced from the adjacent cock counties did not double the usual hen quota, additional hens were brought in from the State Game Farm. In cases where there was an excess of hens, these were stocked in counties not participating in the experiments.

As an inducement to cooperate in these experiments, clubs which gave up their hens were given extra cocks from the State Game Farm shortly before the club birds were stocked. Thus, the cock counties were stocking double their annual quota of cocks, but no hens; the hen counties were stocking twice their hen quota along with their normal cock quota. One county in each group ("control counties", 3 on Fig. 8) carried on normal pheasant stocking activities.

During this study a few clubs discontinued pheasant stocking because of financial difficulties. In order to keep stocking rates fairly constant in all study counties during the stocking manipulations, extra birds were brought in from the State Game Farm to compensate for the loss. Clubs participating in this study are listed in Table 22, Appendix B.

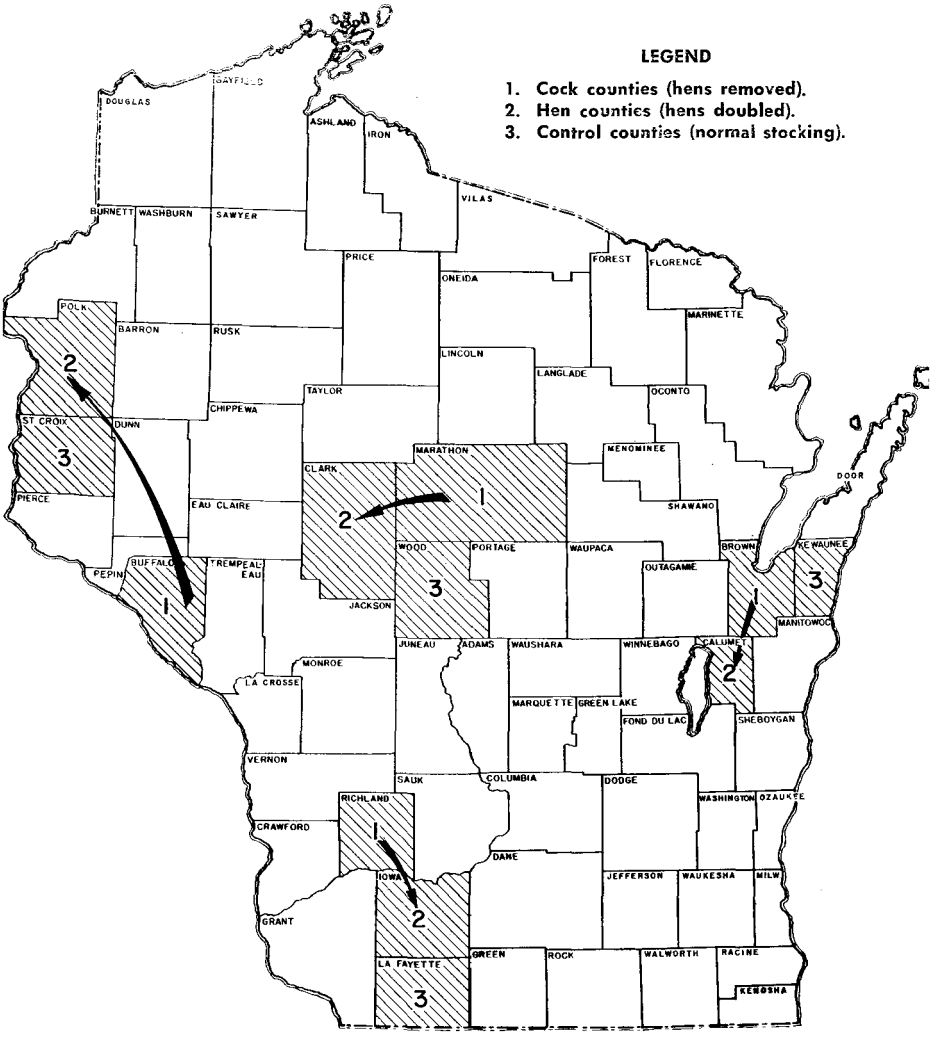


Figure 8. Counties in which hen stocking was evaluated and type of experimental treatment.

Determining Effects of Stocking Manipulations

Three methods were used to follow the effects of stocking manipulations on pheasant populations. The first involved the use of annual game-kill estimates. If stocked hens were contributing any substantial production of young, this should be immediately reflected in the fall kill in those counties where the number of stocked hens was doubled or where the hen stocking was eliminated. The kill estimates for the control counties served as a guide to annual fluctuations in the native pheasant population.

The second method involved the percentage of wild-reared birds in the kill. We used the leg-branding technique described in the cock-stocking phase of this report to mark club birds. All club birds stocked in each of the twelve study counties were leg-branded at about 2 weeks of age as were additional birds brought in from the State Game Farm. Thus, all club-stocked cocks in fall were separable from wild-reared cocks. Postage-free envelopes for the return of wings and legs of birds shot in the study counties were sent to samples of hunters in each county. As in the cock study, the number of envelopes sent to each hunter corresponded to the number of pheasants he reported shooting the previous year (again with the same limitations). In this manner the proportion of stocked cocks in the fall kill was determined. If doubling or eliminating hen stocking had any marked effect on the number of wild-reared cocks shot, this should appear as a change in the unbranded, wild-reared component of the leg sample.

A mailing list was obtained by recording the names and addresses of hunters who reported shooting one or more pheasant roosters on their game-kill report card. Report cards from 1954 through 1957 were used to obtain hunter names and addresses from 1955 through 1958. In addition, 1,000 return envelopes were sent to the county clerk in each of the study counties for distribution to hunters. Department game managers and conservation wardens in several counties were also asked to distribute envelopes to hunters contacted in the field. This method of distributing envelopes was similar to that used in the cock study.

The third method used to follow any population changes involved sending a hunter diary prior to the hunting season to the same hunters receiving the leg-return envelopes. These diaries were printed on stamped, self-addressed postcards (Fig. 9). The hunter was asked to record for each day he hunted pheasants: (1) county or counties hunted, (2) number of hours hunted, (3) hens flushed, and (4) cocks shot. This method gave us another index of pheasant population trends resulting from stocking manipulations.

Intensive Studies of Production by Stocked Hens

This approach expanded on studies reported by Kabat *et al.* (1955) to obtain further information on production by spring- and fall-stocked hens. It was divided into two phases to observe production of stocked hens released in a variety of habitat types: (1) Public hunting ground studies — relatively good habitat, and (2) county-wide studies — good to poor habitat types.

Public Hunting Ground Studies

This phase involved stocking on two selected areas a known number of hen pheasants in late summer prior to the hunting season, a known number in fall after the close of the pheasant hunting season and a known number in early spring before the beginning of the nesting season. These stocking efforts began in 1955 and ended in 1957 with a late spring release on each area.

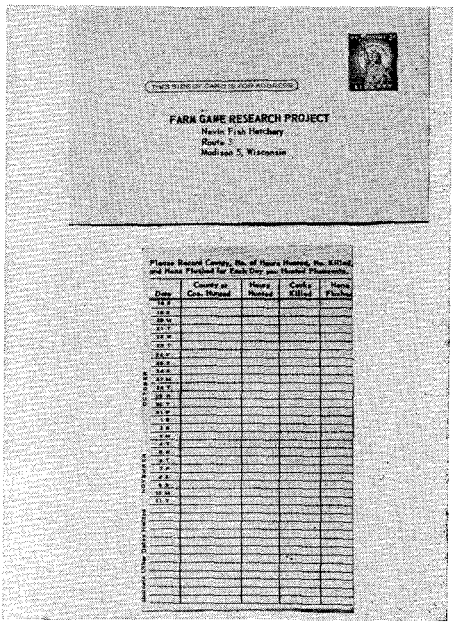


Figure 9. Postcard diaries used to gather information on pheasant hunting success.

Hens for each release were obtained from the State Game Farm. The birds stocked in the late summer and fall of 1955 and 1956 were birds of the current year. The birds stocked in the spring of 1956 and 1957 were from spring hatches of 1955 and 1956. All stocked hens were leg-banded with aluminum bands of different color combinations so that birds in each release could be separated and identified in the field. The hens were released in groups of 25; groups were well distributed throughout the public hunting grounds. The number of hens stocked, dates of stocking and leg-band color combinations are shown in Table 23, Appendix B.

The two areas selected for study – Mazomanie and Brooklyn public hunting grounds – are located in southern Wisconsin and each contains fairly good pheasant habitat. Both areas receive heavy hunting pressure especially during the opening week end of the hunting season. Each area has a good road system. Thus, we were able to make pheasant brood observations along roadsides in summer and conduct complete hunter checks in fall.

In the summer of 1956 and 1957 intensive brood observations were made on each area by cruising the roads in an automobile during the early morning hours and recording all hens seen with and without broods. A special effort was made to carefully observe all hens to determine presence or absence of leg bands and the color combination if the hen was banded.

A hunter check was conducted on each area in the fall of 1956 and 1957 to obtain information on the total juvenile cock production. Our previous hunter checks on other Wisconsin public hunting grounds showed that about 50 per cent of the season's total kill of pheasants occurs on opening day, while about two-thirds of the season's total kill is taken during the first two days (opening week end). With this knowledge of kill we limited our complete hunter checks to the opening day on each area except in 1956 when a complete hunter check was made on the opening week end at the Brooklyn public hunting ground. These hunter checks involved placing checking stations at all exit roads on each area. Although hunters were not obligated to stop, we believe approximately 95 per cent of the hunters using these areas during the checking period were contacted by us.

County-wide Studies

Hen pheasants reared by sportsmen's clubs were used for county-wide production studies in two counties –

Rock in southern Wisconsin and Jackson in west central Wisconsin.

In the summer of 1954 clubs rearing pheasants in these two counties were visited by us and the pheasant chicks were leg-branded. Prior to the time of stocking in fall, all hen pheasants were banded with colored aluminum leg bands for field identification. The number of hens stocked, time of stocking and band colors are shown in Table 24, Appendix B.

The pheasant kill in each of these counties was sampled during the 1954 hunting season using wing and leg envelopes to determine the proportion of stocked (branded) cocks in the kill. During the pheasant brood season of 1955 the entire pheasant range in Rock and Jackson Counties was cruised systematically by traveling on all roads in an automobile to observe and determine the proportion of pheasant broods reared by banded hens released the previous fall and by wild birds.

Findings

Experimental Manipulation of Hen Stocking Intensities

Stocking manipulations began in 1955. We used 1954 as the base or starting year for determining stocking quotas and observing pheasant population trends. The assumption was made that any production from hens stocked by clubs in 1954 would still show up in the kill in 1955. Changes in the pheasant kill resulting from doubling cock stocking efforts in 1955 were immediately noticeable in the kill that fall. Any effects from the 1955 hen stocking manipulations in both hen and cock counties would be realized in the 1956 breeding season and first noticed in the 1956 kill.

No effort was made to change stocking quotas through the egg program because this program contributes only a small percentage to the total stocking effort. Stocking records for the study counties are shown in Table 25, Appendix B.

Kill Estimates

Effects of stocking manipulations are first shown by the Game Management Division annual kill estimates (Table 8). These kill estimates were not corrected for possible sampling error as was done in the cock stocking section of this report. In evaluating hen stocking efforts, we were interested in year-to-year pheasant population trends and the uncorrected kill estimates served this purpose.

In 1954, the total estimated kill in each group of counties was fairly similar: in the hen and cock counties, almost identical, and in the control counties, slightly higher.

The state-wide pheasant population increased in 1955 because of a successful hatch, and the fall kill increased 12 per cent. Increases of larger magnitude occurred in all three county groups. The kill in the control counties increased 43 per cent. This percentage seems high in view of trends in the other county groups. Whether or not this apparent large increase in the population actually occurred or was due to sampling error is not known. By 1956 the kill in the control counties declined by a larger percentage than the other two groups which brought the control counties back into a better relationship with them.

TABLE 8

Trends in Estimated Number of Cocks Killed in the Study Counties, 1954-59

County	1954*	1955**	Per Cent Change	1956**	Per Cent Change	1957**	Per Cent Change	1958*	Per Cent Change	1959*	Per Cent Change
Hen Counties											
Calumet	3,017	3,163	+ 5	2,986	– 6	3,525	+ 18	3,320	– 6	2,328	– 30
Clark	3,623	4,360	+ 20	3,968	– 9	4,063	+ 2	3,709	– 9	1,492	– 60
Polk	2,926	4,254	+ 45	3,152	– 26	3,721	+ 18	1,617	– 57	2,126	+ 31
Iowa	2,373	2,492	+ 5	2,789	+ 12	2,233	– 20	2,611	+ 17	1,946	– 25
Total	11,939	14,269		12,895		13,542		11,257		7,892	
Weighted Average			+ 20		– 10		+ 5		– 17		– 30
Control Counties											
Kewaunee	2,501	2,937	+ 17	1,807	– 38	3,367	+ 86	1,630	– 52	2,168	+ 33
Wood	4,556	6,483	+ 42	4,372	– 33	5,685	+ 30	4,978	– 12	2,364	– 53
St. Croix	2,410	4,254	+ 77	3,300	– 22	2,904	– 12	2,985	+ 3	1,836	– 38
Lafayette	4,169	5,768	+ 38	4,694	– 19	4,136	– 12	4,481	+ 8	1,844	– 59
Total	13,636	19,442		14,173		16,092		14,074		8,212	
Weighted Average			+ 43		– 27		+ 14		– 13		– 42
Cock Counties											
Brown	4,359	4,827	+ 11	5,057	+ 5	6,649	+ 31	4,948	– 26	4,102	– 17
Marathon	2,858	5,753	+101	4,241	– 23	4,014	– 5	3,118	– 22	1,686	– 46
Buffalo	2,698	4,066	+ 51	4,208	+ 3	4,038	– 4	2,143	– 47	1,960	– 9
Richland	1,880	2,643	+ 41	2,368	– 11	2,464	+ 4	1,573	– 36	856	– 46
Total	11,795	17,289		15,874		17,165		11,782		8,604	
Weighted Average			+ 47		– 8		+ 9		– 31		– 27

* – Normal stocking

** – Stocking manipulations

The kill in the hen counties increased 20 per cent in 1955; somewhat higher than the state-wide increase and about half as much as the increase in the control counties. However, this was the first fall in which extra hens were stocked in these counties and any production from these hens would not be realized until the summer of 1956.

An increase of 47 per cent occurred in the fall kill in the cock counties which received a double number of stocked cocks for the first time. This large percentage increase over 1954 was due to both an increase in number of cocks stocked in 1955 which were immediately available for the 1955 hunting season, and to an increase in the native pheasant population.

In 1956, the state-wide pheasant kill decreased 7 per cent. Decreases of similar magnitude occurred in the hen and cock county groups; a larger decrease occurred in the control counties. Since the percentage decreases in both hen and cock county groups were similar to the state-wide decrease, this suggests little influence of club-stocked hens, either through doubling them in the hen counties or eliminating them in the cock counties. The 1956 kill in the hen counties ended up 8 per cent higher than the 1954 kill. This higher kill could be attributed to a good carry-over of wild hens from the large 1955 wild population, and perhaps to some production by the extra hens stocked in 1955. The kill in the cock counties was 35 per cent higher than the 1954 kill, again due to the extra cocks stocked.

There was a small percentage increase in the pheasant kill in all three groups of counties in 1957. These increases were similar to the state-wide increase of 6 per cent. In the hen counties the kill was 13 per cent higher than the 1954 kill; in the control counties it was 18 per cent higher and in the cock counties the 1957 kill was 46 per cent higher.

In 1958, stocking manipulations were discontinued and all clubs in the 12 study counties reared and released a normal quota of cocks and hens. The total number of pheasants stocked was roughly comparable to numbers stocked in 1954. The state-wide kill dropped 8 per cent. Larger decreases were observed in the study counties, but percentage decreases were somewhat similar in the hen and control counties. The largest decrease occurred in the cock county group because clubs stocked about 38 per cent fewer cocks than they did in 1957.

The estimated kill in the hen and cock counties in 1954 was almost identical. After doubling hen stocking efforts in the hen county group for a three-year period the 1958 pheasant kill was 6 per cent lower than the 1954 kill. The kill in the control county group ended up 3 per cent higher than in 1954. Although 38 per cent fewer cocks were stocked in the cock counties in 1958, the pheasant kill that fall was almost identical to 1954. This county group had very few hens stocked for a three-year period. Hence, the fall pheasant kill was almost entirely the result of stocked cocks and production from native pheasant populations.

In 1959 clubs again stocked a normal quota of birds. This was the first year in which the kill in cock counties would benefit from hens stocked by clubs in 1958. The state-wide pheasant

kill decreased 39 per cent because of severe conditions during the winter of 1958-59. Decreases of similar magnitude were observed in all three county groups. However, the kill in the cock county group was 9 per cent higher than in the hen county group.

The data in Table 8 show that the additional hens stocked in the hen counties did not increase the fall kill to the same degree as did stocking a double number of cocks in the cock counties. This might suggest that stocked hens contributed fewer cocks to the shootable fall pheasant populations. Perhaps the additional stocked hens added birds in excess of the carrying capacity in the hen counties and they or a like number of native hens were lost. If stocked hens replaced native hens, then they did make a significant contribution to the fall kill because the kill in the hen county group did increase over the 1954 base year. However, regardless of what did occur in the breeding populations in the hen counties, the kill in this group was lower than in the cock county group throughout the stocking manipulation period. Since the kill in 1956 and 1957 was approximately 25 per cent higher than in the hen counties, the return to the bag for every cock stocked in fall appears to be greater than the return in the next fall of cocks contributed by the additional stocked hens.

Percentage of Wild-reared Birds in the Kill

The data obtained from pheasant legs returned in the wing-and-leg envelopes provided additional information on the effects of pheasant stocking manipulations. The percentages of unmarked cocks in the annual kill in the study counties, as shown by the proportion of unmarked legs in the leg sample, appear in Table 9. Included in the table are estimated percentages of wild-reared cocks in the kill. These percentages were corrected for the number of cocks stocked through the egg program and on public hunting grounds.

Any effect from doubling hen stocking efforts should be expressed in the percentage of wild-reared birds in the kill beginning in 1956. If stocked hens are contributing young to the fall populations, the hen counties should experience an increase in the percentage of wild birds in the 1956 kill because any young produced by the additional hens stocked in 1955 should compensate somewhat for the lower natural production which occurred in 1956. Conversely, the decline in the cock counties should be greater than the natural decline as there were approximately 4,200 fewer hens stocked in these counties in 1955. Since the control counties stocked normal quotas of birds in 1955, we would expect the kill trends in 1956 in these counties to be intermediate between trends in the hen and cock counties. The percentage change in the control counties should only reflect native pheasant population fluctuations. These trends are based on the assumption that there is some contribution from stocked hens. If there is none, we would expect all counties to react similarly and each group would fluctuate in the same degree.

The percentages of wild-reared birds in the kill suggest similar wild population levels in the hen and control county groups in 1955 (Table 9).

TABLE 9

Percentage of Unmarked Cocks in Leg Sample and Estimated Percentage of Wild Birds in the Kill in the Study Counties, 1955-58

County	1955** Leg Sample	1955** % Unmarked	1956** Leg Sample	1956** % Unmarked	1957** Leg Sample	1957** % Unmarked	1958* Leg Sample	1958* % Unmarked	1955** % Wild in Kill	1956** % Wild in Kill	Per Cent Change 1955 to 56	1957** % Wild in Kill	Per Cent Change 1956 to 57	1958* % Wild in Kill	Per Cent Change 1957 to 58
Hen Counties															
Calumet	212	69	238	82	200	68	199	86	53	68	+28	47	−31	71	+51
Clark	192	76	277	76	236	83	152	75	73	74	+ 1	82	+11	75	− 9
Polk	206	84	144	86	161	84	160	91	83	84	+ 1	82	− 2	91	+11
Iowa	276	65	188	77	180	62	215	75	36	65	+81	50	−23	63	+26
Total	886		847		777		726								
Weighted Avg.		75		80		76		81	65	72	+11	68	− 6	73	+ 8
Control Counties															
Kewaunee	203	62	133	51	207	50	177	69	59	47	−20	44	− 6	52	+18
Wood	243	83	237	77	276	84	227	85	73	70	− 4	78	+11	85	+ 9
St. Croix	231	69	211	66	197	72	183	80	62	56	−10	71	+27	80	+13
Lafayette	500	75	426	78	281	80	414	84	59	65	+10	70	+ 8	77	+10
Total	1,177		1,007		961		1,001								
Weighted Avg.		74		72		74		82	65	63	− 4	68	+ 8	78	+15
Cock Counties															
Brown	174	76	237	62	268	71	236	60	66	51	−23	63	+24	45	−29
Marathon	346	63	259	68	205	67	167	55	58	60	+ 3	60	0	43	−28
Buffalo	320	36	302	34	299	33	174	52	30	32	+ 7	20	−38	35	+75
Richland	262	62	231	53	164	44	91	63	54	34	−37	26	−24	51	+96
Total	1,102		1,029		936		668								
Weighted Avg.		60		55		57		58	52	44	−16	47	+ 7	44	− 7

* Normal stocking
** Stocking manipulations

A lower wild population level is suggested in the cock counties.

The data in Table 9 show that wild-reared cocks composed 72 per cent of the kill in the hen counties in 1956, an increase of 11 per cent over 1955. There was a 4 per cent decrease in the wild-reared portion of the kill in the control counties which was similar to the 7 per cent decrease in the state-wide pheasant kill. These data suggest that production from stocked hens not only made up for the population decline in 1956 but gave an increase as well. If the pheasant population had remained stable in 1955 and 1956, the percentage of wild-reared cocks in the kill in the hen counties in 1956 might have been around 15 per cent (11% + 4%). In 1957 and 1958 the wild-reared portion of the kill in the hen counties was similar to that of 1956 indicating constant, yearly production from the stocked hens.

The percentage of wild-reared birds in the cock-county kill decreased 16 per cent from 1955 to 1956 presumably due to reduction in hen stocking in 1955 and to the pheasant population decline. If the natural decline had not occurred, the percentage decrease of wild birds might have been 12 per cent (16% − 4%). From 1957 to 1958 the percentage of wild-reared cocks in the kill in this county group was almost identical to the level obtained in 1956 and reflected only fluctuations in the native pheasant populations.

Trends in wild kill in the control counties generally followed trends in the state-wide pheasant kill, except in 1958. Our data indicate a population increase, while the game-kill estimates show a state-wide population decrease. Whether or not these four control counties actually experienced population gains is not known.

Data obtained from this method of following effects of stocking manipulations suggest that stocked hens made a contribution to the wild populations to give a yearly increase in kill above a level which was obtained without hen stocking. In the cock counties wild hens were able to sustain pheasant populations and kill at a fairly stable, although lower, level without the aid of stocked hens.

Hunter Diaries

Our third method for following pheasant population trends in the study counties was derived from hunter diaries. Indices were based on hens flushed per gun-hour and cocks shot per gun-hour (Tables 10 and 11). The hen-flushing rates in Table 10 provided further evidence of the relative effect of hen stocking. They are a more effective set of indices than the cocks-shot rates since cocks are being removed from the population through hunting. The heavier the hunting pressure, the faster the cocks are removed from the population which results in a rapid drop in the hourly shooting-rate average through the season. The rate of decline in the statistic and hence the season average depends on proximity to human population centers. Pheasant hens are not removed from the population through legal hunting and the hen-flushing rate, though dependent on hunting pressure, should hold up better throughout the season. Each year a big segment of the fall pheasant population in the hen counties will be composed of recently stocked birds (approximately 40 per cent) and the hen-flushing rates will be more con-

TABLE 10

Hens Flushed Per Gun-Hour in the Study Counties, 1955-59

County	1955** Gun-Hours in Sample	1955** Hens Flushed per Gun-Hour	1956** Gun-Hours in Sample	1956** Hens Flushed per Gun-Hour	Per Cent Change 1955 to 56	1957** Gun-Hours in Sample	1957** Hens Flushed per Gun-Hour	Per Cent Change 1956 to 57	1958* Gun-Hours in Sample	1958* Hens Flushed per Gun-Hour	Per Cent Change 1957 to 58	1959* Gun-Hours in Sample	1959* Hens Flushed per Gun-Hour	Per Cent Change 1958 to 59
Hen Counties														
Calumet	1,784.5	1.00	2,214.5	0.87	− 13	2,666.0	0.97	+ 12	2,352.5	0.61	− 37	1,658.0	0.62	+ 2
Clark	1,566.5	1.48	2,348.0	1.22	− 18	1,972.0	1.10	− 10	2,004.0	1.00	− 9	1,279.5	0.77	− 23
Polk	1,160.5	1.12	1,417.0	1.16	+ 4	1,701.5	0.91	− 22	1,481.0	9.81	− 11	1,189.5	0.88	+ 9
Iowa	1,304.5	0.91	1,553.0	0.83	− 9	1,403.5	0.81	− 2	1,453.5	0.81	0	762.0	0.45	− 44
Total	5,816.0		7,532.5			7,743.0			7,291.5			4,889.0		
Weighted Avg.		1.17		1.04	− 11		0.97	− 7		0.81	− 16		0.68	− 16
Control Counties														
Kewaunee	2,238.0	1.06	2,550.5	0.68	− 36	2,576.0	0.72	+ 6	2,208.0	0.75	+ 4	2,042.5	0.79	+ 5
Wood	2,155.5	1.33	2,824.0	0.88	− 34	2,463.0	0.92	+ 5	2,580.0	1.13	+ 23	1,817.5	0.71	− 37
St. Croix	1,191.5	1.00	1,845.0	0.71	− 29	1,856.0	0.62	− 13	1,820.0	0.76	+ 23	1,439.0	0.84	+ 11
Lafayette	2,684.5	1.47	3,017.5	0.99	− 33	2,831.0	0.82	− 17	2,706.0	0.96	+ 17	1,480.0	0.64	− 33
Total	8,269.5		10,237.0			9,726.0			9,314.0			6,779.0		
Weighted Avg.		1.26		0.85	− 33		0.80	− 6		0.95	+ 19		0.74	− 22
Cock Counties														
Brown	2,634.5	0.63	3,466.0	0.48	− 24	3,290.5	0.54	+ 13	3,927.5	0.64	+ 19	3,121.5	0.70	+ 9
Marathon	1,641.0	0.71	2,446.0	0.52	− 27	2,266.5	0.37	− 29	2,005.0	0.64	+ 73	1,484.5	0.38	− 41
Buffalo	1,033.5	0.97	1,380.5	0.94	− 3	1,848.0	0.62	− 34	1,377.0	0.85	+ 37	1,180.0	0.88	+ 4
Richland	1,172.0	0.88	1,315.0	0.65	− 26	1,518.0	0.39	− 40	1,072.5	0.38	− 3	588.0	0.35	− 8
Total	6,381.0		8,607.5			8,923.0			8,382.0			6,374.0		
Weighted Avg.		0.77		0.64	− 17		0.50	− 22		0.64	+ 28		0.64	0

* Normal stocking
** Stocking manipulations

stant because only the 60 per cent wild-reared portion of the population will be susceptible to natural fluctuations. However, in the cock counties the entire hen population is wild-reared and the entire population will be susceptible to natural fluctuation.

The hen-flushing rates in Table 10 reflect pheasant population levels and trends throughout the study period. In 1955 the control counties had the highest fall hen population levels of the three county groups studied as indicated by flushing rates. The hen counties received extra hens that fall and this was immediately reflected in the number of hens flushed per gun-hour. Hens were removed from the cock counties in 1955 and this, too, was immediately reflected in hourly flushing rates. It is conceivable that before stocking manipulations the hen populations in these two county groups were fairly similar.

Hen-flushing rates in the hen-county group declined throughout the stocking manipulation period (1955-57) in spite of an annual double stocking of hens. There was a relatively large decrease in the flushing rate in 1958 because clubs returned to normal hen stocking. The large state-wide population decrease in 1959 was reflected as a further drop in hen-flushing rates in the hen counties.

The control counties also showed downward trends in hen-flushing rates from 1955 through 1959 with the exception of 1958. Again, this one-year difference is unexplainable.

The number of hens flushed per gun-hour in the cock counties also decreased during the 1955-57 period. In 1958 the flushing rate increased because clubs returned to normal hen stocking. The rate, surprisingly, did not follow the state-wide pheasant population decrease in 1959.

The data in Table 10 show that regardless of downward trends in hen-flushing rates in the hen-county group, stocked hens held up the total hen population much better than the native hen population did in the cock counties. These data seem to indicate that hen stocking makes a contribution to the native populations on a year-to-year basis. Hens released in any one year make some contribution a year following release. However, the gain has only a one-year duration which eliminates any realistic long-term effect of hen stocking.

The cock-shooting rates in Table 11 show that decreases in the number of cocks shot per gun-hour occurred throughout the stocking manipulation period in both hen and cock counties. Fluctuations in cocks shot per gun-hour in the control counties generally followed state-wide pheasant population trends during this period. The exception again was in 1958.

The percentage decrease in cock-shooting rates was greater in the cock-county group than in the hen-county group. However, the number of cocks shot per gun-hour was higher for 1955 and 1956; it was the same in 1957. These higher rates reflect the immediate contribution of cocks stocked before the gun in fall. The cock-shooting rate decreased further in 1958 in the cock counties because clubs returned to normal cock-stocking activities. The data in Table 11 show that stocking a double number of cocks in fall will contribute to a higher kill than stocking a double number of hens and relying on their contribution of young

TABLE 11

Cocks Shot Per Gun-Hour in the Study Counties, 1955-59

County	1955** Gun-Hours in Sample	1955** Cocks Shot per Gun-Hour	1956** Gun-Hours in Sample	1956** Cocks Shot per Gun-Hour	Per Cent Change 1955 to 56	1957** Gun-Hours in Sample	1957** Cocks Shot per Gun-Hour	Per Cent Change 1956 to 57	1958* Gun-Hours in Sample	1958* Cocks Shot per Gun-Hour	Per Cent Change 1957 to 58	1959* Gun-Hours in Sample	1959* Cocks Shot per Gun-Hour	Per Cent Change 1958 to 59
Hen Counties														
Calumet	1,676.5	0.13	2,192.0	0.13	0	2,693.0	0.12	− 8	2,455.0	0.11	− 8	1,658.0	0.15	+ 36
Clark	1,574.5	0.18	2,329.0	0.16	− 11	1,972.5	0.17	+ 6	1,930.0	0.15	− 12	1,279.5	0.15	0
Polk	1,173.0	0.21	1,411.0	0.17	− 19	1,728.0	0.17	0	1,557.0	0.17	0	1,189.5	0.18	+ 6
Iowa	1,348.0	0.21	1,532.0	0.20	− 5	1,415.5	0.15	− 25	1,459.0	0.19	+ 27	762.0	0.18	− 5
Total	5,772.0		7,464.0			7,809.0			7,401.0			4,889.0		
Weighted Avg.		0.18		0.16	− 11		0.15	− 6		0.15	0		0.17	+ 13
Control Counties														
Kewaunee	2,181.5	0.11	2,537.5	0.07	− 36	2,586.0	0.12	+ 71	2,203.0	0.12	0	2,042.5	0.15	+ 25
Wood	2,157.0	0.18	2,787.5	0.13	− 28	2,458.0	0.16	+ 23	2,788.0	0.17	+ 6	1,817.5	0.14	− 18
St. Croix	1,202.5	0.16	1,839.0	0.16	0	1,850.0	0.17	+ 6	1,861.0	0.15	− 12	1,439.0	0.17	+ 13
Lafayette	2,691.0	0.19	3,071.0	0.15	− 21	2,842.5	0.13	− 13	2,688.0	0.17	+ 31	1,480.0	0.14	− 18
Total	8,232.0		10,235.0			9,736.5			9,540.0			6,779.0		
Weighted Avg.		0.17		0.14	− 18		0.15	+ 7		0.16	+ 7		0.15	− 6
Cock Counties														
Brown	2,510.0	0.11	3,433.5	0.11	0	3,262.5	0.11	0	4,303.5	0.09	− 18	3,121.5	0.11	+ 22
Marathon	1,641.0	0.18	2,478.0	0.13	− 28	2,266.0	0.11	− 15	2,507.0	0.10	− 9	1,484.5	0.11	+ 10
Buffalo	1,055.0	0.28	1,366.0	0.23	− 7	1,858.0	0.24	− 8	1,533.0	0.19	− 21	1,180.0	0.19	0
Richland	1,145.0	0.25	1,291.0	0.21	− 16	1,493.0	0.16	− 24	1,104.0	0.12	− 25	588.0	0.21	+ 75
Total	6,351.0		8,568.5			8,879.5			9,447.5			6,374.0		
Weighted Avg.		0.20		0.17	− 15		0.15	− 12		0.11	− 27		0.14	+ 27

* Normal stocking
** Stocking manipulations

cocks to the kill the next fall. Stocked hens did keep the fall kill up in the hen counties again suggesting a yearly contribution by these hens.

Estimates of Production by Club-Stocked Hens

Each of the indices used to follow pheasant population trends suggested that there was some contribution from hens stocked in late summer and early fall by sportsmen's clubs. We had no accurate way of determining actual production by stocked hens. However, an attempt was made to obtain some indication of production from available data.

Estimates of the kill of wild-reared cocks were obtained from these indices. By making several reasonable assumptions and making allowances for native population fluctuations, we obtained estimates of production of young cocks. These estimates are summarized in Table 12. Methods used to obtain the range of estimates are explained in Appendix C.

Although each of the methods used to obtain these production estimates had certain aspects or assumptions in common, each had one or more elements unique or independent of the others. The wide range of production figures obtained indicates the weakness in some of the methods used to obtain these data. The data suggest that the average production per stocked hen was between 0.2 and 0.4 young cocks.

These production estimates are comparable to findings of other studies. Stocking studies in the past have shown that the recovery rate of cocks in the hunting season (and presumably survival) is inverse to the length of time between release and the beginning of the hunting season. This reasoning should apply to the hens as well. Kabat *et al.* (1955) have shown that the production of spring-released hens appears to be between 0.3 and 0.5 young cocks per hen released. This poor response was due to low survival of stocked hens. We would expect an even lower survival of hens stocked 6 to 7 months prior to the breeding season. Thus, the top average production figure of 0.4 young per hen seems high; perhaps the 0.2 young per stocked hen is a more realistic figure.

Harper *et al.* (1951) found that reproduction by 500 hens released in 1947 and by 560 hens released in 1948 on a study area in California had no noticeable effect on the pheasant population. Their study showed that game farm hens made up between 6 and 10 per cent of the hen population on the area at time of stocking. A sample of the population one year later showed that these stocked hens made up only 1.5 per cent of the hen population. After two years the stocked hens had disappeared entirely suggesting that stocked hens would have no long-term effect on the pheasant populations.

Evidence from the three methods presented suggests that the stocking manipulation changes best fit part of our third hypothesis advanced in the Method section of the hen study: Hen stocking contributes a constant, perhaps minor increment above a population level that would be self-sustaining if no hens were stocked. Part of the first and second hypotheses also seem to apply: Few hens survive to the following breeding season and, therefore, they do not maintain their own numbers. Because of low survival of

TABLE 12

Summary of Estimated Production of Young Cocks by Stocked Hens

Method of Making Estimate	Estimated Number of Young Cocks Produced Per Hen Stocked	
	Hen Counties	Cock Counties
A. Annual Game-kill Estimates Subtract one-half number of cocks stocked; assume natural decline intermediate between decline in hen and cock counties. (Table 26, Appendix C).	No indication of production by hens using this method.	
B. Percentage of Wild-reared Birds in Kill Multiply annual game-kill estimates by percentage wild in leg samples; assume natural decline intermediate between decline in hen and cock counties. (Table 27, Appendix C).	0.4	0.2
C. Percentage of Wild-reared Birds in Kill Use percentage wild in leg samples; assume 50 per cent recovery of cocks stocked; calculate wild kill from modified Lincoln index. (Table 28, Appendix C).	1.0	0.2
D. Hunter Diaries Use percentage change from 1955 to 1956 in cock-kill rates corrected for percentage wild in leg samples; assume natural decline intermediate between decline in hen and cock counties; use estimates of wild kill from A, B, and C above. (Table 29, Appendix C).	0.1 - 0.4	0.2 - 0.3
Estimated Avg.	0.4	0.2

hens there is no long-term effect on the pheasant populations. The fall pheasant populations in any county in any year are a product of what the available habitat in that county can support. Stocking of (additional) hens adds birds in excess of this carrying capacity and either they or a like number of native birds will be lost.

We conclude that stocking cocks in late summer and early fall will contribute more cocks to the shootable fall populations than stocking similar numbers of hens in fall and relying on their production of young cocks the following fall. The data suggest that the stocked hens' contribution to the fall kill may be as high as 50 per cent of the stocked cock contribution. The native pheasant populations have maintained themselves fairly well without the aid of hen stocking in most study counties in marginal pheasant range.

Sources of Bias

While we were unable to obtain exact figures, the number of hunters receiving wing and leg envelopes and hunting diaries may represent 20 per cent or more of the total hunters in the study counties. One statistical shortcoming is that the two indices based on leg-returns and postcard questionnaires are not independent. They both rely on the same mailing list and, therefore, each index samples the hunting experience of the same group of hunters. It would be desirable if each index relied on a different random sample of hunters, thus each index would be independent of the other. This was impossible since we had to use all available hunter names in order to obtain an adequate list.

Our mailing list is not a truly random sample of hunters. This group also tends to be slightly more successful at bagging pheasants than a random sample of pheasant hunters. However, the study counties are located in mediocre pheasant range and the proportion of hunters in these counties which hunt pheasants and are successful is probably somewhat lower than a similar sample of state-wide hunters. In order to minimize mailing costs it was necessary to confine our contacts to hunters known to have successfully bagged pheasants in the study counties.

The question arises as to whether or not hunters who sent in kill report cards tend to be the same group year after year. In 1953 and 1954, about 14 per cent of the hunting license holders sent in report cards. The degree of duplication in the names for these two years was only 9 per cent. Hence the basis for our earlier statement that our mailing list samples contained about 20 per cent of the hunters in the study counties. Since there undoubtedly is a considerable number of hunters in these counties who do not hunt pheasants, our list could conceivably contain more than 20 per cent of the pheasant hunters; it might be as high as 50 per cent in some counties. Even if we are sampling no more than 30 per cent of the pheasant hunters, this is still a considerable sample which should make up for what is lost through lack of randomness.

Public Hunting Ground Studies

A prescribed number of hen pheasants were stocked at various times of the year on the Brooklyn and Mazomanie public hunting grounds. Each area received the same number of hens with the exception of the Mazomanie area in 1957 when an additional 160 surplus game farm breeder-hens were stocked on March 29. All birds were banded for identification (Table 23, Appendix B).

The results of brood observations conducted during August of 1956 and 1957 are shown in Table 13. A total of 40 hens was observed during approximately 45 hours of intensive cruising of roads on each of the two areas. About two-thirds of the observed hens were banded (stocked). No wild hens were observed on the Mazomanie area indicating that the wild hen population was lower than on the Brooklyn area.

Of the 26 banded hens observed on the two areas, 22 or 85 per cent had broods which is comparable to the figure obtained for wild birds in statewide studies in Wisconsin. Eight (57 per cent) of the 14 wild hens observed had broods. The lower percentage obtained for wild hens might be related to lack of sufficient observations, especially for the Mazomanie area.

The total number of banded hens observed from each release and the percentage which this number made of the total number observed is shown in Table 14. These data show that 81 per cent of the 26 banded hens observed were from spring releases. Only one hen (4 per cent) was observed from the late summer releases which is the time of year when most sportsmen's clubs stock hens. Approximately 90 man-hours were expended in intensive brood observations along roadsides during August of 1956 and 1957

TABLE 13

Pheasant Brood Observations
Brooklyn and Mazomanie Public Hunting Grounds, 1956 and 1957

Date and Area	No. of Hens With Broods		No. of Hens Without Broods		Total Number Observed	
	Banded	Wild	Banded	Wild	Banded	Wild
1956						
Brooklyn	9	3	3	4	12	7
Mazomanie	1	0	0	0	1	0
1957						
Brooklyn	5	5	1	2	6	7
Mazomanie	7	0	0	0	7	0
Total	22	8	4	6	26	14

TABLE 14

Total Observations on Stocked Hens
Brooklyn and Mazomanie Public Hunting Grounds, 1956-57

Time of Stocking	No. of Hens Stocked	Total No. of Banded Hens Observed*	Per Cent of Total Observed
Late summer (Aug.-Sept.)	800	1	4
Late fall (November)	800	4	15
Early spring (March-April)	960	16	62
Late spring (May)	400	5	19
Total	2,960	26	100

* Observations made during the month of August 1956 and 1957.

on the two areas. By chance, some stocked hens and broods could have been missed or they never appeared along roadsides. However, the small number observed from the 2,960 hens originally stocked suggests a substantial loss of stocked hens between time of stocking and the reproductive season.

Complete hunter checks for a limited period of time were conducted on the Brooklyn and Mazomanie areas in 1956 and 1957. With data obtained from these checks and a knowledge of the number of game farm cocks stocked prior to the opening of the hunting season, we estimated the total wild cock kill for each year on each area. These data are shown in Table 15. To the total wild cock kill we added 20 per cent for the unrecovered crippled birds as indicated from hunter interviews during the checks; 15 per cent was added which represented the unharvested cock segment of the population. This latter percentage was based on winter sex ratio observations which indicated that hunters harvested approximately 85 per cent of the cock population on these areas each fall. We subtracted 10 per cent from the total number of wild-reared cocks present on the areas which represented the percentage of adult cocks shot. The results gave the total number of juvenile wild cocks reared on these areas.

The percentage of banded hens with broods was obtained from the brood observation data in Table 13. The total number of juvenile wild-reared cocks was multiplied by this percentage and the resulting figure is the total number of juvenile cocks produced by the stocked hens. This figure was divided by the total number of hens stocked to give the number of cocks produced by each stocked hen.

The data in Table 15 show that 1,162 juvenile cocks were produced by 2,960 hens stocked during the two years of study for an average production figure of 0.4 cocks per hen. This figure is probably too high as we assumed that all production at Mazomanie was from stocked hens. Since 81 per cent of the banded hens observed were from spring releases, we can at-

TABLE 15

Juvenile Cock Production from Stocked Hens
Mazomanie and Brooklyn Public Hunting Grounds, 1956 and 1957

	Brooklyn		Mazomanie	
	1956	1957	1956	1957
Hunter-check pheasant kill	336	225	225	303
Total season estimated kill	500	450	450	606
Minus assumed 50% recovery of fall-stocked cocks	150	150	250	263
Total kill of wild cocks	350	300	200	343
Plus 20% crippling loss	70	60	40	69
Plus 15% unharvested residue	53	45	30	51
Total no. of wild-reared cocks on area	473	405	270	463
Minus 10% for adult cocks shot	47	41	27	46
Total no. of juvenile wild-reared cocks on area	426	364	243	417
Percentage of stocked hens with broods	75	50	100	100
No. of juvenile cocks produced by stocked hens	320	182	243	417
Total no. of hens stocked	600	800	600	960
Cocks per stocked hen	0.5	0.2	0.4	0.4

Avg. estimated cock production for 2,960 stocked hens = 0.4

tribute the majority of production from stocked birds on both areas to spring releases. However, production was poor regardless of the time of stocking since each stocked hen contributed less than one-half of a cock to the hunting bag in fall several months to a year following release.

In order to accurately determine the size of a pheasant brood, it is necessary to obtain a complete count of all chicks in the brood. Complete counts were obtained on 19 of the 30 hens observed with broods in this phase of the study. The average brood size for 13 completely counted broods of banded hens was 7.1; the average for 6 completely counted broods of wild hens was 4.8. This is a very small sample and the difference is not significant. However, the average of 7.1 young for stocked hens is similar to the average brood size obtained from statewide production data. This suggests that surviving stocked hens reproduced about as well as wild hens.

There is always the possibility when confining studies to small areas that some of the stocked birds wander off and although they survive and reproduce, they do not contribute to the kill on the study area. This also would be true for wild birds; they are free to move on or off the study area. Kabat *et al.* (1955) found that for 20 stocked (banded) hen pheasants observed on the Mazomanie area in 1953, 50 per cent moved less than one-half mile

from point of release in spring to point of observation in late summer; 75 per cent moved less than one mile. This suggests little movement of spring-stocked hens. It is possible that the length of time involved between stocking and the breeding season increases the chances for movements of greater distances. This could partly account for the lack of observations on summer-stocked hens.

In California, Mallette and Bechtel (1959) found that for several thousand pen-reared pheasants released on licensed pheasant club areas the average movement of birds from time of release to recapture the same year was 0.4 miles. Game farm birds in the field for one or more years moved about 1.1 miles while wild birds traveled 1.3 miles. They concluded that stocked birds provided little hunting on areas other than where they were released.

County-wide Studies

During the summer of 1954 pheasant hens at all sportsmen's clubs in Jackson and Rock Counties were banded with colored aluminum leg bands to identify these birds in the field. Several hundred hens were held over winter at one club in Rock County; these were banded with a different colored leg band in the spring of 1955 shortly before release. The number of hens banded, dates of release and band color combination are shown in Table 24, Appendix B.

Brood observations were made twice weekly in both counties during the month of August 1955 by systematically cruising all roads in areas where club birds had been released. A total of 23 hens was observed in the two counties; all were unbanded. However, our brood sample is small and by chance banded hens could have been missed.

Both these county-wide studies and the public hunting ground studies suggest that many hens stocked in late summer (and early spring) disappeared between time of release and the following brood season. Perhaps the implied low survival of stocked hens is related in part to our second hypothesis: The fall pheasant populations in any county in any year are a product of what the available habitat in that county can support; stocking of hens adds birds in excess of this carrying capacity and either they or a like number of native birds will be lost. Thus, increasing (doubling or even tripling) the number of stocked hens and relying on their production efforts to bolster the fall populations does not give the desired results.

DISCUSSION AND EVALUATION

There are more than 600 organized sportsmen's clubs in Wisconsin. About one-third of these stock pheasants through the day-old-chick program. Many sportsmen's clubs have built their entire membership around the pheasant stocking program while other clubs have developed a variety of projects to hold the interest of their members. What does the day-old-chick program mean to sportsmen's clubs and the Wisconsin Conservation Department in terms of hunting opportunity and economics?

Day-old pheasant chicks being shipped to a sportsmen's club.

Contribution of the Club-Stocked Bird

Wisconsin's primary pheasant range lies in the southeastern quarter of the state. It is bounded by Green, Dane, Columbia and Marquette Counties on the west; Waushara, Winnebago, Fond du Lac and Sheboygan Counties on the north; Lake Michigan on the east; and the Illinois border on the south. Under primitive conditions this area was interspersed with prairie and oak openings. The topography is flat to gently rolling, soils are among the most fertile and growing seasons are longer than anywhere else in the state. Between 60 and 70 per cent of the total land area is under cultivation with corn, oats and hay providing 80 to 90 per cent of the crops (30 to 40 per cent of the cultivated acreage is in corn). The remaining land area in this region occurs as pasture, marsh, small amounts of idle and unproductive land and some woodlots (Wagner, 1953).

During our study this primary pheasant range received 34 per cent of the day-old-chick stocking effort. Stocked cocks made up about 8 per cent of the kill in representative study counties. This region contributed 68 per cent of the total state-wide pheasant kill.

The remainder of the state may be considered marginal for pheasants. The topography varies from gently rolling in the north, central and eastern portions of the state to extremely hilly country in the southwestern Driftless Area. Shorter growing seasons and lower soil fertility are characteristic of much of the marginal pheasant range. Less than 45 per cent of the land area is under cultivation. Corn acreage varies from 30 per cent of the cultivated land in some of the central and western counties to less than 10 per cent in the northern counties (Wagner, 1953).

This marginal pheasant range received 66 per cent of the day-old-chick stocking effort. Stocked cocks made up about 38 per cent of the kill in representative study counties. This marginal range contributed 32 per cent of the total state-wide pheasant kill during the study.

Our data suggest that although only one-third of the state-wide pheasant kill comes from the marginal range, stocking (mainly cocks) is important to hunting success in this range. Stocked cocks constitute 40 to 65 per cent of the kill in some counties. Without this stocking effort the kill in most marginal counties would be greatly reduced.

In good pheasant range in southeastern Wisconsin the contribution of club-stocked birds (cocks and hens) is insignificant to hunting success and opportunity. Reduction or elimination of pheasant stocking in this range would have little effect on the annual kill.

The percentage of club-stocked

cocks recovered in the year of release compares favorably with birds stocked on Wisconsin public hunting grounds. The returns are somewhat higher on birds stocked in areas with high wild populations than in areas with lower populations within any one county. Some sportsmen's clubs in marginal pheasant range stock substantial numbers of pheasants in areas containing little or no suitable habitat where wild populations are known to be low. We believe the most economical practice for clubs in marginal range would be to stock club-reared pheasants in the best available habitat where native pheasant populations and hunting pressure are relatively high if maximum returns on club-stocked birds are to be obtained.

Wisconsin hunters harvested about 500,000 pheasant cocks annually between 1953 and 1958; sportsmen's clubs stocked about 88,000 cocks annually through the day-old-chick program during this period. We can determine what percentage of the total state-wide pheasant kill was composed of club-stocked cocks during our study by using the range of return estimates from the cock-stocking phase of this study. The reward-band data showed a minimum return of 42 per cent. Using this figure and a kill of 500,000 birds, club-stocked cocks made up 7 per cent of the kill. If a 51 per cent return is used (a return obtained on public hunting grounds), then 9 per cent of the state-wide kill contained club-stocked cocks. Our range of return estimates suggested a maximum return on club-stocked cocks approaching 75 per cent. This return indicates that 13 per cent of the state-wide kill contained club-stocked cocks. Thus, we have a group of estimates on the proportion of club-stocked cocks in the state-wide kill ranging from a minimum of 7 to a maximum of 13 per cent with an average of 10 per cent.

These percentages were representative of years when the pheasant kill approached 500,000 birds. The pheasant kill decreased to a low of 274,300 birds in 1960. Assuming a stocking rate of 88,000 cocks and returns ranging from 42 to 75 per cent, this would suggest that between 13 and 24 per cent of the 1960 kill was composed of club-stocked cocks. Thus, club-stocked cocks make up a larger portion of the state-wide kill in years when native pheasant populations are low.

We can speculate what effect 88,000 club-stocked hens had on the state-wide pheasant kill. In the hen study estimated production of stocked hens ranged from 0.2 to 0.4 young cocks per hen. Using these estimates, 88,000 stocked hens contributed between 17,600 and 35,200 young cocks to the state-wide kill a year following release. If we add this estimated contribution to the figures obtained in the range of estimates for the club-stocked cocks, the total contribution of club-stocked birds to the fall kill ranged between 54,560 (using a 42 per cent return of cocks and a production of 0.2) and 101,200 pheasants (using a 75 per cent return of cocks and a production of 0.4). Thus, with an annual state-wide kill approaching 500,000 birds, between 10 and 20 per cent of this kill contained club-stocked birds.

These data suggest that cock stocking by sportsmen's clubs may add about 10 per cent to the state-wide kill in years when this kill approaches the half-million mark. When the contribution from 88,000 club-stocked

hens is added, club-reared pheasants would contribute about 15 per cent of the state-wide kill.

Cost of Bird Stocked

The cost of a bird stocked through the day-old-chick program is divided into two parts: (1) cost to the club and (2) cost to the Conservation Department. The cost of rearing pheasants at a sportsmen's club varies with the number of chicks being raised, the amount of brooder equipment and the manpower available to care for the pheasants. Some clubs are fortunate to have abundant voluntary help, but the majority of clubs must pay for caretaker services. If birds are held over winter, there is added feed and caretaker costs. Thus, the rearing costs to clubs vary from a few dollars to several thousand dollars annually.

In 1958 a survey was made by the State Game Farm to determine the rearing costs incurred by cooperating sportsmen's clubs. A letter was sent to each club requesting that they determine: (1) total cost of rearing facilities, (2) cost of repairs, (3) caretaker fees, (4) heat and miscellaneous expenses and (5) extra feed costs (usually for birds being held over winter). With this information, an estimate of the pheasant rearing costs for each club was determined. The cost per pheasant released was also calculated.

A total of 117 clubs responded to the survey representing approximately 60 per cent of the number of clubs raising pheasant chicks. The results of this survey are shown in Table 16. Although some clubs had various materials, feed and help donated, clubs reported spending an average of $479 to cooperatively rear pheasant chicks for one year. Expanding this figure to all clubs raising chicks, the total cost to rear and release 170,000 to 180,000 pheasants of both sexes for one year was approximately $93,000. The average cost per chick released as reported by the 117 clubs amounted to $0.49. This is considered a minimum cost figure as various services and extra feed are donated at some clubs and no value was determined for these additional costs.

A cost analysis of State Game Farm operations is made annually by the finance division of the Conservation Department. This analysis provides information on the cost of the day-old-chick program to the Department. These expenditures, shown in Table 17 include the cost of hatching eggs and delivering chicks to the clubs, feed costs and various inspection trips by game farm personnel.

The cost of $0.54 per bird liberated (1959) includes both cocks and hens. We have added to this figure rearing costs sustained by cooperating clubs. The total (minimum) cost to rear and stock a pheasant under the day-old-chick program is $1.03.

Wisconsin pheasant rearing costs are lower than those incurred by some of the other states which raise pheasants. In Ohio, the cost of rearing a pheasant (at the game farm) to 8 weeks of age is about two dollars. Illinois investigators estimate the cost of liberating 7-week-old birds (from their day-old-chick program) to their conservation department at $0.90 to $1.10 each (McCabe, MacMullen and Dustman, 1956). The average cost of producing and rearing a pheasant to 10 weeks of age at Wisconsin's State

TABLE 16

Estimated Cooperator-club Rearing Costs, 1958*

Expenditures**	Number of Clubs Reporting	Total Cost	Average Cost Per Club	Range of Costs
1. Brooder facilities ***	104	$132,666	$1,276	$76 - 12,000
2. Repairs	95	6,082	64	3 - 500
3. Caretaker	109	22,246	204	15 - 1,800
4. Heat and misc. supplies	109	6,340	58	3 - 310
5. Extra feed	88	5,206	59	5 - 823
6. Total cost per year	117	49,335	479	51 - 2,982
Avg. cost per pheasant released			$0.49	$0.13 - 1.93

* Data supplied by W. A. Ozburn, Superintendent, State Game Farm.

** No adjustments were made for donated materials and services.

*** Cost of brooder facilities was figured on 100 per cent depreciation in 15 years.

Game Farm is about $1.13 (from the Cost Report for the State Game Farm, 1959). Wisconsin is able to raise pheasants more economically than most states because of mass production and stream-lined efforts at the game farm and because of the efforts of sportsmen's clubs which cooperatively rear the majority of pheasants stocked each year.

Cost of Bird in the Bag

We can estimate the cost of a stocked bird in the hunter's bag by using the following information: (1) stocking rates of 88,000 cocks and a like number of hens, (2) cock recovery rates ranging from 42 to 75 per cent, and (3) a stocking cost of $1.03 per bird. The data in Table 18 show that if we consider only the contribution of the club-stocked cock, the estimated cost of a cock in the bag ranges from $1.37 (75 per cent recovery of cocks) to $2.45 (42 per cent recovery of cocks). The estimated cost of a cock in the bag from the production of stocked hens ranges from $2.58 (0.4 yg./ stocked hen) to $5.15 (0.2 yg./ stocked hen). The total estimated cost of a cock pheasant in the bag from cock and hen stocking through the day-old-chick program ranges between $1.79 and $3.32 depending upon rate of recovery of stocked cocks and degree of production of stocked hens.

Disposition of Club-reared Hens

The data in this report suggest that we can expect between 0.2 and 0.4 of a cock in the bag for each hen stocked by sportsmen's clubs. The data also indicate that the young hens produced by the stocked hens contribute very little to future native pheasant populations. Since the total contribution of these club-reared hens is low, the question arises as to whether or not it is economical to continue to rear and release these hen pheasants.

TABLE 17

Cost of Producing and Stocking Pheasants Through the Day-old-chick Program in 1959*

1. Number of day-old chicks distributed		208,375	
2. Cost per hatched chick			$0.2399
3. Day-old-chick distribution costs		$10,723.35	
4. Day-old-chick distribution cost per chick (3 ÷ 1)			0.0515
5. Cost per chick laid down in club brooders (2 + 4)			0.2914
6. Birds liberated from day-old-chick program (survival rate: 89.2 per cent)		185,941	
7. Cost of birds liberated:			
Cost of day-old-chicks distributed (1 x 5)	$60,720.48		
Cooperative rearing costs (includes feed costs)	39,349.03		
	$100,069.51		
8. Cost per bird liberated from day-old-chick program			0.5382

* Propagation costs obtained from Cost Report for State Game Farm, 1959.

How could club hen stocking be reduced and what should be done with these hens if they are not stocked? The problem begins with the eggs at the State Game Farm. The sex ratio of young pheasant chicks at hatching time is about 50:50. Thus in a group of 200,000 pheasant chicks shipped to sportsmen's clubs, 100,000 are hens.

In order to find a way to utilize these hen pheasants, several cooperative studies were carried on by endocrinologists at the University of Wisconsin. The objective of one study was to find a method whereby the plumage coloration in the hen pheasant could be reversed to a cock plumage thereby increasing the potential hunting value of stocked birds. Several different hormones were administered to female chicks at the time of the post-juvenile molt to study plumage color changes. In another study androgenic hormones were either injected in the eggs or applied to the shells of the eggs at various stages of incubation in an attempt to reverse the sex of the embryo in favor of male pheasants. At the present time little success has been obtained from either study (R. K. Meyer *et al.*, unpubl. data).

Plumage dyes have been applied to pheasants by several wildlife workers with various degrees of success. Dyes currently available are limited in number, are not brilliant enough unless applied to birds with light-colored or white feathers and fade or wear off in a few months (Taber and Cowan, 1960). A plumage dye which could be rapidly applied to a large number of pen-reared hen pheasants in summer to identify these stocked birds during the fall hunting season would solve the problem. These hens

TABLE 18

Estimated Cost of a Cock Pheasant in the Bag from Cock and Hen Stocking by Sportsmen's Clubs

A. Fall-stocked Cocks			
Number of cocks stocked		88,000	
Cost per cock stocked*		$1.03	
Total cost of cocks stocked		$90,640	
Cost per bird stocked using various recovery rates:			
Percentage of recovery	42	50	75
Cocks recovered	36,960	44,000	66,000
Cost per cock in the bag	$2.45	$2.06	$1.37
B. Fall-stocked Hens			
Number of hens stocked		88,000	
Cost per hen stocked*		$1.03	
Total cost of hens stocked		$90,640	
Number of young cocks in bag (0.2 - 0.4 yg. cocks/hen released)		17,600-35,200	
Cost per cock in the bag		$5.15 - $2.58	

C. Estimated Cost Per Cock in the Bag

1. Assume a 42 per cent cock recovery and 0.2 yg./stocked hen.
   36,960 cocks @ $2.45 = $90,552
   17,600 cocks @ $5.15 = $90,640
   54,560 cocks $181,192
   Cost per bird in the bag = $3.32
2. Assume a 75 per cent cock recovery and 0.4 yg./stocked hen.
   66,000 cocks @ $1.37 = $90,420
   35,200 cocks @ $2.58 = $90,816
   101,200 cocks $181,236
   Cost per cock in the bag = $1.79

Range of costs depending upon rate of cock recovery and production by stocked hens: $1.79 to $3.32.

* Includes both club and state costs.

could be dyed a brilliant color before release and made legal targets thus increasing the potential hunting value of stocked hens. More research is needed in this direction.

Pheasant chicks can be sexed shortly after hatching by examining the feather development in the vicinity of the eye and ear regions (Latham, 1951; Lassen, Doty and Saucerman, 1955). Sexing techniques at the State Game Farm have been refined and the sex of 85 to 90 per cent of the pheasant chicks can accurately be determined. This method would enable cooperating clubs to obtain sexed chicks con-

taining approximately 85 per cent cocks. With more cocks being stocked in fall, more birds would be immediately available for the hunter's bag. Although the chick-sexing method provides more hunting opportunity, it leaves us with the problem of surplus hens. California has solved this problem by selling the excess hen chicks to private breeders and destroying the unsold surplus (Lassen *et al.*, 1955). This could also be done in Wisconsin.

Should we make all hen pheasants legal targets and harvest them in fall in marginal pheasant range or good pheasant range or both? This question is voiced frequently by sportsmen. A second look at the pheasant population distribution map (Fig. 2) will enable a better understanding of the hen harvest problem. This map shows that medium to good native pheasant populations are scattered over the southern two-thirds of the state. The bird populations are fairly sparse in the forested northern third of the state. Our hen study data indicated that the native pheasant populations were able to maintain themselves each year fairly well without the aid of stocking. The cock study data showed that in the majority of counties in Wisconsin native pheasant populations contribute most of the annual kill.

Pheasant winter sex ratio data, gathered over the entire pheasant range, indicate that we harvest approximately 80 per cent of all available pheasant cocks during the fall hunting season. Young birds hatched during the year make up about 90 per cent of the kill each year (Wagner and Besadny, 1958).

In the marginal pheasant range the harvest of cocks may be 60 or 70 per cent but this still is a large portion of the annual cock population. If the season were also open on hens, we could easily harvest a similar percentage of the native hen population. The shooting of hens to utilize stocked birds would also mean that we would be making a substantial dent in the native hen population which is providing the major portion of our annual kill through the production of young wild-reared cocks. For the first few years the state-wide kill would be higher as a result of hens in the bag, but after a few years the kill would be greatly reduced because the native hen population would have been substantially reduced.

A hen season was tried in nine northwestern counties in 1946 and 1947 and this is exactly what happened. The first year in which hens were legal game, the pheasant kill doubled in these counties. The next year it dropped about half in spite of continued hen shooting. In 1948 the counties went back to shooting only cocks. Although the number of birds stocked during the period had increased, the 1948 kill was below that of 1945, the year before the hen seasons started (Wagner and Besadny, 1958).

The only counties where we might end up with a permanently higher kill by shooting hens (with continued stocking) are those counties where stocked birds make up more than half of the kill. There are only a very few counties in the state where this is the case. Opening the season on hens in a few scattered counties would present a very difficult law enforcement problem. Hence in the best interests of our native pheasant populations it

is unadvisable to make pheasant hens legal game.

Conclusions

Although pheasant stocking has been decreasing or has even been eliminated in some states it has been steadily increasing in Wisconsin. Many sportsmen's clubs feel that this is the only program which will hold the interest of their members. It is a program where members can see their sport in the making from June to September. However, more and more clubs are beginning to realize that this program is a put-and-take situation and must be repeated yearly for any benefits. These clubs are devoting larger proportions of their budgets to habitat improvement projects for long-term benefits. Some clubs in the very marginal pheasant range are concentrating on habitat management for game species native to Wisconsin.

Wisconsin's pheasant populations will never be able to compete with those of South Dakota, Minnesota or Nebraska. Our native populations will never be able to supply the quality and quantity of shooting each small game hunter would like in his back forty. Our dairy economy with its associated abundant hay acreages and pasture lands reduces the amount of secure nesting cover so vital to pheasants. A large percentage of the annual pheasant hatch in Wisconsin comes from marsh cover. This secure cover is dwindling because of continued drainage. A bright spot in the habitat picture is the converting of cropland to grassland cover under various Federal agricultural programs. Another is the accelerated land purchase program of the Conservation Department through the Outdoor Recreation Act Program. These programs, along with existing habitat development programs, should do much in the way of preserving and establishing cover essential to pheasant production.

In spite of various habitat programs in Wisconsin pheasant stocking will continue to be an important game management tool under certain conditions. It will furnish additional hunting for sportsmen on heavily hunted public hunting grounds. Cock stocking through the day-old-chick program will provide the hunter in the marginal pheasant range with some pheasant shooting he could not expect to get entirely from sparse native populations.

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APPENDIX A

Lists of Sportsmen's Clubs Participating in the Cock-stocking Study — 1953-55

TABLE 19

Sportsmen's Clubs Participating in the Study in 1953

County	Cooperator Club	Number Chicks Rec'd	Date Rec'd	Number Alive At Release	Date of Release	Age At Release (In Weeks)	Per Cent Surviving
Barron	Barron Co. Game Farm	6,000	6/17	5,477**	8/24-25	10	91.3
Dunn	Dunn Co. Fish & Game Assoc.	3,500	6/5				
		200*	9/14	3,235**	9/16	15	87.4
		3,700					
Jefferson	Waterloo Sportsmen's Club	350	5/20			12	56.2
		200*	6/25	309	8/9	7	
	Lake Mills Cons. Club	700	5/20	684	8/1	11	97.7
	Jeff. Co. Cons. Alliance	2,000	5/20	1,656	9/19	18	82.8
		3,250		2,649			
Dane	Dane Co. Cons. League	3,500	5/12				
		700*	6/29	3,303	8/16	14	78.6
	Middleton Sportsmen's Club	700	5/20	550	9/15	17	78.6
	Stoughton Conservation Club	1,050	5/20	982	7/26	10	93.5
	Mt. Horeb Sportsmen's League	700	5/20	638**	8/9	12	91.1
	Verona Sportsmen's League	350	5/20	100	8/2	11	28.6
	Dane Sportsmen's League	350	5/28	182	7/15	7	52.0
	Belleville Rod & Gun Club	300	5/20	270	8/29	15	90.0
	Westport Sportsmen's Club	350	5/20	340	9/26	19	97.1
		8,000		6,365			

* Replacements
** Includes those birds being held over winter

TABLE 20

Sportsmen's Clubs Participating in the Study in 1954

County	Cooperator Club	Number Chicks Rec'd	Date Rec'd	Number Alive At Release	Date of Release	Age At Release (In Weeks)	Per Cent Surviving
Green	Green Co. Cons. League	2,100	5/17	1,007	8/14	13	
		350*	6/6			10	41.1
		2,450					
Iowa	Iowa Co. Cons. Club	700	5/17	None			
		700*	6/26	582	9/18	12	41.6
	Mineral Point Cons. Club	350	6/26	301**	9/12	11	86.0
	Dodgeville Rod & Gun Club	350	5/17	69	8/29	15	19.7
	Rewey, Arthur, Mifflin Cons. Club	600	5/17	311	9/5	16	51.8
	Avoca Rod and Gun Club	600	5/17	340	8/13	12	56.6
	Highland Sportsmen's Club	250	5/17	None			
		350*	6/6	280	8/15	10	46.6
		3,900		1,883			
Richland	Richland Co. Rod & Gun Club	2,450	5/17	987	8/8	12	
		700*	6/6			9	46.8
		1,050*	6/26	980	8/22	8	
	Bloom City Rod & Gun Club	250	5/17	77	8/23	14	30.8
		4,450		2,044			
Jackson	Jackson Co. Spts. Council	2,450	5/21	1,530	8/8	11	62.4
		900*	6/30	672	9/15	11	74.7
	Melrose Rod & Gun Club	700	5/21	592	8/15	12	84.6
		4,050		2,794			
Vernon	Vernon Co. Cons. Club	1,750	5/21			18	
		1,400*	6/26	1,141	9/22	13	36.2
	Chaseburg Rod & Gun Club	250	5/21	172	8/23	13	68.8
		3,400		1,313			

TABLE 20 (Continued)

County	Cooperator Club	Number Chicks Rec'd	Date Rec'd	Number Alive At Release	Date of Release	Age At Release (In Weeks)	Per Cent Surviving
Racine	Racine Co. Cons. League	600	5/29	103	8/28	13	**17.1**
	Farmers Spts. Association	700	5/29	445	8/7	10	
		350*	6/30	251	9/11	10	66.2
	Burlington Cons. Club	1,050	5/25	488**	8/29-9/12	14-16	46.5
		2,700		1,287			
Rock	Janesville Cons. Club	1,400	5/29	900	8/29	13	64.3
	Edgerton Cons. Club	250	5/29	133	9/12	15	53.2
	Lima Center Pheasant Club	300	5/29	117	9/5	14	39.0
	Rock Co. Pheasant Ass'n	3,250	5/29		9/5	14	
		1,500*	6/30	3,300**	9/12	11	69.5
		6,350		4,450			
Walworth	Lake Geneva Spts. Club	700	5/29	450	8/1	9	64.2
Dodge	Clyman Spts. Club	250	6/2	161	9/14	15	64.4
	Ashippun Spts. Club	350	6/2	318**	8/18	11	90.8
	Brownsville & Knowles Spts. Club	700	6/2	386**	8/29	13	55.1
	Horicon Rod & Gun Club	700	6/2	475	—	—	67.8
	Reeseville Spts. Club	700	6/2	600	8/14	11	85.7
	Waupun Cons. Club	1,400	6/2	1,012	8/21	12	72.2
	Lowell Rod & Gun Club	350	6/2	271**	8/22	12	77.4
	Theresa Rod & Gun Club	1,050	6/2	850	—	—	80.9
	Iron Ridge Rod & Gun Club	350	6/2	298	9/2	13	85.1
	Better Friends Cons. Club	350	6/2	295	9/11	14	84.2
	Atwater Cons. Club	700	6/2	485	8/30	13	69.3
	Lebanon Spts. Club	350	6/2	168	—	—	48.0
	Beaver Dam Cons. Club	1,050	6/2	887	—	—	84.4
	Hustisford Rod & Gun Club	700	6/2	580**	8/8	10	82.9
		9,000		6,786			
Kewaunee	Algoma Hunting & Fishing Club	700	6/10	670	—	—	95.7
	Casco Hunting & Fishing Club	700	6/10	632	8/20	10	90.2
	Kewaunee Hunting & Fishing Club	700	6/10	506	8/28	11	72.2
	Luxemburg Hunting & Fishing Club	1,050	6/10	358	8/29	11	
				359	9/15	14	68.2
		3,150		2,525			

TABLE 20 (Continued)

County	Cooperator Club	Number Chicks Rec'd	Date Rec'd	Number Alive At Release	Date of Release	Age At Release (In Weeks)	Per Cent Surviving
Manitowoc	Manitowoc Co. Fish & Game Prot. Ass'n	5,000	6/10	4,399**	8/21	10	87.9
		350*	6/30			7	
	Schoolhill Trap Shooting Club	350	6/10	322	8/3	8	92.0
	West Shore Cons. Club	350	6/10	332	8/15	9	94.8
		6,050		5,053			
Shawano	Bowler Fish & Game Club	350	6/18	335**	—	—	95.7
	Tigerton Fish & Game Club	700	6/18	670	9/20	13	95.7
	Wolf River Game Club	700	6/18	422	9/12	12	60.2
	Shawano Fish & Game Prot Ass'n	1,000	6/18	431	8/22	9	43.1
	Caroline Fish & Game Club	600	6/18	549	8/29	10	91.5
	Shawano Co. Cons. Ass'n	5,000	6/18	4,530**	8/20	9	90.6
	Briarton Game Club	500	6/18	445**	—	—	89.0
	Gresham Spts. Club	1,100	6/18	880	—	—	80.0
	Bonduel Cons. Club	500	6/18	374	8/20	9	74.8
	Krakow Spts. Club	400	6/18	325	9/3	11	81.2
		10,850		8,961			
Clark	Neillsville Spts. Club	700	6/22	596**	8/28	10	85.1
	Riplinger Spts. Club	700	6/22	546**	9/1	10	78.0
	Loyal, Greenwood & Granton Clubs	1,050	6/22	915	8/29	10	87.1
	Abbotsford Spts. Club	350	6/22	243**	—	—	69.4
		2,800		2,300			

* Replacements

** Includes those birds being held over winter

TABLE 21

Sportsmen's Clubs Participating in the Study in 1955

County	Cooperator Club	Number Chicks Rec'd	Date Rec'd	Number Alive At Release	Age At Release (In Weeks)	Per Cent Surviving
Kenosha	Conservation Club of Kenosha County, Inc.	1,800	5/20	1,703		94.6
Ozaukee	Ozaukee County Fish & Game Protection Ass'n	1,400	5/20	1,200		85.7
Racine	Burlington Cons. Club	1,050	5/20	960*		91.4
	Racine Co. Cons. League	600	5/20	541		90.2
		1,650		1,501	10-12	91.0
Walworth	Lake Geneva Spts. Club	700	5/20	570		81.4
Waushara	Redgranite Cons. Club	700	6/13	350		50.0
Winnebago	Winnebago Cons. Club	1,400	6/1	1,288		92.0

* Includes 50 birds being held until after the hunting season

APPENDIX B
Supplementary Tables for the Hen-stocking Study

TABLE 22

Sportsmen's Clubs Participating in the Hen Stocking Evaluation Study 1955-58

SOUTHWEST GROUP

Richland County

Bloom City Rod and Gun Club (no pheasants raised in 1957 or 1958)
Richland County Rod and Gun Club

Iowa County

Avoca Rod and Gun Club
Highland Sportsmen's Club
Mineral Point Conservation Club (No pheasants raised in 1958)
Rewey, Arthur, and Mifflin Clubs
Jonesdale Sportsmen's Club (Began raising pheasants in 1956)

Lafayette County

Darlington Conservation Club
Shullsburg Conservation Club
Belmont Sportsmen's Club
Blanchardville Rod and Gun Club (No pheasants raised in 1957 or 1958)
Argyle Rod and Gun Club
Gratiot Sportsmen's Club
South Wayne Rod and Gun Club (No pheasants raised in 1958)
Fever River Sportsmen's Club (Began raising pheasants in 1958)

NORTHEAST GROUP

Brown County

Brown County Reforestation Camp
Denmark Sportsmen's Club
DePere Sportsmen's Club
Brown County Sportsmen's Club (Began raising pheasants in 1956)
New Franken Sportsmen's Club (Began raising pheasants in 1958)

Calumet County

Brillion Conservation Club
St. Anna Sportsmen's Club
Outdoors, Inc.
East Shore Sportsmen's Club

Kewaunee County

Luxemburg Hunting and Fishing Club
Red River Conservation Club (No pheasants raised in 1958)
Algoma Hunting and Fishing Club
Kewaunee Hunting and Fishing Club

TABLE 22 (Continued)

NORTH CENTRAL GROUP

Clark County

Riplinger Sportsmen's Club (No pheasants raised in 1957 or 1958)
Neillsville Sportsmen's Club
Loyal, Granton, and Greenwood Clubs
Abbotsford Sportsmen's Club

Marathon County

Wisconsin River Fish and Game Club (No pheasants raised in 1956)
Rothschild Rod and Gun Club
Ringle Sportsmen's Club
Marathon County Fish and Game Club
Elderon Sportsmen's Club (Began raising pheasants in 1958)

Wood County

Heart of Wisconsin Conservation League
DuBay Sportsmen's Club

NORTHWEST GROUP

Buffalo County

Bufffalo County Sportsmen's Club
Fountain City Rod and Gun Club
Waumandee Rod and Gun Club

Polk County

Amery Sportsmen's Club (No pheasants raised in 1958)
Cushing Sportsmen's Club

St. Croix County

St. Croix Alliance of Conservation Clubs

TABLE 23

Experimental Hen Stocking
Mazomanie and Brooklyn Public Hunting Grounds: 1955, 1956 and 1957

Area	No. of Hens Stocked	Date Stocked	Band Color Combination
Mazomanie Public Hunting Ground (NW Dane County)	200	8/30/55	orange
	200	11/15/55	silver
	200	4/8/56	red
	200	9/17/56	silver/silver
	200	11/14/56	red/silver
	200	3/29/57	orange/silver
	160	3/29/57	silver
	200	5/7/57	orange
Total	1,560		
Brooklyn Public Hunting Ground (NE Green County)	200	8/30/55	orange
	200	11/15/55	silver
	200	4/8/56	red
	200	9/17/56	silver/silver
	200	11/14/56	red/silver
	200	3/29/57	orange/silver
	200	5/7/57	orange
Total	1,400		

TABLE 24

Experimental Hen Stocking
Jackson and Rock Counties, 1954-55

County	No. of Hens Stocked	Date Stocked	Band Color Combination
Jackson	981	August – Sept. 1954	orange
Rock	1,279	August – Sept. 1954	orange
	271	April 1955	red

TABLE 25

Number of Birds Stocked in the Study Counties, 1954-59

Year and County	Stocked Through Clubs*		Stocked Through PHG and Co. Allotment		Stocked Through Egg Program		Total	
	Cocks	Hens	Cocks	Hens	Cocks	Hens	Cocks	Hens
1954-Hen Counties								
Calumet	1,023	1,014	516	525	14	14	1,553	1,553
Clark	1,045	1,209	93	370	55	55	1,193	1,634
Polk	603	526	62	200	117	116	782	843
Iowa	926	947	532	450	104	104	1,562	1,501
Total	3,597	3,696	1,203	1,545	290	289	5,090	5,531
1955-Hen Counties								
Calumet	1,280	1,945	658	500	6	5	1,944	2,450
Clark	1,154	2,328	143	360	16	15	1,313	2,703
Polk	385	1,052	20	90	0	0	405	1,142
Iowa	706	1,865	572	552	19	18	1,297	2,435
Total	3,525	7,190	1,393	1,502	41	38	4,959	8,730
1956-Hen Counties								
Calumet	1,159	1,905	875	900	12	11	2,046	2,816
Clark	1,157	2,495	55	270	27	26	1,239	2,791
Polk	420	1,051	60	320	8	8	488	1,379
Iowa	1,240	1,856	556	615	101	101	1,897	2,572
Total	3,976	7,307	1,546	2,105	148	146	5,670	9,558
1957-Hen Counties								
Calumet	1,276	2,041	822	1,150	0	0	2,098	3,191
Clark	957	2,024	50	700	21	21	1,028	2,745
Polk	498	1,169	60	425	0	0	558	1,594
Iowa	1,106	1,941	329	980	22	21	1,457	2,942
Total	3,837	7,175	1,261	3,255	43	42	5,141	10,472
1958-Hen Counties								
Calumet	1,268	1,223	1,350	850	0	0	2,618	2,073
Clark	833	857	60	700	14	14	937	1,571
Polk	232	406	60	550	3	3	295	959
Iowa	1,051	1,187	500	300	0	0	1,551	1,487
Total	3,414	3,673	1,970	2,400	17	17	5,401	6,090
1959-Hen Counties								
Calumet	1,190	1,305	943	230	8	8	2,141	1,543
Clark	905	772	67	268	71	70	1,043	1,110
Polk	287	290	0	0	22	22	309	312
Iowa	1,213	1,345	200	810	0	0	1,413	2,155
Total	3,595	3,712	1,210	1,308	101	100	4,906	5,120

* The number of hens stocked by the clubs in the "Hen" counties includes the additional birds brought in from the "Cock" counties.

TABLE 25 (Continued)

Year and County	Stocked Through Clubs*		Stocked Through PHG and Co. Allotment		Stocked Through Egg Program		Total	
	Cocks	Hens	Cocks	Hens	Cocks	Hens	Cocks	Hens
1954-Cock Counties								
Brown	1,528	1,159	497	625	6	5	2,031	1,789
Marathon	1,150	911	450	800	133	133	1,733	1,844
Buffalo	806	850	105	400	5	5	916	1,255
Richland	1,096	948	326	325	0	0	1,422	1,273
Total	4,580	3,868	1,378	2,150	144	143	6,102	6,161
1955-Cock Counties								
Brown	1,864	1	643	520	121	120	2,628	641
Marathon	2,874	90	361	300	14	14	3,249	404
Buffalo	1,857	0	105	350	58	57	2,020	407
Richland	2,635	0	585	350	0	0	3,220	350
Total	9,230	91	1,694	1,520	192	191	11,117	1,802
1956-Cock Counties								
Brown	3,247	0	650	400	258	258	4,155	658
Marathon	2,291	0	520	0	23	23	2,834	23
Buffalo	1,889	0	0	0	47	46	1,936	46
Richland	2,190	0	480	0	395	395	3,065	395
Total	9,617	0	1,650	400	723	722	11,990	1,122
1957-Cock Counties								
Brown	3,164	0	810	400	5	6	3,979	406
Marathon	2,390	0	510	0	0	0	2,910	0
Buffalo	2,066	0	365	0	35	34	2,466	34
Richland	2,100	0	310	0	378	377	2,788	377
Total	9,720	0	2,005	400	418	417	12,143	817
1958-Cock Counties								
Brown	1,802	1,392	650	0	26	26	2,478	1,418
Marathon	1,701	1,721	450	0	9	9	2,160	1,730
Buffalo	926	985	325	0	0	0	1,251	985
Richland	1,248	1,249	400	0	18	18	1,666	1,267
Total	5,677	5,347	1,825	0	53	53	7,555	5,400
1959-Cock Counties								
Brown	1,613	1,457	645	310	0	0	2,258	1,767
Marathon	846	804	411	0	0	0	1,257	804
Buffalo	1,273	1,431	370	188	0	0	1,643	1,619
Richland	1,300	1,300	300	300	175	175	1,775	1,775
Total	5,032	4,992	1,726	798	175	175	6,933	5,965

* The numbers of cocks stocked by the clubs in the "Cock" counties includes the extra cocks brought in from the State Game Farm in exchange for the hens given up.

TABLE 25 (Continued)

Year and County	Stocked Through Clubs*		Stocked Through PHG and Co. Allotment		Stocked Through Egg Program		Total	
	Cocks	Hens	Cocks	Hens	Cocks	Hens	Cocks	Hens
1954-Control Counties								
Kewaunee	1,319	1,206	136	475	40	40	1,495	1,721
Wood	1,857	1,443	283	500	0	0	2,140	1,943
St. Croix	1,166	1,628	165	575	3	3	1,334	2,206
Lafayette	1,416	1,186	712	741	0	0	2,128	1,927
Total	5,758	5,463	1,296	2,291	43	43	7,097	7,797
1955-Control Counties								
Kewaunee	1,451	1,438	127	375	0	0	1,578	1,813
Wood	519	1,443	156	370	137	137	812	1,950
St. Croix	1,193	1,804	131	440	122	122	1,446	2,366
Lafayette	1,690	1,666	885	520	168	168	2,743	2,354
Total	4,853	6,351	1,299	1,705	427	427	6,579	8,483
1956-Control Counties								
Kewaunee	1,209	1,249	40	225	61	61	1,310	1,535
Wood	681	959	40	200	177	177	898	1,336
St. Croix	897	1,462	25	225	0	0	902	1,687
Lafayette	1,779	1,626	951	695	125	125	2,855	2,446
Total	4,546	5,296	1,056	1,345	363	363	5,965	7,004
1957-Control Counties								
Kewaunee	1,753	1,833	76	450	141	140	1,970	2,423
Wood	906	879	113	550	233	233	1,252	1,662
St. Croix	1,229	1,743	50	300	12	11	1,291	2,054
Lafayette	1,512	1,482	764	850	0	0	2,276	2,332
Total	5,400	5,937	1,003	2,150	386	384	6,789	8,471
1958-Control Counties								
Kewaunee	1,076	1,044	210	1,075	387	388	1,673	2,507
Wood	770	750	0	0	93	94	863	844
St. Croix	1,598	1,168	0	0	0	0	1,598	1,168
Lafayette	1,846	1,689	820	410	0	0	2,666	2,099
Total	5,290	4,651	1,030	1,485	480	482	6,800	6,618
1959-Control Counties								
Kewaunee	1,139	1,336	239	220	488	489	1,866	2,045
Wood	594	549	60	140	171	172	780	906
St. Croix	1,300	1,729	0	0	12	13	1,312	1,742
Lafayette	1,669	1,594	955	1,148	0	0	2,624	2,742
Total	4,657	5,253	1,254	1,508	671	674	6,582	7,435

* Includes birds brought in from the State Game Farm to compensate for clubs which dropped out of the day-old-chick program during the study.

APPENDIX C

Methods Used to Obtain Estimates of Production by Stocked Hens

While we had no accurate means of calculating actual production by stocked hens in the 12 study counties, several methods were used to obtain a range of estimates of production using available data. Each method had certain assumptions common to one or more of the others; each had one or more elements unique and independent of the others. The various kill estimates obtained and used to calculate production figures did not always agree with each other indicating weaknesses in some of the methods.

It was impossible to accurately assign sampling limits to these production estimates because of large sampling variations obtained within individual counties within any one group. We made a direct judgement of trends in production from the variation between counties within the groups. From a rigid analytical viewpoint, no real confidence can be placed on the estimated production figures. However, since there does appear to be some trend throughout the entire series of data, there is some confidence generated in our conclusions. A chi-square test on these trends gives a significant value at the 5 per cent level. However, it must be remembered that the data are not entirely independent. Thus, the estimates of production by stocked hens should be regarded as tentative and provisional. This indicates the need for additional research to better define production. The information is presented under headings comparable to those in the report to give the reader an opportunity to compare similarities and differences obtained using various methods.

Kill Estimates

The annual pheasant population is made up of cocks produced by native pheasant populations, cocks produced by stocked hens and cocks stocked each fall. Our studies showed a 42-75 per cent recovery of club-stocked cocks which approached the recovery of 51 per cent obtained on public hunting grounds. We obtained an index of the wild-reared component of the annual kill by assuming a 50 per cent recovery of club-stocked cocks (Table 26). We used 50 per cent rather than 51 per cent in this analysis for convenience. Thus, one-half the number of cocks stocked each fall in each county was subtracted from the estimated county kill to give this index.

Trends in the estimated number of wild-reared cocks killed (Table 26) are similar to those in Table 8. In 1955, an additional 3,199 hens were stocked in the hen counties (as compared to the base year 1954) and 4,359 fewer hens were stocked in the cock counties. If we assume that the additional number of hens in the hen counties produced about the same number of young as the cock counties lost through being deprived of their hens, then the population change in 1956 due to the natural decline should have been intermediate between the changes experienced by these two county groups. Therefore, the native pheasant population decline in 1956 should have been 15.5 per cent (percentage change in hen county kill in 1956, Table 26, column 6, plus percentage change in cock county kill in 1956 divided by 2: $15\% + 16\% \div 2$). The difference between this change and the observed change

TABLE 26

Trends in Estimated Number of Wild-Reared Cocks Killed in the Study Counties, 1954-59***

County	1954*	1955**	Per Cent Change	1956**	Per Cent Change	1957**	Per Cent Change	1958*	Per Cent Change	1959*	Per Cent Change
Hen Counties											
Calumet	2,240	2,191	− 2	1,963	− 10	2,476	+ 23	2,011	− 19	1,257	− 37
Clark	3,026	3,703	+ 22	3,348	− 10	3,549	+ 6	3,240	− 9	970	− 70
Polk	2,535	4,051	+ 60	2,908	− 28	3,442	+ 19	1,469	− 57	1,971	+ 34
Iowa	1,591	1,843	+ 16	1,840	0	1,504	− 18	1,835	+ 22	1,239	− 32
Total	9,392	11,788		10,059		10,971		8,555		5,437	
Weighted Avg.			+ 26		− 15		+ 9		− 22		− 36
Control Counties											
Kewaunee	1,753	2,148	+ 23	1,152	− 46	2,382	+107	793	− 67	1,235	+ 56
Wood	3,485	6,077	+ 74	3,923	− 35	5,059	+ 29	4,546	− 10	1,974	− 57
St. Croix	1,743	3,531	+103	2,849	− 19	2,258	− 21	2,186	− 3	1,180	− 46
Lafayette	3,105	4,396	+ 42	3 266	− 26	2,998	− 8	3,148	+ 5	532	− 83
Total	10,087	16,152		11,190		12,697		10,673		4,921	
Weighted Avg.			+ 60		− 31		+ 14		− 16		− 54
Cock Counties											
Brown	3,343	3,513	+ 5	2,979	− 15	4,659	+ 56	3,709	− 20	2,973	− 20
Marathon	1,991	4,128	+107	2,824	− 32	2,559	− 9	2,038	− 20	1,057	− 48
Buffalo	2,240	3,056	+ 41	3,240	+ 6	2,805	− 13	1,517	− 46	1,138	− 25
Richland	1,169	1,033	− 12	835	− 19	1,070	+ 28	740	− 31	0	− 100
Total	8,743	11,730		9,878		11,093		8,004		5,168	
Weighted Avg.			+ 34		− 16		+ 12		− 28		− 35

* Normal stocking

** Stocking manipulations

*** The total estimated kill (Table 8) minus one-half of the number of cocks stocked in each year

in the two groups of counties is plus 0.5 per cent for the hen counties and minus 0.5 per cent for the cock counties. This would mean that the hens added in the hen counties in 1955 contributed one-half of 1 per cent of the 1955 estimated kill of wild cocks to the 1956 wild kill. This suggests that there was very little production by stocked hens. However, on the basis of direct judgment from the variations between counties within the groups in Table 26, any conclusions on production from this method would be meaningless.

Percentage of Wild-Reared Birds in the Kill

By using data from Table 9 we also obtained estimates on the number of wild-reared birds in the kill (Table 27). These data were obtained by multiplying the kill estimates (Table 8) by the estimated percentages of wild-reared birds in the kill (Table 9).

With these data another set of estimates of production by stocked hens was obtained by again making the assumption that the degree of natural decline was intermediate between the amount of increase in the hen counties and the decrease in the cock counties. This was 11.5 per cent (21% + 2% ÷2: Table 27, column 4). The estimated production by the 3,199 hens added in 1955 in the hen counties was 13.5 per cent (11.5% + 2%) of the 1955 kill or 1,254 young cocks produced. This is an average production of 0.4 young cocks per stocked hen.

The estimated production by the 4,359 hens stocked in 1954 and not in 1955 in the cock counties was 9.5 per cent (21.0% − 11.5%) of the 1955 kill in these counties or 871 young cocks produced. This is an average production of 0.2 young cocks per stocked hen.

The production figures obtained from this method again are rough estimates and are not to be construed as exact figures. They involve the errors in kill estimates as well as any variations that may be present in the leg samples.

The number of wild-reared cocks shot was estimated by a method which was completely independent of annual kill estimates. This method involved using the proportion of stocked and unstocked (wild) cocks in the kill as shown by the leg sample data (Table 9). It also involved the assumption that one-half of the cocks stocked were recovered in the kill. Using this new method, the following proportion was set up:

$$\frac{\text{Percentage of stocked cocks in leg sample}}{\text{½ number of cocks stocked}} = \frac{\text{Percentage of wild cocks in leg sample}}{\text{Total kill of wild cocks}}$$

In this manner, we estimated the wild-reared kill for each county from 1955 through 1958 (Table 28).

These data were used to provide a third set of estimates of production by stocked hens. The 3,199 additional hens stocked in the hen counties in 1955 not only made up for the 10 per cent natural decline as shown by the control counties but produced a 65 per cent increase. Their production was 75 per cent (65% + 10%) of the 1955 estimated kill of 4,228 wild cocks. This is 3,171 cocks or an average production of about 1.0 young cocks per stocked hen.

Since some decline in the cock counties was due to the 10 per cent natural decline, the decline due to removal of hens in 1955 was 12 per cent (22% − 10%) of the 1955 wild kill. The number of cocks produced was 854 or 0.2 young cocks produced for each

TABLE 27

Estimated Number of Wild-Reared Cocks Shot Obtained from Product of Kill Estimates and Estimated Percentage of Wild-Reared Birds in the Kill

County	Wild Cocks Shot 1955**	Wild Cocks Shot 1956**	Per Cent Change	Wild Cocks Shot 1957**	Per Cent Change	Wild Cocks Shot 1958*	Per Cent Change
Hen Counties							
Calumet	1,676	2,030	+ 21	1,657	− 18	2,357	+ 42
Clark	3,183	2,936	− 8	3,332	+ 14	2,782	− 17
Polk	3,531	2,648	− 25	3,051	+ 15	1,471	− 52
Iowa	897	1,813	+102	1,117	− 38	1,645	+ 47
Total	9,287	9,427		9,157		8,255	
Weighted Avg.			+ 2		− 3		− 10
Control Counties							
Kewaunee	1,733	849	− 51	1,481	+ 74	848	− 43
Wood	4,733	3,060	− 35	4,434	+ 45	4,231	− 5
St. Croix	2,637	1,848	− 30	2,062	+ 12	2,388	+ 16
Lafayette	3,403	3,051	− 10	2,895	− 5	3,450	+ 19
Total	12,506	8,808		10,872		10,917	
Weighted Avg.			− 30		+ 23		+ 0.4
Cock Counties							
Brown	3,186	2,579	− 19	4,189	+ 62	2,227	− 47
Marathon	3,337	2,545	− 24	2,408	− 5	1,341	− 44
Buffalo	1,220	1,347	+ 10	808	− 40	750	− 7
Richland	1,427	805	− 44	641	− 20	802	+ 25
Total	9,170	7,276		8,046		5,120	
Weighted Avg.			− 21		+ 11		− 36

* Normal stocking

** Stocking manipulations

of the 4,359 hens stocked in 1954 and not in 1955.

The production estimate of 1.0 cocks per stocked hen is extremely high. Since this figure represents cocks produced, we also would expect 1.0 hens produced per stocked hen. This young hen production should have been reflected as an increase in fall hen-flushing rates; this did not occur. Perhaps some of the error lies in the assumption that we can expect a 50 per cent return of stocked cocks in all counties. A higher return of stocked cocks in some counties would lower the estimated wild-reared kill and thus would lower the stocked-hen production figures. The sampling variation is tremendously high, even though the trends indicate some production for all matched counties between the groups and only a low degree of confidence can be held in the result.

Hunter Diaries

Estimates of the number of wild-reared cocks shot per gun-hour were obtained by multiplying the percentage of wild birds in the leg sample (Table 9) by the cock kill rates (Table 11). Production estimates were obtained from these data by again assuming that the native population decline was intermediate between the

TABLE 28

Estimated Number of Wild-Reared Cocks Shot Obtained from Percentage of Stocked and Wild Birds in Kill, Assuming 50 Per Cent Recovery of Stocked Birds

County	Wild Cocks Shot 1955**	1956**	Per Cent Change	Wild Cocks Shot 1957**	Per Cent Change	Wild Cocks Shot 1958*	Per Cent Change
Hen Counties							
Calumet	1,096	2,174	+ 98	930	− 57	3,205	+245
Clark	1,776	1,765	− 1	2,341	+ 33	1,407	− 40
Polk	991	1,281	+ 29	1,271	− 1	1,496	+ 18
Iowa	365	1,762	+383	729	− 59	1,321	+ 81
Total	4,228	6,982		5,271		7,429	
Weighted Avg.			+ 65		− 25		+ 41
Control Counties							
Kewaunee	1,135	581	− 49	774	+ 33	907	+ 17
Wood	1,098	1,048	− 5	2,219	+112	2,448	+ 10
St. Croix	1,180	574	− 51	1,582	+176	3,196	+102
Lafayette	1,974	2,652	+ 34	2,655	0	4,463	+ 68
Total	5,387	4,855		7,230		11,014	
Weighted Avg.			− 10		+ 49		+ 52
Cock Counties							
Brown	2,551	2,163	− 15	3,388	+ 57	1,014	− 70
Marathon	2,244	2,126	− 5	2,183	+ 3	815	− 63
Buffalo	433	456	+ 5	308	− 33	337	+ 9
Richland	1,890	790	− 58	490	− 38	867	+ 77
Total	7,118	5,535		6,369		3,033	
Weighted Avg.			− 22		+ 15		− 52

* Normal stocking

** Stocking manipulations

trend in the hen and cock counties or 10 per cent. According to data in Table 29, the wild hen population in the hen county group did not change between 1955 and 1956. The extra hens stocked in 1955 presumably produced in 1956 the 10 per cent of the 1955 wild kill which the native populations failed to produce in 1956. Similarly, since the wild populations in the cock counties dropped 20 per cent in 1956, the removal of the 4,359 hens in 1955 caused a reduction of 10 per cent in the 1955 wild kill in addition to the 10 per cent natural decline.

These data suggest that the 3,199 hens added to the hen counties produced a number of young cocks equivalent to 10 per cent of the 1955 wild kill in these counties. Also, the 4,359 hens stocked in the cock counties in 1954 and not in 1955 produced in 1955 a number of young cocks equivalent to 10 per cent of the 1955 wild kill in these counties.

The wild kill in 1955 in the hen counties ranged between 4,228 (Table 28) and 11,788 (Table 26). Ten per cent of these estimates is 423 and 1,179 young cocks produced by 3,199 hens, or an average production of between 0.1 and 0.4 young cocks per hen.

Wild kill estimates in 1955 in the cock counties ranged between 7,118 (Table 28) and 11,730 (Table 26).

TABLE 29

Wild Cocks Shot Per Gun-Hour in the Study Counties, 1955-58

County	1955** Wild Cocks Shot per Gun-Hour***	1956** Wild Cocks Shot per Gun-Hour***	Per Cent Change	1957** Wild Cocks Shot per Gun-Hour***	Per Cent Change	1958* Wild Cocks Shot per Gun-Hour***	Per Cent Change
Hen Counties							
Calumet	0.09	0.09	0	0.06	− 33	0.08	+ 33
Clark	0.13	0.12	− 8	0.14	+ 17	0.11	− 21
Polk	0.17	0.14	− 18	0.14	0	0.15	+ 7
Iowa	0.08	0.11	+ 38	0.08	− 27	0.12	+ 50
Weighted Avg.	0.12	0.12	0	0.11	− 8	0.11	0
Control Counties							
Kewaunee	0.06	0.03	− 50	0.05	+ 67	0.06	+ 20
Wood	0.13	0.09	− 31	0.12	+ 33	0.14	+ 17
St. Croix	0.10	0.10	0	0.12	+ 20	0.12	0
Lafayette	0.11	0.10	− 9	0.09	− 10	0.13	+ 44
Weighted Avg.	0.11	0.08	− 27	0.10	+ 25	0.12	+ 20
Cock Counties							
Brown	0.07	0.06	− 14	0.07	+ 17	0.04	− 43
Marathon	0.10	0.08	− 20	0.07	− 13	0.04	− 43
Buffalo	0.09	0.08	− 11	0.05	− 38	0.07	+ 40
Richland	0.14	0.07	− 50	0.04	− 43	0.06	+ 50
Weighted Avg.	0.10	0.08	− 20	0.06	− 25	0.05	− 17

* Normal stocking
** Stocking manipulations
*** The product of the percentage of wild birds in the leg sample (Table 9) and the cock-kill rates (Table 11)

Ten per cent of these estimates is 712 and 1,173 young cocks produced by 4,359 hens stocked in 1954 and not in 1955. This is an average production of between 0.2 and 0.3 young cocks per hen.

The data in Table 29 contain lower variation. The results are suggestive of a difference between groups but again on a low confidence level.

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