

THE CONDOR

VOLUME 53

NOVEMBER-DECEMBER, 1951

NUMBER 6

A FIELD STUDY OF SOME GROUPING AND DOMINANCE RELATIONS IN RING-NECKED PHEASANTS

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The purpose of this report is to describe some aspects of social organization in a wild population of birds. Part of the evidence for the population under consideration, with special reference to the breeding season, has already been reported (Taber, 1949*a*). The current report places more emphasis on social organization during the late winter and early spring. More specifically, we have attempted to answer two main questions for a population of wild Ring-necked Pheasants, *Phasianus colchicus*: (1) Are social groups formed consistently of the same individuals? (2) Do wild pheasants have a dominance hierarchy and, if so, what is the value of and the basis for high social rank? A preliminary abstract of our results has been published (Collias and Taber, 1948).

In large part these problems stem from previous laboratory studies on the domestic fowl, which, like the Ring-necked Pheasant, is a member of the pheasant family (Phasianidae). Fischel (1927), who studied the grouping relations of 500 white leg-horns in a large chicken yard, observed that small subgroups were readily formed and that the individual membership of these groups was constantly shifting. Schjelderup-Ebbe (1922) has given detailed evidence for the existence of a dominance hierarchy in domestic fowl, and his work has been confirmed by Masure and Allee (1934). The value of and basis for high social rank in the dominance hierarchy have been summarized by Collias (1943, 1944). The results of all these studies were taken by us as working hypotheses to be tested in our study of wild Ring-necked Pheasants.

PLACE AND METHODS OF STUDY

The study was carried out about five miles from Madison, Wisconsin, in one part of a 349-acre marsh lying along Nine Springs Creek in the town of Fitchburg, Dane County, and in the surrounding uplands which consist of farm country. This marsh, the Nevin Fish Hatchery Refuge, is owned and operated by the Wisconsin Conservation Department. The marsh is frozen in winter and the principal roosting cover is formed by stands of *Phragmites communis* on slightly elevated areas and *Carex stricta* elsewhere. These plants form dense stands within which the pheasants readily find hiding places from enemies and shelter from the weather.

During the period of study the winter population of pheasants on the Fish Hatchery Refuge, as counted by a drive census on January 24, 1948, was at a high level, compared with the seven preceding years as counted by the same method on the same area. The population counts from the winter of 1940-41 to the winter of 1947-48, inclusive, were: 224, 216, 263, 260, 364, 151, 162, and 312. We are indebted to Dr. Robert A. McCabe of the Department of Wildlife Management, University of Wisconsin, for these data and for a critical reading of the manuscript.

Thirty-eight of the 81 cocks and 170 of the 231 hens counted in the marsh during the drive census of 1948 were trapped and individually color marked. Each bird at the time of trapping was weighed, aged by means of the bursa technique (Gower, 1939), and banded with an aluminum band and with a distinctive combination of colored bands. The trapping and banding of the birds was supported by Pittman-Robertson Project 9-R of the Wisconsin Conservation Department. Since colored leg-bands are often not

readily identifiable in dense vegetation or at a distance, each bird was also marked with a rubber film tag pinned through the skin at the back of its neck. These tags carried a colored number fastened to a background of a different color; this method made it possible to identify many individuals readily from a distance. Taber (1949*b*) has described the details of this method.

This population, like other pheasant populations, is subject to rapid turnover. Thus, in the subsequent season's banding operations, there were recovered only one cock and 11 hens of the total banded during the winter of 1947-48. We wish to acknowledge the courtesy of the Wisconsin Conservation Department in providing these data on retrapping in the winter of 1948-49.

Our studies of the grouping and dominance relations of individuals, as reported here, were made mainly during the period February 2 to April 25, 1948. A pile of corn was placed at each of the three main observation posts, and the birds came to feed on this bait. Bait was also used at various trapping stations which extended throughout the marsh. The observation stations were placed at spots known to be most favorable for concentration of the birds. One of these observation stations (I) was well within the marsh, another (II) was on the edge of the marsh where it adjoined a field, and the third (III) was in the marsh next to a creek. The observer was stationed in a blind 15 to 75 feet from the bait. One blind was in a tree (at station I), another on a 20-foot tower (at station II), and the third (at station III) was on the ground. Most of the observations were made at station III. The birds were watched with 9-power binoculars or with a 20-power telescope loaned by the Wisconsin Conservation Department. The observer stationed himself in the blind before dawn and then remained in the blind from two to four hours. Because of the dense vegetation only birds in the immediate vicinity of the bait could be seen from the blind.

The birds generally visited the observation stations in small groups. Each individual which carried a marker or bands was then identified. In some cases it was possible to identify unmarked individuals by various plumage peculiarities. A record was kept of the exact time when a bird arrived at the observation station and also of the time of its departure. The small feeding flocks were somewhat loose and, although the birds of a given flock often arrived at the same instant, sometimes the individuals straggled in over a period of several minutes. It was decided to call members of the same flock all those birds that arrived within a five-minute period of each other or of intermediate flockmates. This arbitrary period seemed sufficiently long to be truly inclusive of individuals moving as one coherent group and sufficiently short to exclude in most cases overlap with subsequent groups.

Additional information on more general grouping behavior of the birds was obtained from trapping records and from observations made during the course of trapping and at other times.

Dominance relations were studied by noting and recording each definite instance of aggressive-submissive interaction between two given birds. The form and significance of such interactions varied according to the sexes of the birds involved and the season during which the interaction took place. Since these observations were begun near the end of the period of sexual quiescence and extended well into the breeding season, the interactions were not all of the simple type leading to precedence in feeding. No clear-cut line could be drawn between the pattern of dominance hierarchies in late January and that of defended territories in April. As the breeding season advanced there was a gradual increase in antagonism between individuals of one sex and attraction between individuals of opposite sexes, the former being more noticeable in males. The occurrence of antagonisms and attractions are presented graphically in figure 1.

Here it may be seen that as testis weight increased, cocks stopped pecking hens and instead began to court them; groups of males were reduced because of mounting antagonism until dominant-submissive pairs were seen, and then these give way to true territory establishment; antagonism between females manifested in fighting or display was seen only as the season advanced to the point where harems began to be established,

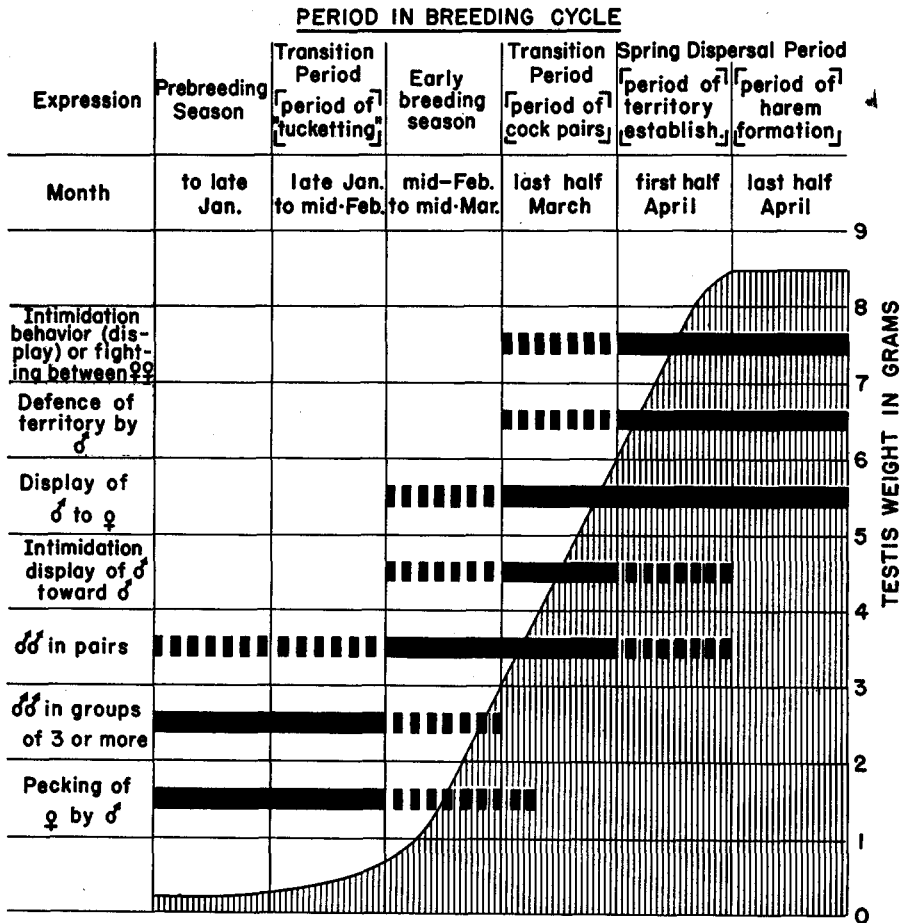


Fig. 1. Expressions of display or dominance between and within sexes of Ring-necked Pheasants near Madison, Wisconsin, from January through April (derived from Taber, 1949). Broken lines represent infrequent occurrence; solid lines, frequent occurrence. The sequence of behavior changes is superimposed upon the increase in testis size.

whereas earlier aggressive-submissive interactions between hens had consisted only in pecking, threatening or chasing. It is possible that this late appearance of fighting or display among hens is based on the dispersal of hens preceding harem formation; this dispersal results in the appearance of "new" hens in the harem, so that these obvious manifestations of antagonism may indicate first encounters between individuals and the placing of the new arrival in the hierarchy of the harem.

GROUPING RELATIONS OF INDIVIDUALS

Three degrees of inclusiveness in grouping patterns among the wintering pheasants in the area of study could be recognized: (1) the entire population of the study area was to a large extent a discrete unit fairly distinct from other local populations; (2) the different sections of the marsh or marsh edge were characterized by certain "local residents" repeatedly recorded in those particular sections; and (3) within each section were small flocks of shifting composition.

From a broad viewpoint the entire pheasant population of the Madison Fish Hatchery Wildlife Refuge can be considered as a unit and one might inquire into the extent of interchange with other local populations. We did not directly investigate this problem.

McCabe (1950) has investigated this problem with reference to the University of Wisconsin Arboretum which lies 1.8 miles to the north of the Fish Hatchery Refuge. This arboretum contains some 600 acres of pheasant cover. The Fish Hatchery Refuge is the first good winter range lying south of the Arboretum. The Arboretum is hemmed in on its other boundaries by large lakes and by the city of Madison. Nevertheless, of 1115 pheasants trapped and banded at the Arboretum and of 1732 trapped and banded at the Fish Hatchery Refuge, during seven winters only one pheasant trapped at one area was recovered in the other. The Fish Hatchery Refuge is surrounded by farm uplands which form something of a barrier to the free interchange of wintering individuals with other local populations. However, there is a possibility of some ingress or egress along the marsh bordering Nine Springs Creek which drains the Fish Hatchery marsh. But on the whole, the winter pheasant population of the study area seemed to be a well-defined and relatively isolated population.

Subdivision of the marsh population into overlapping and local subpopulations was indicated by repeated observation, either on the basis of sight or trapping records or both, of certain individuals at the same bait stations or trapping stations. Neighboring stations were placed between 50 and 100 yards apart. Some degree of interchange was indicated by the trapping of the same individuals at different traps, sometimes widely separated traps, within the marsh. However, there was a tendency toward localization. At station III, for example, the birds seen could be arbitrarily divided into "local residents" and "visitors." Out of approximately 55 individually marked hens observed from the blind at this station, during 50 observation days, only 14 (residents) were seen on nine or more different days, whereas 40 hens (visitors) were seen six or fewer times each (22 hens only once each). Each of the other three was seen eight times. The cocks show a somewhat similar pattern, but with possibly a higher proportion of "local residents." Thus, out of 16 individually identified cocks, 8 were seen six or more times each, whereas 7 were seen only one to three times apiece. The remaining cock was seen four times.

Temporary winter flocks in which individuals moved about and fed together as a more or less coherent unit were found to comprise a shifting membership. Males and females often fed together, but also were often apart during the winter as separate unisexual groups. In these unisexual groups the same individual birds might feed and move and rest together for several hours; but frequently membership of these unisexual flocks shifted from hour to hour. These feeding groups usually consisted of two to 25 individuals. Large flocks seen feeding in an open field might scatter out over a distance of 75 yards and within the larger flocks could be seen loose subgroups composed usually of 6 to 9 birds. Birds were seen at times to move from one such subgroup to another.

More precise observations of the individual composition of winter feeding flocks were made at station III. An example of a typical morning's observation, showing how the birds came and went, is given for the pheasant hens seen on the morning of April 1,

1948. Each individual is represented by a letter. Birds that paid more than one visit are shown in italics.

Time of arrival	Birds seen											Departed by		
	A	B	C	D	E	F	G	H	I	J	K		L	M
5:30 a.m.														5:32 a.m.
5:45-5:53														6:12
6:06														6:12
6:20-6:23														6:35
6:37-6:40														6:44
6:47														6:55

The observations on this and other mornings indicated that successive groups arriving at the corn pile tended to be made up largely of different individuals, but that the same individuals in some cases might show up again with different companions in later groups. Occasionally birds came alone and left in the same solitary fashion.

In order to find out whether or not there was any consistent tendency of individual hens to associate with some individuals much more than with others, tabulation was made of the numbers of times that each "resident" hen came to the corn pile within five minutes (*i.e.*, within the same "flock") of the arrival of every other "resident" hen. Table 1 indicates that any such tendency, if it exists at all, must be very slight.

Table 1

Frequency of Specific Association between Individual Pheasant Hens at Station III*																Came alone	Number of visits
A	B	C	D	E	F	G	H	I	J	K	L	M	N				
A		2	3	1	2	4	2	3	5	1	3	4	2	1	0	15	
B	2		1	1	2	1	2	4	2	3	1	3	1	1	0	12	
C	3	1		2	2	2	4	0	3	3	3	4	2	3	1	16	
D	1	1	2		2	2	3	2	1	0	3	0	1	0	0	12	
E	2	2	2	2		2	3	2	2	2	3	3	2	1	2	10	
F	4	1	2	2	2		5	5	8	2	3	5	2	1	0	12	
G	2	2	4	3	3	5		2	6	5	2	4	4	2	2	27	
H	3	4	0	2	2	5	2		5	1	3	3	2	2	1	16	
I	5	2	3	1	2	8	6	5		4	3	5	3	4	1	21	
J	1	3	3	0	2	2	5	1	4		2	3	3	1	2	14	
K	3	1	3	3	3	3	2	3	3	2		2	1	3	0	13	
L	4	3	4	0	3	5	4	3	5	3	2		2	4	2	18	
M	2	1	2	1	2	2	4	2	3	3	1	2		0	0	9	
N	1	1	3	0	1	1	2	2	4	1	3	4	0		1	12	

*Tabulated are the number of times each resident hen came to the corn pile in company with each other resident hen. Period of observations, February 2 to April 25, 1948.

Only 12 times did resident hens come alone, and only 28 times with "non-resident" hens, but when they came with other residents the specific flock companions varied greatly. Thus Female G came to the food pile 27 times, but with the same companion at most only six times, and she came with every other resident hen at least twice.

Twenty-one flocks of males came to the corn pile at station III. All but four of these flocks consisted of only two or three birds, and these small groups were composed of different combinations of individuals in all but two cases. The gregariousness of winter cocks is indicated by the fact that until well after the onset of the breeding season they were much more likely to come in company with other cocks than they were to come alone. With the onset of the breeding season the average size of male flocks gradually decreased (see figure 1).

Roosting groups of pheasants varied from two to two dozen birds or more. When the weather was very cold, the roosting groups were larger and at least some of the birds of each group roosted closer together. The location of roosts varied somewhat although there were favorite roosting spots.

DOMINANCE RELATIONS OF INDIVIDUALS

Evidence for the existence of a dominance hierarchy among wild Ring-necked Pheasants in winter.—Table 2 illustrates a dominance hierarchy observed on March 16, 1948, in a group of three cocks at a pile of corn at station I. These birds came and went as a definite flock several times. This table refers only to aggressive-submissive interactions over food. All of the three possible relations between any two of the birds, A, B, and C, were observed. The dominance relations were consistent and no cases were observed of a bird subordinate to an individual which it had previously dominated.

Table 2
Number of Aggressive-submissive Interactions among Cocks at Station I
Observed on March 16, 1948

Dominant birds	Subordinate birds		
	A	B	C
A	7	5
B	3
C

Table 3
Number of Aggressive-submissive Interactions among Cocks at Station II, February to April, 1948

Dominant birds	Subordinate birds								
	D	E	F	G	H	I	J	K	L
D	5	2	4	2
E	2	1	....	....
F	1	1	....	....	....	....
G	1	1	1	....	....
H	3	2	....
I	1	....	....
J	3	....
K
L

The problem of the significance of these relations is the same as the problem of the chances of always obtaining successive heads or tails in a series of tosses of coins. If the process were a random one, aggressive-submissive encounters between birds subsequent to the first encounter, like the case of coin tossing, would lead to the same results as the first encounter 50 per cent of the time. The number of encounters with the same outcome as the first encounter is $\Sigma(n-1) = 15$. There are no cases in the opposite category. The probability of this happening by chance is $(\frac{1}{2})^{15}$, an exceedingly remote contingency. The application of this statistical method to our problem was suggested to us by Dr. James Crow of the Department of Zoology, University of Wisconsin.

Table 3 shows similar evidence for the existence of a dominance hierarchy in a group of nine cocks observed from station II. The aggressive-submissive interactions in this table refer to pursuits and avoidances, including in some cases avoidance of a display-

ing male. Many of these interactions may have had significance with respect to the onset of territoriality rather than with respect to food, since many of them took place away from the immediate vicinity of the bait. Again there was no case observed of reversal of dominance relations in subsequent encounters between the same individuals. This

Table 4

Number of Aggressive-submissive Interactions among Cocks at Station III, February 2 to April 15, 1948

Dominant birds	Subordinate birds							
	H	M	N	O	P	Q	R	S
H	1	....	1	....	....	....	....
M	7	....	2	....	....	....
N	1	3	1	6	2
O	2*	....	1*	....	6	6	....	3
P	1	2
Q	3	....
R
S

*Territorial cases of apparent dominance reversal. See text.

Table 5

Number of Aggressive-submissive Interactions among Hens at Station III, February 2 to April 25, 1948

Dominant birds	Subordinate birds													
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
A	1	....	....	....	1	....	2	....	....	....	5	1	1
B	3	....	....	....	....	6	....	....	....	1	....	2
C	1	....	....	....	3	....	1	....	9	....	....	10	2	....
D	3	....	....	2	3	....	2	....	2	....
E	1	1	....	1	1	2	1	....	....
F	7	3	1	1	....	5	....	....
G	5	1	3	....	5	1	2
H	4	....	....	....	....	....	....	....	2	....
I	6	4	1
J	1	2	1	....
K	7	1	....
L	1	....	....	....	....	....	1
M	3	....	....	....	....	....	....	....	....	....	....	....	....
N

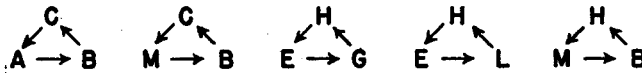
indicates the existence of a dominance hierarchy, although only 11 of the 36 possible paired relationships as calculated by the formula $n(n-1)/2$ were observed.

Table 4 presents evidence for the existence of a dominance hierarchy at station III in a group of eight cocks. The aggressive-submissive interactions referred to in this table were mostly encounters over food, although territorialism may have been involved in a few instances. Seven of the cocks, including cocks M, N, O, P, Q, R and S, are individuals not mentioned above, but one of them, cock H, was also involved in the dominance hierarchy described for the previous observation post (table 3). Only 13 of the 23 possible paired dominance relations of these eight cocks were observed, but all of these were consistent, with the exception of two cases of reversed dominance. These exceptions both involved male O which became territorial and thereupon gained dominance, at least while on his territory, over male H and male N. Actually, the two instances in

which male O dominated male H merely represent successes of O in border conflicts since H had established his territory immediately adjacent to that of O and the observation station was on the border between the two territories. Male N continued to be non-territorial during the period of observations. The evidence for a dominance hierarchy in this group of eight cocks is conclusive, since of 33 aggressive-submissive encounters observed subsequent to the first observed encounter, there was none with an outcome which differed from the first encounter, with the exception of the three territorial instances just described.

A dominance order was found to exist also among pheasant hens, as shown by table 5 for 14 marked hens observed at station III. One bird would peck or threaten to peck another at the food pile, and the threatened bird would thereupon retreat. These hens were the ones most frequently seen at this station, each having been recorded nine or more times. Fifty of the 91 possible paired relationships of these 14 hens were observed. Of 85 instances where an aggressive-submissive encounter involving the same two hens was observed more than once, not one instance was different from the first observed encounter. The probability of chance occurrence of these results is $(\frac{1}{2})^{85}$ or 10^{-60} . It is established, therefore, that these pheasant hens were organized on the basis of a dominance hierarchy during the season of study.

At least five triangles of dominance-submissive relationships existed among these 14 hens, as follows:



All cocks dominated all hens but stopped pecking them soon after the onset of the breeding season (see figure 1).

While the expression of dominance-submission relations within the flock was facilitated by the competitive interaction over food involved at the bait station, such relations were not confined to the bait stations nor to their immediate vicinity. It was sometimes observed out in the open field that when one member of a flock happened to scratch up an ear of corn with a few kernels remaining upon it, another apparently more dominant member of the flock would come, drive off the first bird, and appropriate the find for itself. Such encounters were observed too infrequently, from too great a distance, and too often with unmarked birds to make feasible a systematic study of them.

Interrelations of territorialism and rank in the dominance order.—At each of the three observation stations the cocks that remained to establish territory at or near the food pile were at or near the top of the dominance hierarchy of their winter flocks. At station I the male highest in the dominance hierarchy was the only male seen at this station after March 16, and this male had begun to crow repeatedly and regularly by March 18. At station II the four highest males in the dominance order were the only ones known to crow, and they established territories that adjoined upon this field. At station III, two of the four males highest in the dominance order among eight cocks were the only birds known to crow and establish territories; these territories adjoined the observation station. Of the remaining two males with high dominance, one disappeared (male M), and the other was seen to be beaten in a bluffing contest with one of the territorial males. The beaten bird (male N) possibly became non-territorial since, while it was seen at the corn pile a number of times thereafter, it generally came alone and was never seen to crow.

Summary of all our data indicates a strong association between the establishment of crowing territories and ability to dominate other cocks. Thus, seven territorial cocks

were seen to dominate 22 cocks but were dominated by only four cocks. In contrast, 14 non-territorial males dominated 14 males and were dominated by 34.

The association between high rank in the winter cock hierarchy and ability to establish a territory during the breeding season is suggestive of the true nature of the basis of breeding success. If the winter hierarchy had one basis and the breeding season hierarchy another, one would expect frequent reversals during the transition period as testis growth in some low-dominance cocks commenced earlier than in some high-dominance cocks. Since such reversals were practically absent it would seem either that all high-dominance cocks came into breeding condition before all low-dominance cocks or that high-ranking cocks continued to dominate low-ranking regardless of variation among cocks in testis growth, their submissive status causing the low cocks to become, to some extent, psychological castrates (Guhl, Collias and Allee, 1945). Of these two possibilities the second seems by far the more likely, especially since it may be noted that the eventual fate of many low-dominance cocks probably is to be non-territorial, a state in which low-dominance has caused a suppression of the ornaments and behavior typical of the breeding male.

This general pattern, however, is not invariably followed. It is quite possible that a bird of low-dominance which comes into breeding condition exceptionally early may rise in the hierarchy. Male hormone is well established as a stimulus to aggressive behavior. It has been shown that testosterone stimulates crowing and growth of the wattles in a pheasant capon (Collias, 1950). Allee, Collias and Lutherman (1939) have shown that in domestic hens, male hormone stimulates rise in the dominance order. A single reversal which was apparently based on early functioning of the testes was observed in the course of the present study. Two other cases were observed in which a cock of lower position in the winter hierarchy established a territory adjacent to the territory of a cock which had held a higher winter position. The former successfully defended his territory against the latter in each case; these, however, were by no means true reversals. It is obvious that where a large number of cocks establish territories, not all of the territorial cocks could have been of highest position in the winter hierarchy. Since the defense of territory seems to be invariably successful it is apparent that a territorial cock within his territory is imbued with a valor which quite transcends the arrangements of the previous winter.

During the winter there was a tendency for local residents to dominate "visitors," that is, birds of more casual occurrence, as seen at station III. Seven resident cocks dominated nine visitors and were dominated by only two visitors. A similar but less pronounced trend existed in females. Thus, 15 resident hens dominated 28 visitors and were dominated by 22 visitors.

Value of high rank in the dominance order.—The value of high rank in leading to breeding success in cocks has been pointed out. In winter flocks of cocks and among hens throughout the period of observation, high-dominance rank obviously was associated with precedence to food; and much of the aggressive competition observed centered over food, as described above. Such food precedence probably finds its greatest value at critical periods of food shortage. The birds lost weight steadily during the winter, and the period of study probably represented a relatively unfavorable season with respect to food. Of a total of some 450 aggressive-submissive interactions noted among all hens seen at station III during 50 observation-days, 45 per cent or almost half of these encounters were recorded on three mornings (February 19, March 20 and April 1) when the marsh and adjoining fields had been flooded by rains or pronounced thaws, forcing the birds to rely heavily on the bait stations for food. It should also be noted that the frequency of the aggressive interactions on these mornings was such that

we estimated only one-fourth to one-half of the total number of the interactions which actually took place were recorded.

Survival to the following winter was very restricted, as seems to be usual among pheasant populations. Of 96 hens (15 adult) and ten cocks (two adult) that were trapped in the winter of 1948-49 (Kozlik, 1949) only 11 hens and one cock had been trapped and banded in the winter of 1947-48. We knew the dominance position of only one of these retrapped birds. This bird, hen M, during the time of our study had been near the bottom of the dominance order of hens resident near station III. She was at that time in the first year of life. Her survival to the following winter was not therefore a matter of high dominance nor of age and experience but was either accidental or related to factors unknown to us.

Basis for high rank in the dominance order.—The tendency of local residents to dominate visitors has been mentioned. No definite correlation of weight with dominance was established, although the trend was in a positive direction. All territorial cocks which could be weighed were high in the dominance order and all were relatively heavy birds, but this was also true of some of the non-territorial cocks of lower dominance status. At station III resident hens were weighed from one to nine times each during the period from January 21 to March 13, 1948. The average weight of seven resident hens of high dominance rank was 1000 grams; the average weight of seven resident hens of lower dominance status was 970 grams. The small difference is of doubtful significance.

Age is probably a factor facilitating dominance. At station III, three of the seven most dominant resident hens were two years of age or older, whereas all seven of the hens in the lower half of the dominance order were less than one year old. Data for cocks were insufficient on this point.

The manner in which winter dominance predisposes a cock toward breeding success and the way in which a cock may occasionally reverse positions with a former despot at the start of the breeding season have been presented above.

Some connection is probable between trap shyness and high dominance. Six of the ten most dominant cocks could not be trapped, in contrast to only three of ten low-ranking cocks that could not be trapped in the areas of most intensive study. These individuals, unmarked during the course of our study, were recognized by plumage peculiarities.

THE POPULATION IN SUBSEQUENT YEARS

In the two years following our study, the pheasants counted on the study area fell from 312 birds in the winter of our study (1947-48) to 106 in the winter of 1948-49 (Kozlik, 1949) and 109 in the winter of 1949-50 (Thompson, 1950). We are indebted to the Wisconsin Conservation Department for permission to cite the census data for these last two years. It is evident that our study was made just before a sharp decline in the population. The decrease was first noted during the summer of 1948 in the course of brood observations. So few broods and adult birds were seen that brood observations were discontinued on the area. In the winter of 1949-50 it was found that three groups of pheasants were using the marsh and that there was little or no intermingling among the groups. This situation contrasts with the greater intermingling between birds from different sections of the marsh that we observed in a more dense population.

SUMMARY

During the winter of 1947-48, in a high density population of pheasants in a marsh near Madison, Wisconsin, 38 cocks and 170 hens were trapped, individually color-marked, and released. Many of these birds were observed more or less regularly during late winter and early spring, along with unmarked birds some of which could be distin-

guished as individuals. Unisexual groups of hens or cocks, although often separate, not infrequently mixed together while feeding. The birds were especially gregarious in winter and gradually formed into harems of hens, each harem under a single cock, as the breeding season progressed. Flocks seen at a feeding station showed little if any consistent association between given individuals. Much of the dominance order in these open groups was worked out, and was related to food competition in both hens and cocks. In addition, those cocks which began early to crow and to establish individual territories during the breeding season were generally higher in the dominance order of cocks than those that did not. All cocks dominated all hens, but ceased to peck or drive hens from food soon after the onset of the breeding season. Older birds and trap-shy birds tended to be relatively high in dominance rank; ordinary weight differences within the sexes seemed to be of relatively small importance in deciding social level.

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