

SELECTION AND USE OF DRUMMING SITES  
BY MALE RUFFED GROUSE

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SINCE the spring of 1956, the density, distribution, and drumming behavior of male Ruffed Grouse (*Bonasa umbellus*) have been under investigation on the Cloquet Forest Research Center, a facility of the University of Minnesota, School of Forestry, about 20 miles west of Duluth, Minnesota. From 1931 to 1934, Ralph T. King carried out one of the first intensive research studies of Ruffed Grouse on this same area. Although few of King's findings have reached publication (King, 1937), many of his original data are available at Cloquet and have enhanced our understanding of the factors influencing the current grouse population.

There have been many studies of the drumming of male Ruffed Grouse, but little seems to have been reported concerning either the historical use of sites or the interactions between male grouse. Bent (1932: 142), Allen (1934), Fisher (1939), Graham (1940), Bump *et al.* (1947: 274), Frank (1947), Hardy (1950), C. D. Fowle ("An analysis of the territorial behavior of the Ruffed Grouse [*Bonasa umbellus* (L.)],” Ph. D. dissertation, University of Toronto, 1953), Hungerford (1953), Petraborg *et al.* (1953), Dorney *et al.* (1958), R. L. Eng ("A study of the ecology of male Ruffed Grouse [*Bonasa umbellus* L.] on the Cloquet Forest Research Center, Minnesota,” Ph. D. dissertation, University of Minnesota, 1959), Ammann and Ryel (1963), and Palmer (1963) all have reported upon various aspects of drumming behavior, some from the life history or behavioral viewpoint, and others by using it as a "tool" for learning more about the abundance or longevity of these grouse.

The purpose of this paper is to examine the use of specific drumming sites (and the grouse using them) from a historical viewpoint and, based on Cloquet examples, to point out some behavioral traits which may be used as a valid basis for studying grouse populations and those which can be misinterpreted, resulting in incorrect assumptions concerning Ruffed Grouse population densities, longevity, and age composition. Information on these topics should be useful to wildlife biologists exploiting drumming behavior as a method of measuring changes in population levels, either as a result of natural environmental influences or in response to planned or accidental manipulation of grouse habitat (see also Gullion, 1966).

This study has been one phase of a broader study designed to determine the influence of forestry management practices on a Ruffed Grouse

population in a boreal forest environment. Since 1960, the primary project has been supplemented by a National Science Foundation supported GROUSAR project, involving the development of miniature radio transmitters to be used on grouse for tracking movements and studying their behavior (Marshall and Kupa, 1963).

#### METHODS

The history and features of the five-square-mile Cloquet Research Forest are well enough described in the literature to make further description of the area redundant (Allison and Brown, 1946; Schantz-Hansen and Jensen, 1956; Marshall, 1958; Brown, 1960; Gullion, King, and Marshall, 1962). However, it should be pointed out that in the springs of 1963, 1965, and 1966, the area included in this study was expanded beyond the Research Center until about nine square miles were intensively searched for drumming grouse and their logs.

Throughout this study, the capture and marking of as many active drummers as possible has represented a major effort; the male grouse were captured primarily by using the mirror-trap, modified from an original design by Tanner and Bowers (1948). The grouse were marked with individual combinations of anodized, butt-end, aluminum leg bands and (through 1958) with back-tags to facilitate field identification (Gullion, Eng, and Kupa, 1962; Gullion, 1965).

Each spring several forestry students helped in locating active drumming logs. Each was assigned an area ranging from a few hundred acres to over a square mile, which he systematically searched each morning (0500 to 0700 hours) when the weather was favorable, recording the times of all drumming heard and also locating the logs used by all known drummers. Periodic counts were made of the droppings deposited at many drumming logs. This effort, lasting from about 15 April to 10 May, resulted in our finding nearly every active drumming log on the study area each spring (see Gullion, 1966).

Additionally, all logs or sites with records of prior use were checked for evidence of activity at periodic intervals. In the fall drumming season, when assistance was not available and drumming infrequent, most data on the use of logs were gathered by periodic inspection of known logs.

From 1956 through 1965, records were obtained concerning at least 593 logs used by male Ruffed Grouse for drumming, on and adjacent to the Cloquet Research Forest. In this period, more than 520 individual male Ruffed Grouse are known to have participated in drumming activity, 412 of which have been trapped, and 408, banded.

#### CLASSIFICATION OF DRUMMING PLACES

*Objects used in drumming activity.*—The *drumming stage* is an area of about six inches square on a larger object, the *drumming log*, where the bird stands while drumming. Although drumming “logs” are usually fallen trees, they may also be boulders, mounds of dirt, or other objects which permit the grouse to stand above the surrounding terrain. The general forest area used by a male grouse which is associated with a specific log or logs is termed an *activity center*, and it may include from 10 to 30, or more, acres, depending upon forest type and topography.

The activity center may be synonymous with Fowle's "Primary Areas" (*op. cit.*: 49), but my definition suggests merely a central area of intensive activity in the proximity of one or more drumming logs used by a single male grouse. This definition describes my concept of a flexible periphery to a defended area (I am considering drumming as a defensive act, as defined by Lack and Lack [1933: 199]). Fowle (*op. cit.*: 42) notes "Since active defense [fighting] has not been observed in the ruffed grouse, recognition of boundaries of the occupied areas is not evident. The several observations on the overlappings of occupied areas in the spring suggests that [territorial] boundaries are not sharply defined."

*Historical status.*—Drumming logs and activity centers are considered to be either *transient* (used by one grouse for his lifetime and generally not used again for many years) or *perennial* (used year after year by a succession of grouse). Three combinations of these situations can be recognized: the transient log which is the focal point of a transient activity center; the transient log which is but one of a number of logs used over a period of years, but all located within a single perennial activity center; and the perennial log which is also the focal point of a perennial activity center.

Some exceptions to these generalized combinations occur. Frequently a second male grouse, apparently having had contact with the previous occupant, will use a transient log briefly after his predecessor's disappearance, but once this second bird has died the log becomes inactive for an indefinite period of time. Also, occasionally an individual male grouse will use a transient log in a perennial center rather than the perennial log which normally has been used.

The crucial test for the perennial status of a log comes when an activity center has been vacant for two or more drumming seasons and a new occupant, with no possible contact with his predecessors, uses the same drumming stage on the same log. Until this occurs the status of a log may remain in doubt, since subsequent use may be based on an association between the replacement male and his predecessor while the latter was still active on the log.

However, many gradations between obviously perennial or transient logs occur, and it is not always easy to classify a log. Also, many logs and several centers cannot be classified at the present time, either because our contact with them has been of too short duration or too infrequent, or because one male has occupied the center so long that we have had no opportunity to see what the replacement pattern might be.

*Log status.*—Logs also may be classified according to the intensity with which they are used by individual grouse. The log used most persistently for drumming by a male Ruffed Grouse in a given season is

considered his *primary log* for that season. Often one or more additional logs are used voluntarily by the same bird during the same season, these being his *alternate logs*. Also, the disturbance created by placing traps on the primary and alternate logs sometimes forces male grouse to use *secondary logs* temporarily.

Seldom is a log used exclusively as a primary log over several years. Of the 190 transient logs in perennial centers which were used as primary logs, at least 97 (51 per cent) were used as alternate or secondary logs at some time during their history. Of the 57 perennial logs receiving primary use, 22 (39 per cent) were used in another way in one or more seasons. Often the perennial primary log was rated as an "alternate log" while an individual grouse was in the process of shifting his primary attention to that log from another. This occurred especially after the peak of the spring drumming season. In transient centers only 17 (19 per cent) of the 91 transient logs chosen to be primary logs were used as alternate or secondary logs at some other time.

Not all drumming is done in well defined situations. In some activity centers individual male grouse drifted from one log to another, choosing sites apparently at random and never using one log consistently enough for it to be called a primary log. There were also instances when a bird walked along ahead of an observer, drumming at regular intervals, each time from a different location, but these usually have been well established birds chased off their primary logs, and temporarily continuing to drum, even though they used nondescript sites.

*Challenge sites.*—Under conditions of exceptionally intense drumming activity (as occurred in 1961) some male grouse temporarily shift to logs not normally used, to engage in drumming "duels" with other males. These briefly used sites are referred to as *challenge sites*. Occasionally they were alternate logs of the males being challenged, but at other times the challenge site was any readily available site. In 1962, J. J. Kupa (unpublished data) recorded challenging by a male Ruffed Grouse carrying a miniature radio transmitter (RF [radio frequency] marked), which had moved north about 900 feet from his primary log and challenged the male using a perennial log about 200 feet from the challenge site.

The incidences of challenging are probably much more frequent than my assistants and I have recorded. During the particularly intensive drumming activity of the 1960 and 1961 seasons, we obtained a number of records of apparently extraneous drumming, heard only once or twice, in areas where we were unable to locate active logs. Since many of these occurrences were near logs being used intensively it seems probable that many represented challenging by male grouse normally active at more distant sites.

*Expanded occupancy.*—In 1965, with the density of drumming male Ruffed Grouse at a very low level in the area (about 4.4 males per square mile), several birds expanded their radii of activity to include two perennial activity centers, a behavior I have called *expanded occupancy*.

One of the males involved had dominated a perennial center (SE-66) since the spring of 1962, but in the middle of the 1965 drumming season he began moving to and from another perennial log 1,190 feet from his normally occupied center. Prior to the 1965 season this other log (66H10, Table 1) had been occupied continuously since 1959. Two different grouse had been successive residents there during the years this bird had remained exclusively in the SE-66 activity center.

A second male which was engaged in expanded occupancy was an immature replacement using a log between two perennial centers. He made heavy use of the perennial primary logs in both centers (C-48 and WC-49, 660 feet apart), occupying them as alternates to his primary log.

A third male used as his primary log one having had continuous use since at least 1962, and in 1965 he occasionally also went 800 feet south and across a creek to use logs in a perennial center (SC-104, Tables 1 and 7), vacant since the fall of 1962.

In 1966 a new occupant was established on log 66H10 and the older male remained in the SE-66 center he had occupied since at least 1962. Both of the other male grouse continued to occupy their expanded activity centers through the spring season of 1966.

I think that this expanded occupancy is related to the challenging discussed above. In all cases these birds moved nearer to other actively drumming grouse, from logs which were probably out of range of the sound of drumming by their nearest neighbors. R. W. Barrett (unpublished notes) documented a similar type of behavior by two RF-marked adult male grouse in 1965. One of these males spent as much, or more, time in vacant activity centers, or centers occupied by other males, as he did in the center he had occupied since the fall of 1962.

It should be noted that 74 (44 per cent) of the 168 banded male Ruffed Grouse known to have used drumming logs for 12 months or longer have, voluntarily, permanently shifted their primary activity from one log to another one or more times. This will be discussed in more detail in another paper (Gullion and Eng, MS).

#### CLASSIFICATION OF MALE GROUSE

*Dominant bird.*—The status of an individual male Ruffed Grouse in an activity center or in reference to his drumming activity may be de-

fined in several ways. The *dominant* bird is the normal occupant of the primary log and the male grouse which is heard drumming most frequently. The majority of the activity centers on the Cloquet Forest are apparently occupied only by the dominant male each season.

The dominant male can be further classified with reference to prior use of the log or center and the bird's possible contact with his predecessor. Thus, a male making an initial appearance on a log is considered to be one of the following: a *new* drummer, using a log which has not been used before for drumming, at least within the last four or five years; a *replacement* drummer, using a log immediately (within five to six months) following the disappearance of his predecessor (this category implies possible contact between the two males and a prior association of drumming activity with this log); a *displacement* drummer, a usually superior bird dislodging another grouse from a log; or a *repeat* drummer, a male using a perennial log but with no likelihood of contact with his predecessor or association of earlier drumming activity with this log.

*Alternate drummer.*—In at least four activity centers a second, or *alternate*, drummer has usually been present. The alternate bird is seldom heard drumming but is frequently seen in the activity center, especially when the dominant bird is drumming. This bird can usually be identified as a male when he fans his tail and struts away at the approach of an observer (although hens will also do this). We have trapped and banded at least seven alternate males, all immature birds. In a few instances alternate males have been heard drumming on another log in an activity center when the dominant drummer was confined in a trap. In these centers, the dominant male can be removed with no interruption in drumming activity, or in accumulation of droppings, since the alternate drummer immediately assumes the status of dominance.

In 1959, a bird was killed on his drumming log by a Goshawk (*Accipiter gentilis*) one morning, and his alternate was trapped on the same log less than 24 hours later. In 1961, the remains of a male were found scattered in a black spruce (*Picea mariana*) bog about 1,450 feet from his primary log. Since there had been no apparent interruption in drumming activity, or especially in dropping accumulations on his log, a mirror-trap was placed on the log. A replacement bird was caught six days later. This second bird was surely present in this activity center while his predecessor was alive.

*Satellite drummers.*—Occasionally a dual or shared occupancy of certain activity centers has been noted, with two males using nearby logs. In this situation the bird using the perennial log is considered the dominant male, and his nearby rival as his *satellite* drummer. In 1961, under intensive drumming pressure, seven satellite drummers were present in the

Forest, but normally no more than one or two birds a year, if any, could be placed in this category.

One example from 1961 illustrates the role of the satellite drummer. The SW-33 activity center was used by drumming Ruffed Grouse in 1932, 1933, 1934, 1949, and 1950, and continuously each year from 1957 through 1966. Since 1958 there has been an unbanded replacement (usually adult) present each spring, except in 1963 and 1966. This center has been a typical example of transient log use in a perennial center, with replacement birds normally selecting a log different from the one used by the predecessor. Also, there normally was an alternate drummer present. However, in 1961, in contrast to the earlier situation with dominant and alternate drummers, a second male became a satellite drummer, and he and the dominant often engaged in lengthy drumming duets.

On the morning of 27 April, both of these birds were captured in traps set 79 feet apart at their respective drumming stages. The dominant bird was an adult replacement on a log used in 1960 and the satellite bird was on a log last used in 1958. The dominant adult male weighed 625 grams and the immature satellite weighed 621 grams. Thus, in an area where one male usually was a dominant drummer, two males, both evenly matched physically, came into contact in 1961 and the two shared the activity center. As had been the rule in this activity center, both of these males failed to survive to the next spring, and they were replaced in 1962 by another red-phase, adult bird together with a red-phase, alternate male whose age was unknown.

*Non-drummers.*—There is another group of male Ruffed Grouse which are *non-drummers*. They seem to be virtual phantoms and do not become established in definite activity centers. If they drum at all, they do so very infrequently, and they constitute an almost unknown quantity in our study of grouse behavior and population dynamics (Gullion, 1966). Although, over the past 10 years, we have trapped and banded 11 males and have recovered predator kills, road kills, and hunter kills of 8 more which apparently belonged in this category, we still do not know much about the size of this segment of the population or its role in the life history of this species.

These birds are distinct from the alternate male group, although both groups are probably "silent" throughout most of the drumming season. The alternate males are associated with a specific activity center and actively used drumming logs, whereas the non-drummers are known not to be associated with any activity centers or logs, but rather seem to be free agents in the population. Presumably most of the birds in this

TABLE 1  
SPRING USE HISTORY OF SOME PERENNIAL DRUMMING LOGS AND THE  
COLOR PHASE OF MALES USING THESE LOGS<sup>1</sup>

| Activity<br>center | Log <sup>2</sup> | Year           |     |                |     |     |       |                 |     |      |     |
|--------------------|------------------|----------------|-----|----------------|-----|-----|-------|-----------------|-----|------|-----|
|                    |                  | 1956           | '57 | '58            | '59 | '60 | '61   | '62             | '63 | '64  | '65 |
| SW-5               | 5C9              | G <sup>3</sup> | G   | v              | R   | R   | O     | O               | O   | v    | v   |
| NE-18              | 18K2             | -              | v   | v              | G   | R   | G     | O               | G   | v    | v   |
| EC-19              | 19G2             | -              | G   | G              | G   | G   | Ge    | v               | G   | v    | v   |
| WC-24              | 24D7             | v              | G   | O-?a           | G   | G   | O     | O               | G   | O    | R   |
| SE-25              | 25B2             | v              | G   | O              | G   | R   | G     | O               | O   | Re   | v   |
|                    | (25A2)           | R              | v   | v              | v   | v   | v     | v               | v   | v    | v   |
| NE-32              | 32G2             | -              | G   | R              | R   | G   | G     | G               | O   | O    | O   |
| NE-42              | 42J2             | -              | -   | G              | R   | R   | Rk    | Ge              | v   | v    | v   |
| SC-49              | 49B5             | v              | v   | G              | R   | O   | R     | O               | R   | v    | v   |
|                    | (49D6)           | G              | v   | v              | v   | al  | v     | v               | v   | v    | v   |
| SC-55              | 55B6             | -              | ?   | R              | O   | O   | G     | al              | al  | al   | v   |
|                    | (55B7)           | -              | -   | v              | v   | v   | v     | G               | O   | R    | v   |
| EC-57              | 57E4             | -              | G   | O              | G   | G   | Rk-Gs | Gk <sup>4</sup> | v   | v    | v   |
| NC-59              | 59J4             | -              | -   | -              | G   | G   | G     | R               | O   | v    | v   |
| SW-62              | 62A9             | -              | -   | G              | v   | Ok  | v     | v               | G   | v    | v   |
|                    | (123K8)          | -              | -   | v              | G   | al  | al    | al              | v   | v    | v   |
|                    | (62A9A)          | -              | -   | t              | t   | v   | Ok    | O               | v   | v    | v   |
|                    | (123J9)          | -              | -   | -              | -   | -   | -     | -               | -   | Ok   | O   |
| WC-66              | 66H10            | -              | v   | v              | G   | O   | G     | O               | O   | Oe/G | X   |
|                    | (66E9)           | -              | v   | ? <sup>3</sup> | n   | n   | n     | n               | n   | n    | n   |
| EC-76              | 76D2             | v              | v   | v              | R   | Oe  | v     | al              | R   | O    | O   |
|                    | (76F3)           | v              | v   | v              | v   | v   | v     | G               | v   | v    | v   |
| SC-104             | 104A6            | G              | G   | v              | R   | R   | G     | v               | v   | v    | X   |
|                    | (104B4)          | v              | v   | v              | v   | al  | v     | G               | v   | v    | v   |

<sup>1</sup> See Key to Symbols.

<sup>2</sup> Log numbers in parentheses are transient logs which occasionally were used, instead of the perennial log, as the primary log.

<sup>3</sup> Log severely affected by logging or forest management activities.

<sup>4</sup> Same bird as in 1960.

KEY TO SYMBOLS USED IN TABLES

|  |   |
|--|---|
| A = adult  | k = bird known to have shifted from another log                               |
| (A) = adult but age of prior occupant unknown            | n = log not usable as result of forest cutting or other environmental change  |
| G = gray-phase male                                      | s = satellite bird  |
| I = immature   | sl = log used only as secondary log   |
| O = same individual as preceding year                    | t = tree not fallen (log non-existent)  |
| P = primary use  | u = log location unknown  |
| Pr = primary log used by replacement bird in same season | v = log vacant  |
| R = red-phase male                                       | - = log not located   |
| S = log used by satellite bird                           | ? = bird present but age and/or color not known                               |
| X = log used during expanded occupancy                   | / = early use by the first bird and replacement or displacement by the second |
| a = alternate bird                                       |   |
| al = log used only as alternate log                      |   |
| e = log active only prior to 20 April                    |   |



group are young male grouse unable to find suitable locales for drumming activity in their first year (see Dorney and Kabat, 1960: 18).

We have particularly good records concerning at least four males in this category. For example, one male was originally trapped when he was 17+ weeks old, on 9 October 1959. He was retaken at the same trap-site on 18 October 1960, although there was no indication that he occupied a drumming log in the spring of 1960. However, in April, 1961, he became active on a perennial log, 890 feet from where he had been trapped, only to be displaced by a superior younger male, whereupon he assumed a satellite drummer status.

#### HISTORICAL RECORD OF DRUMMING SITES

*Use of perennial logs.*—At least 57 drumming logs on the study area have been used as primary logs with enough persistence to be classified as perennial logs. Table 1 shows the record of use and re-use of 15 representative perennial logs.

The reason for repeated and persistent use of certain logs is not clear. Their physical characteristics certainly do not differ sufficiently from other logs to suggest a preferred physical situation, nor does the biotic environment differ from that of logs showing less persistent use. However, it is apparent that perennial logs act as definite "ecological magnets" (borrowing the term from Hickey, 1942), even attracting birds previously established on other, seemingly satisfactory logs. At least 23 grouse spending one or more drumming seasons on a transient log have abandoned the initial drumming site and moved to a perennial log. In at least one instance, a male, after having spent two years in a transient center, displaced another male to use a perennial log; the displaced male returned a year later to occupy the perennial log again (Table 1, log 57E4).

The perennial log and activity center are seldom the most secure habitat for male Ruffed Grouse. We have survival data which clearly show that the birds using perennial logs have an appreciably shorter life expectancy than those using transient logs. As will be discussed in another paper (Gullion and Marshall, MS) this seems to be the result of raptors recognizing that certain sites are preferred by grouse and "learning" how to hunt grouse successfully in these specific areas.

*Use of transient logs in perennial activity centers.*—In the Cloquet Forest area, at least 35 activity centers are recognized as being perennial but with transient use of the logs within the center. Table 2 shows the history of log use in 7 representative centers of this type.

The logs used as primary drumming sites in these perennial centers usually change from bird to bird, and it is not uncommon for logs which have been used as primary logs by one grouse to be used as alternate logs

TABLE 2  
TRANSIENT LOG STATUS AND SPRING USE IN SOME REPRESENTATIVE  
PERENNIAL ACTIVITY CENTERS<sup>1</sup>

| Activity center | Log    | Year |     |     |     |     |     |     |     |     |     |
|-----------------|--------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                 |        | 1956 | '57 | '58 | '59 | '60 | '61 | '62 | '63 | '64 | '65 |
| SE-8            | 8B2    | P    | v   | v   | v   | v   | v   | sl  | v   | ?   | al  |
|                 | 8B4    | -    | -   | -   | P   | P   | Pe  | P   | v   | v   | P   |
|                 | 8A4    | al   | v   | v   | v   | v   | Pr  | v   | v   | v   | v   |
|                 | 13H4   | -    | -   | -   | -   | -   | S   | v   | v   | v   | v   |
|                 | 8C3    | -    | -   | -   | -   | -   | -   | S   | v   | ?   | v   |
| C-18            | 18D7   |      | P   | v   | v   | v   | v   | v   | v   | v   | v   |
|                 | 18B6   |      | -   | P   | v   | v   | v   | v   | v   | v   | v   |
|                 | 18B5   |      | -   | -   | Pe  | v   | v   | v   | v   | v   | v   |
|                 | 18D4   |      | -   | -   | Pr  | P   | v   | al  | v   | v   | v   |
|                 | 18F5   |      | -   | -   | -   | -   | -   | P   | P   | al  | P   |
|                 | 18F3   |      | -   | -   | -   | -   | -   | -   | al  | P   | al  |
| NE-24           | 24H3   | P    | P   | v   | v   | v   | v   | al  | v   | v   | v   |
|                 | 24J4   | -    | -   | -   | P   | al  | v   | v   | v   | v   | v   |
|                 | 24G3   | -    | -   | -   | -   | Pe  | u   | -   | -   | -   | -   |
|                 | 24J2   | -    | -   | -   | -   | -   | P   | S   | v   | ?   | v   |
|                 | 24J4A  | t    | t   | t   | t   | t   | -   | P   | P   | ?   | v   |
| WC-29           | 29D7   |      |     | P   | v   | v   | al  | v   | v   | al  | P   |
|                 | 29D9   |      |     | -   | P   | P   | v   | v   | v   | v   | v   |
|                 | 29E7   |      |     | -   | ?   | v   | al  | P   | al  | P   | al  |
|                 | 29D7A  |      |     | -   | -   | -   | P   | v   | v   | v   | al  |
|                 | 29D7B  |      |     | -   | -   | -   | -   | -   | P   | al  | al  |
| NE-31           | 31K2   |      | P   | v   | al  | al  | al  | al  | v   | v   | v   |
|                 | 31G4   |      | ?   | P   | P   | P   | al  | S   | v   | v   | v   |
|                 | 31J3   |      | -   | -   | S   | S   | P   | P   | P   | P   | P   |
| SW-33           | 33C10  |      | P   | P   | v   | v   | S   | al  | v   | v   | v   |
|                 | 34C1   |      | -   | -   | P   | P   | al  | v   | v   | ?   | v   |
|                 | 33B10  |      | -   | -   | al  | al  | P   | al  | Pe  | v   | v   |
|                 | 33B10A |      | -   | -   | -   | -   | al  | P   | Pr  | v   | v   |
|                 | 33C10A |      | -   | -   | -   | -   | -   | al  | v   | v   | al  |
|                 | 34D2   |      | -   | -   | -   | -   | -   | -   | -   | -   | P   |
| 34E2            |        | -    | -   | -   | -   | -   | -   | -   | -   | al  |     |
| SC-103          | 103A5  | P    | al  | P   | al  | v   | v   | v   | v   | v   | v   |
|                 | 103A4  | -    | P   | v   | v   | v   | v   | v   | v   | v   | v   |
|                 | 1H7    | -    | -   | S   | v   | P   | v   | v   | v   | v   | v   |
|                 | 103B5  | t    | t   | t   | t   | -   | P   | P   | v   | v   | v   |
|                 | 1J7    | t    | t   | t   | t   | t   | -   | S   | P   | P   | P   |

<sup>1</sup> See Key to symbols.

by later drummers. Some logs have been used rather consistently over a period of several years, even though they were the primary log of only one male.

*Use of transient logs and centers.*—There has been some problem in defining transient use of centers—when we go back to the 1930's and the intervening years, there are only a few areas on the Cloquet Forest which have not been used as drumming activity centers at some time

or another. Therefore, in contradiction to the treatment used in an earlier paper (Gullion, King, and Marshall, 1962) it seems useful to place an arbitrary limit on the interval between periods of use in order to define the difference between perennial and transient use. An interval of five years (10 drumming seasons) of non-use has been chosen as time enough to indicate that the use of a certain log or center is transient.

In the past 10 years, 91 different centers have been used on a transient basis. However, as Table 3 shows, there does not seem to be any great change in the percentage of logs used on a transient basis as population densities rise and fall.

*Seasonal use.*—Although less actual drumming is heard in the fall, attendance at logs is nearly as common then as it is in the spring, and often intensity of log attendance in the fall exceeds that by the same bird in the spring. Frequently, logs which are used as alternate logs in the spring will be used by the same bird as a primary log in the fall, and vice versa. Although it is considerably more difficult in the fall than in the spring to obtain a good estimate of the number of male grouse active on drumming logs, my data indicate that the density of males associated with logs in the fall is very close to that of the spring season.

Summer use of about one-fourth to one-third of the logs active in the spring has been noted. This is indicated by body, wing, and tail feathers which have been molted and are present near the logs. Often as many as four or five primary remiges will be present, and frequently rectrices are found which match those collected from the occupant of the log in the spring.

*Time of log selection.*—Although most use of drumming logs by young male Ruffed Grouse appears to commence in April or early May, when the birds are about 10 to 11 months old, at least a few young males become established on logs in the fall, when no older than 17 to 20 weeks. Surprisingly, these young birds usually choose perennial logs, often under conditions where there was no possible contact with their predecessor.

Examples include a male who was first seen on a perennial log on 6 October 1959 and was trapped and banded there on 8 October, at an age of about 17 weeks. There was prior use of this log as late as 18 May 1959 (about three weeks before this young bird hatched) but no evidence of summer use.

Another example is a young bird first heard drumming on the evening of 20 October 1960, at an age of about 18 weeks. He was trapped and banded on 21 October and continued making heavy use of this perennial log through the fall of 1960. His immediate predecessor on this log was killed about 6 April 1960, or about eight weeks before this young male hatched.

TABLE 3  
NUMBER OF OCCUPIED PERENNIAL AND TRANSIENT  
DRUMMING ACTIVITY CENTERS

| Season <sup>1</sup> | <i>Perennial centers</i> |                          | <i>Transient centers</i> | <i>Per cent transient</i> | <i>Status uncertain</i> <sup>2</sup> |
|---------------------|--------------------------|--------------------------|--------------------------|---------------------------|--------------------------------------|
|                     | <i>Perennial log use</i> | <i>Transient log use</i> |                          |                           |                                      |
| 1956                |                          |                          |                          |                           |                                      |
| Spring              | 6                        | 12                       | 8                        | 77                        | 0                                    |
| Fall                | 5                        | 11                       | 9                        | —                         | 0                                    |
| 1957*               |                          |                          |                          |                           |                                      |
| Spring              | 11                       | 18                       | 11                       | 72                        | 0                                    |
| Fall                | 8                        | 12                       | 10                       | —                         | 0                                    |
| 1958*               |                          |                          |                          |                           |                                      |
| Spring              | 16                       | 22                       | 16                       | 70                        | 0                                    |
| Fall                | 21                       | 17                       | 18                       | —                         | 0                                    |
| 1959*               |                          |                          |                          |                           |                                      |
| Spring              | 31                       | 34                       | 19                       | 63                        | 3                                    |
| Fall                | 27                       | 29                       | 14                       | —                         | 1                                    |
| 1960                |                          |                          |                          |                           |                                      |
| Spring              | 33                       | 33                       | 25                       | 64                        | 7                                    |
| Fall                | 34                       | 31                       | 18                       | —                         | 4                                    |
| 1961*               |                          |                          |                          |                           |                                      |
| Spring              | 37                       | 42                       | 29                       | 66                        | 18                                   |
| Fall                | 31                       | 35                       | 22                       | —                         | 11                                   |
| 1962*               |                          |                          |                          |                           |                                      |
| Spring              | 29                       | 43                       | 27                       | 71                        | 5                                    |
| Fall                | 25                       | 26                       | 10                       | —                         | 16                                   |
| 1963*               |                          |                          |                          |                           |                                      |
| Spring              | 27                       | 34                       | 13                       | 64                        | 28                                   |
| Fall                | 23                       | 30                       | 5                        | —                         | 17                                   |
| 1964                |                          |                          |                          |                           |                                      |
| Spring              | 20                       | 19                       | 4                        | 54                        | 14                                   |
| Fall                | 11                       | 26                       | 1                        | —                         | 15                                   |
| 1965*               |                          |                          |                          |                           |                                      |
| Spring              | 10                       | 23                       | 1                        | 71                        | 33                                   |

<sup>1</sup> The increasing numbers of birds from 1956 to 1963 and in 1965 represent an increased sampling area, not an increase in drumming activity. Years marked with an asterisk are not comparable with the preceding year.

<sup>2</sup> The percentage of centers of uncertain status increases towards the current year since several years of contact with a center are needed to determine its proper status, and as additional areas were added to the study area more centers with short histories are included.

In 1964 a male, banded as a 10-week-old juvenile on 16 August, was actively using a transient drumming log on 21 October, at an age of 19 weeks; another young male was active on another transient log as early as 10 October, at a probable age of 17 weeks.

There undoubtedly have been several more young males which have become established on drumming logs in the area early in the fall, but others are not as well documented as are these four.

Evidence in the form of small accumulations of droppings on many scattered logs in the fall, representing two or three hours on one log and then another, and still another, bear witness to much apparent

TABLE 4  
AGE STRUCTURE OF THE DRUMMING MALE RUFFED GROUSE POPULATION

| Year | Minimum age (in months) <sup>1</sup> |      |      |     |     |     |                | Sample size |
|------|--------------------------------------|------|------|-----|-----|-----|----------------|-------------|
|      | 10                                   | 22   | 34   | 46  | 58  | 70  | 82             |             |
| 1956 | 50 <sup>2</sup>                      | 50   | —    | —   | —   | —   | —              | 20          |
| 1957 | 48                                   | 38   | 14   | —   | —   | —   | —              | 29          |
| 1958 | 44                                   | 48   | 4    | 4   | —   | —   | —              | 50          |
| 1959 | 49                                   | 37   | 14   | 0   | 0   | —   | —              | 74          |
| 1960 | 37                                   | 31   | 23   | 9   | 0   | 0   | —              | 79          |
| 1961 | 46                                   | 35   | 11   | 8   | 0   | 0   | 0              | 103         |
| 1962 | 40                                   | 33   | 15   | 6.5 | 5.5 | 0   | 0              | 92          |
| 1963 | 42                                   | 29   | 14.5 | 8.5 | 3.5 | 2.5 | 0              | 83          |
| 1964 | 30                                   | 37.5 | 20   | 7.5 | 2.5 | 2.5 | 0              | 40          |
| 1965 | 49                                   | 24   | 16   | 7   | 2   | 0   | 2 <sup>3</sup> | 55          |

<sup>1</sup> Some adults may have been more than two years old (22 months) when they were first taken.

<sup>2</sup> Figures represent percentages. The higher rate of loss among grouse back-tagged in 1958 and earlier is thought to be responsible for the lack of grouse in the older age classes (zero percentages) in the years 1959 through 1964 (see Gullion, Eng, and Kupa, 1962). Also, the lack of previously banded grouse precludes identification of birds in the age classes where dashes are shown.

<sup>3</sup> Represents one bird, which died in April, 1966, at an age of 94 months.

“testing” of different sites by males seeking a suitable log. Often these scattered groups of droppings in the fall can never be related to a drummer subsequently established in the vicinity, indicating either a loss of the interested bird, or his having moved on to some other area before selecting a log.

On at least seven occasions, heavy fall use (in the order of 140 to 443 droppings, representing 35 to 110 hours) has been recorded for logs where there was no spring occupant, either before or afterwards. These birds were either lost over winter or moved to other, distant sites by the next spring.

#### AGE STRUCTURE OF ESTABLISHED DRUMMERS

Table 4 shows the age structure of identified male grouse using drumming logs on the Cloquet study area each year since 1956. Most noteworthy is the slow appearance of young males as active drummers. Consistently the percentage of young males active on logs remains at or below 50 per cent, yet other indices of age composition indicate that the young grouse should comprise at least 60 per cent of the male population. This further suggests the possible proportion of young, non-drumming males which may be present but not attached to a specific drumming log or activity center each spring.

This uncertain proportion of unattached young males makes it hazardous to estimate overwinter survival based on the percentage of marked young males using drumming logs.

TABLE 5  
 COLOR PHASE OF DRUMMING MALE RUFFED GROUSE USING  
 TRANSIENT LOGS IN SOME PERENNIAL ACTIVITY CENTERS<sup>1</sup>

| Activity center | Year |     |      |      |      |      |      |      |     |     |
|-----------------|------|-----|------|------|------|------|------|------|-----|-----|
|                 | 1956 | '57 | '58  | '59  | '60  | '61  | '62  | '63  | '64 | '65 |
| NE-3            | G    | O   | O    | R    | v    | R    | v    | R-Rs | G   | O   |
| SE-8            | G    | v   | v    | R    | G    | G-Rs | O-Rs | v    | ?   | G   |
| N-10            | R    | O   | v    | G    | G    | R    | R    | G    | O   | O   |
| SC-11           | G    | v   | G    | O    | R    | Re   | v    | R-Ra | v   | v   |
| C-11            | G    | O   | G-Gs | v    | ?    | G    | G    | v    | G   | R   |
| C-18            | -    | ?   | R    | Oe/G | O    | v    | R    | O    | O   | O   |
| NE-24           | R    | O   | v    | G    | ?e   | G    | G-Rs | Os   | ?   | v   |
| NW-26           | R    | O   | R    | R    | R    | G    | G    | O    | O   | v   |
| WC-29           | -    | v   | G    | G    | O    | G    | O    | G    | O   | O   |
| NE-31           | -    | G   | R    | O-?s | O-Gs | Os   | O-?s | G    | R   | O   |
| SW-33           | -    | ?   | G    | G-Ga | G-Ga | G-Rs | R-Ra | Re/R | ?   | G   |
| C-48            | v    | v   | v    | G    | O    | O    | G    | O    | v   | X   |
| NE-76           | G    | G   | v    | v    | G    | O    | O    | O-Rs | Os  | O   |
| SW-101          | G    | v   | v    | v    | ?    | G    | Oe/G | G    | v   | v   |
| SC-103          | G    | G   | O-Gs | R    | G    | O    | O-Gs | Os   | O   | O   |

<sup>1</sup> See Key to Symbols.

#### AGE AND COLOR PHASE OF GROUSE USING SPECIFIC SITES

As shown in Tables 1 and 5, birds of certain color phases tend to show a preference for certain drumming logs or activity centers. Normally about 35 per cent of the male grouse on the Cloquet Forest are red-phase birds, hence it would be expected that one out of three birds using a certain perennial log or a perennial activity center should be a red-phase bird. However, 9 perennial logs and 11 perennial centers have been the exclusive domain of gray-phase males, to the total exclusion of the red birds. Only 2 perennial logs, and 2 perennial centers have been used exclusively by red males. Table 6 summarizes these data.

Similarly, certain activity centers tend to attract adult male Ruffed Grouse as replacements for the former occupants (Tables 7 and 8). These birds apparently are drawn from a "reservoir" of non-drumming males which seem always to be present in a Ruffed Grouse population (Dorney and Kabat, 1960: 18-19; Eng and Gullion, 1962: 239). It is also possible that some of these birds were active in preceding years on logs which were not located (and perhaps the birds were never heard) and were first contacted when they shifted to known perennial sites, responding to the attraction of the "ecological magnet" mentioned above. Also, movement in from outside the study area is possible, since a few adult male grouse in the Cloquet area have moved substantial distances in the fall from the areas they had occupied the previous spring (P. Schladweiler, "Movements and activities of Ruffed Grouse [*Bonasa umbellus* L.] during the summer period," Master's thesis, University of Minnesota, 1965; Gullion and Eng, MS).

TABLE 6  
NUMBERS OF DRUMMING ACTIVITY CENTERS OCCUPIED BY VARIOUS  
COMBINATIONS OF COLOR PHASES OF MALE RUFFED GROUSE

|   |   | <i>Number of individual red-phase grouse</i> |    |   |   |   |
|---|---|--|----|---|---|---|
|   |   | 0  | 1  | 2 | 3 | 4 |
| <i>Number of individual gray-phase grouse</i> | 0 | -  | 24 | 4 | 1 | 0 |
|   | 1 | 49   | 21 | 9 | 0 | 2 |
|   | 2 | 18   | 10 | 7 | 3 | 2 |
|   | 3 | 5  | 7  | 4 | 2 | 0 |
|   | 4 | 2  | 3  | 2 | 1 | 0 |
|   | 5 | 3  | 0  | 1 | 1 | 0 |
|   | 6 | 0  | 0  | 0 | 0 | 0 |
|   | 7 | 1  | 0  | 0 | 0 | 0 |

ACTIVITY CLUSTERING

The distribution of drumming activity centers in the past 10 years shows an interesting pattern of grouping so that *activity clustering* becomes apparent (Figure 1).

This pattern of the distribution of drumming male grouse varies and does not appear to be entirely related to population densities, but rather seems to reflect an attraction exerted by one, usually older, dominant male which induces other, younger birds to establish new drumming centers in the general proximity of his activity center.

The 31SE cluster provides a good example of this behavior (Figure 2). When this area was first studied in 1957, four drummers were present, all using drumming logs on the north side of this cluster. In 1958, at least five, and possibly six, males were active in this cluster (Figure 2, A). In 1959, the number of active males dropped to four, including two survivors from 1958 and one possibly from 1957. All four of the 1959 occupants were present in 1960 and they were joined by two more birds (Figure 2, B). In 1961, three of the males surviving from the preceding year were joined by five more (Figure 2, C), but in 1962 only three birds had survived from 1961 (one of these from 1958 on DL 54E4 and the other from 1959 on DL 75G6). Five new males joined these three in 1962, two on logs used in 1961 and one on a log not used since 1958 (Figure 2, D). In 1963, only four male grouse were present, three survivors from 1962, one of whom shifted 800 feet during the spring of 1963 to occupy a log left vacant (75G6) after the bird originally taken in 1959 was lost. In 1964, three of the 1963 birds were lost, but were replaced by two others, one occupying a perennial log used previously in 1958 and 1962. Only

TABLE 7  
AGES OF REPLACEMENT MALE GROUSE USING SOME PERENNIAL DRUMMING LOGS<sup>1</sup>

| Activity center <sup>2</sup> | Log <sup>3</sup> | Year |     |     |     |     |     |                |     |      |     |
|------------------------------|------------------|------|-----|-----|-----|-----|-----|----------------|-----|------|-----|
|                              |                  | 1956 | '57 | '58 | '59 | '60 | '61 | '62            | '63 | '64  | '65 |
| SW-5                         | 5C9              | (A)  | I   | v   | I   | ?   | (A) | O              | O   | v    | v   |
| NE-18                        | 18K2             | -    | v   | v   | I   | A   | I   | O              | I   | v    | v   |
| EC-19                        | 19G2             | -    | I   | I   | I   | I   | Oe  | v              | I   | v    | v   |
| WC-24                        | 24D7             | -    | I   | O   | I   | I   | O   | O              | I   | O    | I   |
| SE-25                        | 25B2             | -    | I   | O   | I   | I   | I   | O              | O   | ?    | v   |
|                              | (25A2)           | I    | v   | v   | v   | v   | v   | v              | v   | v    | v   |
| NE-32                        | 32G2             | -    | I   | I   | I   | I   | I   | I              | O   | O    | O   |
| NE-42                        | 42J2             | -    | -   | (A) | I   | I   | Ak  | Ie             | v   | v    | v   |
| SC-49                        | 49B5             | v    | v   | I   | A   | O   | I   | O              | I   | v    | v   |
|                              | (49D6)           | I    | v   | v   | v   | v   | v   | v              | v   | v    | v   |
| SC-55                        | 55B6             | -    | ?   | (A) | O   | O   | A   | al             | al  | al   | v   |
|                              | (55B7)           | -    | -   | -   | -   | -   | -   | ?              | (A) | A    | v   |
| EC-57                        | 57E4             | -    | (A) | O   | I   | I   | Ak  | A <sup>4</sup> | v   | v    | v   |
| NC-59                        | 59J4             | -    | -   | -   | (A) | A   | I   | I              | O   | v    | v   |
| SW-62                        | 62A9             | -    | -   | (A) | v   | O   | v   | v              | I   | v    | v   |
|                              | (123K8)          | -    | -   | v   | I   | al  | al  | al             | v   | v    | v   |
|                              | (62A9A)          | -    | -   | t   | t   | v   | O   | O              | a   | v    | v   |
|                              | (123J9)          | -    | -   | -   | t   | t   | t   | t              | -   | O    | O   |
| WC-66                        | 66H10            | -    | v   | v   | (A) | O   | I   | O              | O   | Oe/I | X   |
|                              | (66E9)           | -    | v   | ?   | n   | n   | n   | n              | n   | n    | n   |
| EC-76                        | 76D2             | v    | v   | v   | I   | Oe  | v   | al             | I   | O    | O   |
|                              | (76F3)           | v    | v   | v   | v   | v   | v   | I              | v   | v    | v   |
| SC-104                       | 104A6            | (A)  | I   | v   | I   | I   | I   | v              | v   | v    | X   |
|                              | (104B4)          | v    | v   | v   | v   | al  | v   | I              | v   | v    | v   |

<sup>1</sup> See Key to Symbols.

<sup>2</sup> Same centers and logs as in Table 1.

<sup>3</sup> Log numbers in parentheses are transient logs occasionally used instead of the perennial log.

<sup>4</sup> Same bird as in 1960.

the bird occupying the log in use since 1959 (75G6) survived to drum in 1965, but he was joined by a second bird.

Thus, in summary, beginning in 1957 there were four birds in this area; at least five in 1958, four, 1959; six, 1960; eight, 1961; eight, 1962; four, 1963; three, 1964; and two in 1965. It appears that the bird using DL 75G6 was the key bird in this area, and the long survival of the 1959 occupant of this log induced at least 11 other males to occupy adjacent activity centers over a three-year period.

Table 9 summarizes the changing status of 15 activity clusters which can be recognized on the Cloquet Forest (Figure 1). In addition to these multi-bird clusters, from year to year, there are varying numbers of "clusters" of two males in close association but not in a satellite situation.

#### EFFECT OF DRASTIC ENVIRONMENTAL CHANGE ON LOG USE

In the 10 years this study has been in progress, no fewer than 66 logs in 34 activity centers have been affected by forest cutting or other forest



TABLE 8  
AGES OF REPLACEMENT MALE RUFFED GROUSE USING TRANSIENT LOGS  
IN SOME PERENNIAL ACTIVITY CENTERS<sup>1</sup>

| Activity center | Year |     |      |      |      |      |      |      |     |     |
|-----------------|------|-----|------|------|------|------|------|------|-----|-----|
|                 | 1956 | '57 | '58  | '59  | '60  | '61  | '62  | '63  | '64 | '65 |
| NE-3            | (A)  | O   | O    | I    | v    | A    | v    | I-Is | I   | O   |
| SE-8            | I    | v   | v    | I    | I    | I-As | O-Is | v    | ?   | I   |
| N-10            | I    | O   | v    | I    | I    | I    | I    | I    | O   | O   |
| SC-11           | I    | v   | I    | O    | I    | Oe   | v    | A-?a | v   | v   |
| C-11            | (A)  | O   | I-Is | v    | ?    | I    | ?e   | v    | I   | I   |
| C-18            | -    | ?   | I    | Oe/I | O    | v    | I    | O    | O   | O   |
| NE-24           | (A)  | O   | v    | I    | ?e   | I    | O-Is | Os   | ?   | v   |
| NW-26           | (A)  | ?   | I    | I    | I    | I    | I    | O    | O   | v   |
| WC-29           | -    | v   | I    | I    | O    | I    | O    | I    | O   | O   |
| NE-31           | -    | (A) | A    | O-?s | O-As | Os   | O-?s | I    | ?   | (A) |
| SW-33           | -    | ?   | (A)  | A-?a | A-?a | A-Is | A-?a | Oe/I | ?   | I   |
| C-48            | v    | v   | v    | I    | O    | O    | I    | O    | v   | X   |
| NE-76           | I    | ?   | v    | v    | A    | O    | O    | O-Is | Os  | O   |
| SW-101          | I    | v   | v    | v    | ?    | (A)  | Oe/? | I    | v   | v   |
| SC-103          | (A)  | I   | O-Is | I    | I    | O    | O-Is | Os   | O   | O   |

<sup>1</sup> See Key to Symbols.

<sup>2</sup> Same centers as in Table 5.

management activities. Of the primary logs affected, 27 were buried under slash or disturbed to such an extent that they could no longer be used for drumming. Use subsequent to disturbance continued on 18 of 27 primary logs not badly disturbed.

Several specific instances could be cited showing the type of response to disturbance (in addition to those noted earlier, Gullion, King, and Marshall, 1962: 621). One example is perennial center NW-26, having a history of use dating from 1931 (Figure 3). A male grouse used DL 26G9 in 1956, but the 1957 status of this area was not clear. The 1958 replacement grouse used DL 26K9, which appears to have a record of use in 1931. In the fall of 1958, another bird began using DL 26F9, and he may be the same bird later trapped on DL 26F9 in the spring of 1959. This center, dominated by high-tree, closed-canopy jack pine (*Pinus banksiana*) (see Smith, 1958) proved to be an "ecological trap" for grouse, and annual turnover was the rule. A young male was the 1960 replacement, using DL 26E9 as his primary log, and 26F9, F8, and E7 as alternates. Again a young replacement grouse took over, using DL 26J9 in the fall of 1960, but moving onto a newly fallen jack pine, DL 26G9A, early in the spring of 1961 (Figure 4, C). This area was clear-cut of jack pine and aspen (*Populus tremuloides*) over the winter of 1961-62, and logs 26J9, K9, G9, F9, and E9 were all made unavailable for drumming (Figure 4, A and B). The 1962 replacement was again a young male and he chose an aspen log (DL 25A10) on the north edge of

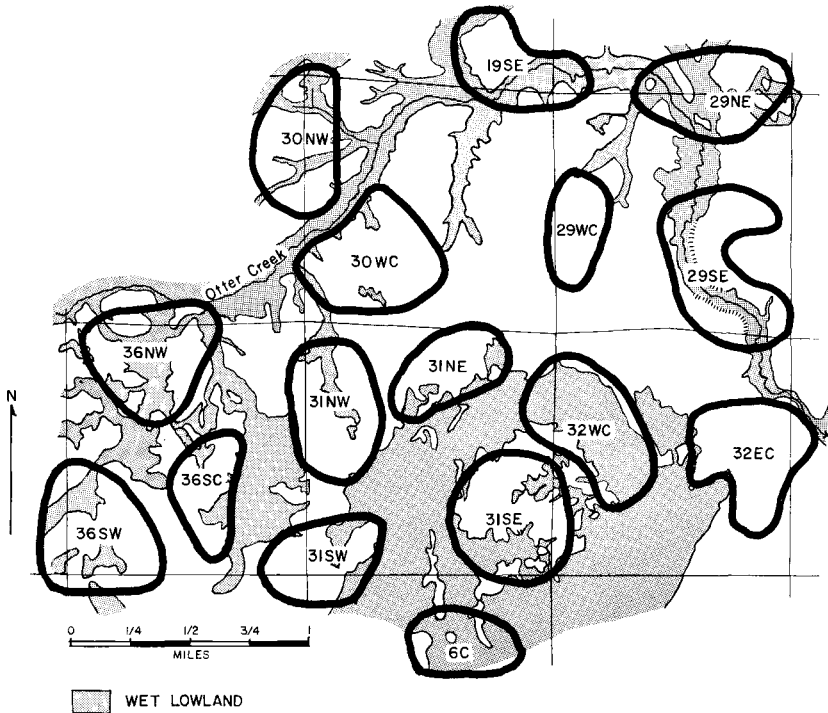
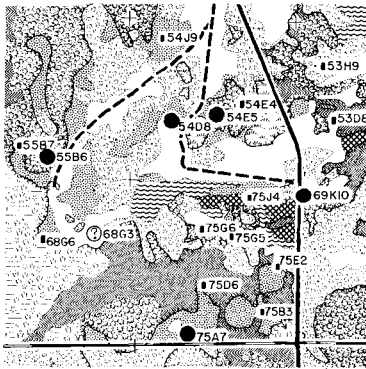


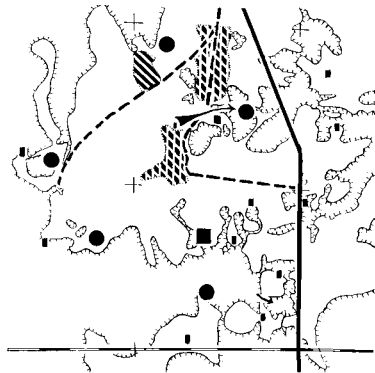
Figure 1. The distribution of drumming activity clusters on and adjacent to the Cloquet Forest Research Center.

Figure 2. The distribution of drumming activity in the 31SE activity cluster, in various years. For 1960–62 the “key log,” DL 75G6, is shown as a black square. The log shifting in 1960 was completed in the summer of 1959, before the aspen was cut. In 1961 the first bird on DL 75B3 shifted to satellite status on DL 75G5, being replaced (or displaced?) by the male originally established on DL 75E2. In 1962 the replacement male using DL 75G5 was again a satellite to DL 75G6.

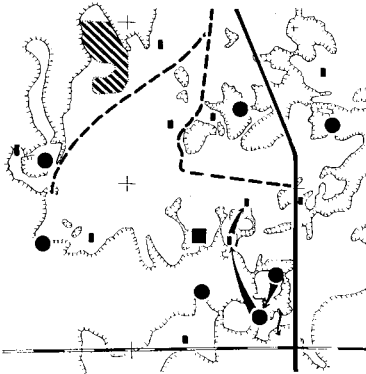
Aspen = an all-hardwood forest with aspen (*Populus tremuloides* and *P. grandidentata*) dominating, in association with paper-birch (*Betula papyrifera*) and red maple (*Acer rubrum*). Mixed Conifer-Hardwood = includes the above and balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), and/or various pines (*Pinus* spp.). Upland Spruce-Balsam = an upland all-conifer type with spruce, balsam fir, and scattered pines. Pine = pure or nearly pure stands of jack, white, or red pine (*P. banksiana*, *P. strobus*, *P. resinosa*). Upland Brush = brushy areas not dominated by a forest canopy; the dominant shrub is usually beaked hazel (*Corylus cornuta*), and may include various shrub dogwoods (*Cornus* spp.), cherries (*Prunus virginiana* and *P. pensylvanica*), june-berry (*Amelanchier* spp.), and willows (*Salix* spp.). Lowland Hardwoods = a boggy, open forest type with black ash (*Fraxinus nigra*) prominent, in association with yellow birch (*B. lutea*) and often with scattered spruce, tamarack (*Larix laricina*), and balsam fir. Lowland Conifer = a boggy, usually dense, conifer forest generally dominated by black spruce (*P. mariana*) in association



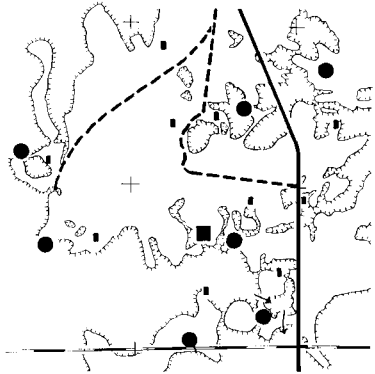
A. 1958 STATUS & VEGETATION TYPES



B. 1960 STATUS



C. 1961 STATUS



D. 1962 STATUS



SCALE

LEGEND

- |                              |                          |                      |
|------------------------------|--------------------------|----------------------|
| ■ VACANT DRUMMING LOG        | VEGETATION TYPES         |                      |
| ● OCCUPIED DRUMMING LOG      | □ ASPEN                  | ▨ LOWLAND HARDWOODS  |
| + 40 ACRE COMPARTMENT CORNER | ▨ MIXED CONIFER-HARDWOOD | ▨ LOWLAND CONIFER    |
| - - - UPLAND-LOWLAND BORDER  | ▨ UPLAND SPRUCE-BALSAM   | ▨ LOWLAND BRUSH      |
| ▬ PAVED COUNTY HIGHWAY       | ▨ PINE                   | ▨ MARSH-MUSKEG       |
| ▬ GRAVELLED COUNTY ROAD      | ▨ UPLAND BRUSH           |                      |
| ▬ WOODS ROAD                 |                          |                      |
| ▬ SHIFTING MOVEMENT          | RECENT FOREST CUTTING    |                      |
|                              | ▨ ASPEN                  | ▨ MIXED BALSAM-ASPEN |

with balsam fir, tamarack, and sometimes white cedar (*Thuja occidentalis*). Lowland Brush = a bog shrub type usually dominated by speckled alder (*Alnus rugosa*), in association with mountain maple (*A. spicatum*), red-osier dogwood (*C. stolonifera*), willows, bog birch (*B. pumila*), and meadow-sweet (*Spiraea alba*). Marsh-Muskeg = boggy areas lacking significant tree or brush cover. There seldom is any brush in Upland Spruce-Balsam, Pine, and Lowland Conifer. Upland Brush is always present in at least moderate density in Aspen and Mixed Conifer-Hardwood. Lowland Brush is always in Lowland Hardwood. Recent Forest Cutting = timber harvesting done in the preceding 12 months. Scale: 1 inch = 1,500 feet.

TABLE 9  
NUMBER OF DRUMMING MALE RUFFED GROUSE IN SOME ACTIVITY CLUSTERS

| Activity cluster <sup>1</sup> | Year <sup>2</sup> |     |       |      |     |      |      |     |     |     |
|-------------------------------|-------------------|-----|-------|------|-----|------|------|-----|-----|-----|
|                               | 1956              | '57 | '58   | '59  | '60 | '61  | '62  | '63 | '64 | '65 |
| 29SE                          | (10)              | 7   | 8     | 8    | 8   | 8    | 7    | 8   | 6   | 4   |
| 29NE                          | 3                 | 4   | 4     | 3    | 5   | 7    | (10) | 9   | 6   | 5   |
| 32EC                          | 2                 | 2   | 3     | 4    | (6) | 5    | 3    | 5   | 4   | 3   |
| 30WC                          | —                 | 5   | 6     | (7)  | 6   | 5    | 4    | 4   | 1   | 1   |
| 31NE                          | —                 | 3   | 4     | 5    | (6) | 5    | (6)  | 5   | 2   | 2   |
| 31NW                          | —                 | 5   | 5     | (10) | 9   | 9    | 8    | 5   | 2   | 3   |
| 31SW                          | —                 | 1   | 1     | 6    | 5   | (7)  | (7)  | 4   | 3   | 1   |
| 31SE                          | —                 | 4   | 5 + ? | 4    | 6   | (8)  | (8)  | 3   | 3   | 2   |
| 19SE                          | —                 | —   | 2     | 4    | 5   | (9)  | 4    | 5   | 4   | 2   |
| 36SW                          | —                 | —   | 4     | 7    | 9   | (13) | 7    | 5   | 2   | 2   |
| 32WC                          | —                 | —   | —     | 6    | 7   | (9)  | 8    | 4   | 2   | 2   |
| 36NW                          | —                 | —   | —     | 7    | 6   | 6    | (8)  | 3   | 3   | 1   |
| 36SC                          | —                 | —   | —     | 8    | (9) | 5    | 5    | 4   | 2   | 1   |
| 30NW                          | —                 | —   | —     | 3    | 4   | 4    | (5)  | 4   | 2   | 2   |
| 6C                            | —                 | —   | —     | —    | —   | (5)  | 4    | 4   | 1   | 1   |

<sup>1</sup> See Figure 1 for map showing these clusters.

<sup>2</sup> Figures in parentheses represent peak numbers in each activity cluster. A dash indicates that this cluster was not examined thoroughly enough for all active drummers to have been located.

this activity center as his primary log, and the exposed root of a white spruce (*Picea glauca*), where he was trapped, as his alternate (Figure 4, D). This root (DL 26K9A) is only 33 feet from DL 26K9. In the summer of 1962 more cutting of jack pine and aspen was done in the area but no more logs were destroyed or buried. Perhaps significantly, the 1962 occupant was the first male grouse to survive more than one winter in this activity center, and his survival followed the removal of the closed-canopy, high-tree jack pine. He was finally lost in the summer of 1964 (Tables 5, 8).

Since all the activity centers which have been logged off have had similar histories, it is apparent that as long as the specific drumming stages or logs are not destroyed or made unavailable (and a food resource remains), the conversion of a forest environment from a closed-canopy pine stand to an open, brushy area, usually with scattered red and white pine (*Pinus resinosa* and *P. strobus*), paper birch (*Betula papyrifera*) spruce, and balsam (*Abies balsamea*), will not discourage continued use of perennial activity centers by male Ruffed Grouse and probably increases the birds' individual security and survival. However, if the mature aspen (*Populus tremuloides* or *P. grandidentata*) is also removed at the time the pine is cut, the overwinter food resource for grouse in this region is eliminated and the activity center will, in all probability, become vacant when the resident male grouse dies.

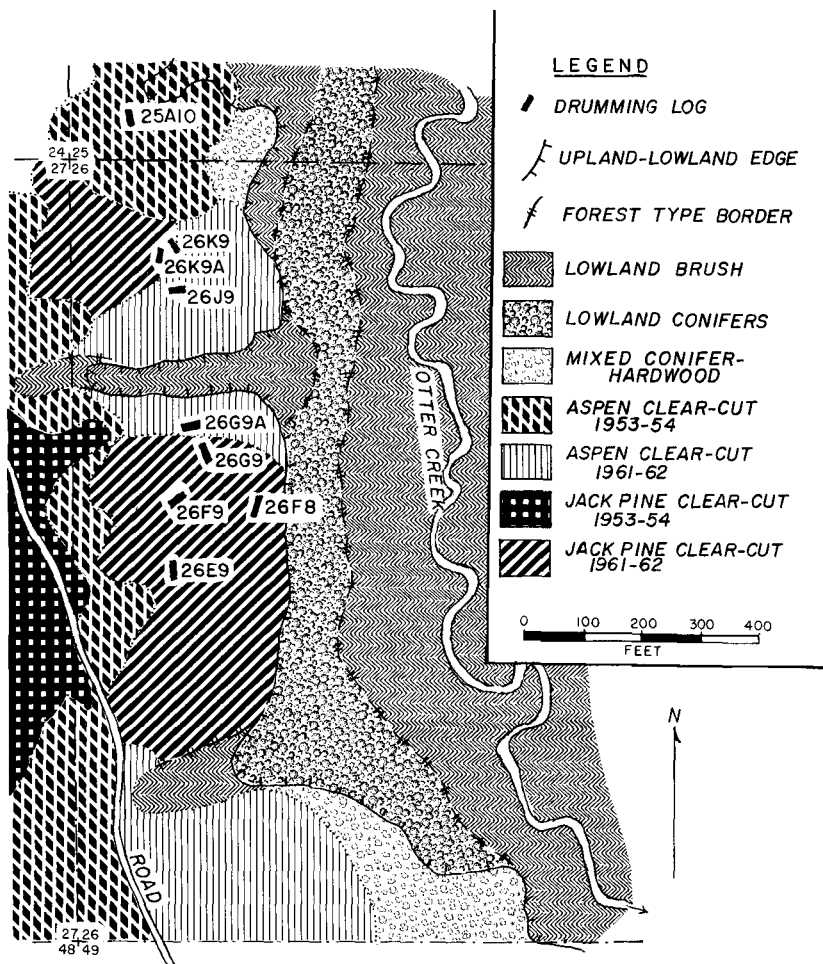


Figure 3. The distribution of drumming logs used from 1956 to 1964 in the NW-26 perennial activity center, in relation to timber harvesting in this area. Forest types are as described for Figure 2.

### DISCUSSION

This paper has pointed out some consistent patterns of behavior which can be exploited as a means of determining the size of male Ruffed Grouse populations on fairly extensive forested areas. At the same time, some points of caution have been interjected, to warn of the need for fairly close contact with the male grouse population to avoid being deceived by misleading behavioral traits.



Figure 4. Drumming logs in the NW-26 activity center affected by forest cutting. The white triangles are directly below the drumming stages. A, DL 26F9 (fall, 1959); B, DL 26F9 (spring, 1962) buried under jack pine slash (same view as in A); C, DL 26G9A, not disturbed by cutting although all surrounding forest cover was removed; D, DL 26K9A on the northeastern surface root of a white spruce.

Some investigators have assumed (notably Frank, 1947, and Hardy, 1950) that continued use of a particular drumming log implied survival of certain individual grouse. Here at Cloquet we have found that the drumming logs which are most persistently used (perennial logs) have the highest rate of turnover and are commonly occupied by replacement grouse each spring. (This supports an earlier suggestion to this effect by Chambers and Sharp, 1958: 237.) For example, one log has had seven different birds in the nine years it has been occupied since 1957, while another has been occupied by five different male Ruffed Grouse in the six years it has been used since 1957. Still another has been occupied by five grouse while in continuous use since 1957.

On the other hand the male grouse which have lived longest on the Cloquet Forest have changed logs one or more times during their tenure. Our oldest male grouse has used five different logs during the 14 drumming seasons (spring and fall) he has survived since the spring of 1959. Another bird, which reached an age of about 53 months before disappearing, used at least three different logs during the nine drumming seasons in which he participated. In fact, all of the male grouse which have survived more than eight drumming seasons on the Cloquet Forest have changed primary logs one or more times in their life.

Also, knowledge of the color phase of the log occupant is not a sufficient basis for assuming survival of a given individual. We find that certain logs tend to be occupied most consistently by gray-phase males, whereas other logs are favored by red-phase male grouse. One log, in nearly continuous use since 1957, has been used by seven gray-phase males in succession, and three others in nearly continuous use since the fall of 1956 have each been occupied by five different gray-phase grouse to the exclusion of red birds. On the other hand, one log has been used by three different red-phase males in the past five years.

Therefore, unless the birds are individually marked, or otherwise identified, few assumptions can be made concerning the identity, and hence the age and survival, of male Ruffed Grouse using specific drumming sites. Nor is absence from a given log necessarily conclusive evidence that the bird is dead. Although uncommon, we have recorded a male grouse moving as far as 3,600 feet to replace another male on an apparently preferred site. No fewer than 74 of the 408 banded male grouse studied at Cloquet since 1956 have shifted from one drumming log to another in their tenures as active drummers.

The presence of alternate and non-drumming male grouse as a normal component of the Ruffed Grouse population introduces additional problems, and we still are not satisfied that we know the adult male:female ratio. Therefore, some caution is necessary in expanding figures based on male counts (Gullion, MS).

No further interpretation of the function of drumming has resulted from this study. At the present time, we are content to agree with Allen's statement (1934: 183-184), "The drumming of the Grouse . . . apparently takes the place of the territorial song in other birds. It is an expression by the male of his feeling of superiority. In the spring it becomes an announcement to females, and a challenge to other males."

Although Fowle (*op. cit.*) stresses the isolation obtained by male Ruffed Grouse by virtue of their drumming activity, in contrast to the communal display grounds or leks of the plains grouse, I think the activity clustering we have documented suggests that these forest grouse also prefer to use

a communal display ground, but one which is considerably expanded in the forest habitat. Just as the Sage Grouse (*Centrocercus urophasianus*), prairie chickens (*Tympanuchus* spp.), and Sharp-tailed Grouse (*Pedioecetes phasianellus*) tend to return to a specific area for communal displaying year after year, we have found (Gullion, King, and Marshall, 1962) that Ruffed Grouse tend to concentrate their drumming activity centers as clusters in the same forest areas for generation after generation. The "attachment" to these areas overrides the effects of gross changes in the forest environment brought about by forest-cutting programs. On the other hand, there are other forest areas which appear to me to have all the attributes of satisfactory drumming activity centers but where no drumming activity has been recorded over the past 35 years.

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#### SUMMARY

A 10-year study of the selection and use of drumming sites by male Ruffed Grouse has been made on the Cloquet Forest Research Center in northern Minnesota.

Objects or areas used for drumming include the drumming stage (where the grouse stands), the drumming "log" (which may or may not be a log) on which the drumming stage is situated, and the drumming activity center (perhaps synonymous with "drumming territory") which is the area of most intensive activities of the attendant male.

Historically, depending on whether or not they are repeatedly used by successive male grouse, logs and centers are defined as perennial or transient. Annually a log may be used as a primary, alternate, or perhaps incidentally as a secondary drumming log. During drumming duels logs or objects with no prior history of use may be used briefly as challenge sites. The status of the male grouse established on a log with relation to his predecessor may be that of a new drummer (on a log not used before), a replacement



drummer, a displacement drummer (having routed his predecessor), or a repeat drummer.

The social status of the male grouse established in an activity center may be that of the dominant drummer; the subdued alternate drummer; a satellite drummer sharing a center on nearly even terms with the dominant male; or the non-drummer, who is apparently not persistently associated with any definite log or activity center.

Of the 593 logs used for drumming since 1956 at least 57 can be classified as perennial logs and the focal points of perennial activity centers. Another 35 activity centers are considered as perennial centers, but the logs contained within them are used on a transient basis. Another 91 logs and centers have been used only on a transient basis.

The spring season is the period of most intensive drumming activity, but many logs are quite closely attended throughout the summer as well. Drumming log attendance in the fall generally approaches and sometimes exceeds the spring activity. The activity of young males seeking and becoming established on logs at ages of 18 to 20 weeks probably stimulates increased activity by older, established males.

Although a few young male Ruffed Grouse become established on logs their first fall, others apparently fail to become established the next spring, and the birds occupying logs are predominately adults 22 months old or older.

A definite tendency has been noted for a succession of birds of one color phase or the other to occupy the same center or log year after year.

Natural aggregations of drumming activity centers into activity clusters has been documented. I have speculated on the possibility that these represent an expanded communal display ground, or lek.

In further support of earlier findings, the effect of environmental change in the forest on the persistence of drumming log and activity center occupation has been examined in more detail.

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