

Observations on Ecology and Behavior of Indiana Ruffed Grouse¹

JOHN P. MUEHRCKE and CHARLES M. KIRKPATRICK, Purdue University

Abstract

On an 840-acre study area in Monroe County, vegetation types consisted of second-growth hardwoods including a 19-year-old burn, old fields, pine plantations, and wildlife openings. Flush surveys showed that grouse used hardwoods most consistently (especially the burn), pines for winter and hunting season protection, and other types very little. Age ratios of summer-flushed and summer-trapped grouse were essentially even in 1968. Eight grouse broods found in summer of 1968 averaged 3.1 young, less than noted in 1965. Brood hens showed protective behavior until young were 10-12 weeks old. Extent of brood separation movements varies among individual young. Fifteen drumming males were found in 1969 compared with 12 in 1968. In 1969, drumming began February 28, the number of drumming males increasing until April 10 when all 15 males drummed, and decreasing afterward until only 2 were heard April 23. The daily period from about ½ hour before sunrise until ½ hour after sunrise marked the most intense drumming activity. The intervals between drumming performances were shortest just before and just after sunrise. The drumming act averaged 5+ seconds. Males occasionally roosted on drumming logs, but rarely drummed at night. Besides their main drumming logs, all males had one or more alternate logs.

A century ago ruffed grouse (*Bonasa umbellus*) were probably found throughout Indiana woodlands, being reported in 58 counties (13), but the effect of man has limited this species to the less intensively used hills of south-central Indiana. Evidence mounts that the bird is holding its own if not actually thriving in the managed public forest lands. Thurman (25) started a study on ruffed grouse ecology in Monroe County to which a report by Muehrcke (19) represents a continuation. The work of these students, supervised by the junior author, proposes to accumulate data for the better understanding of Indiana ruffed grouse ecology to aid in management practices that will benefit this fine bird.

The study concentrated on an 840-acre part of the Hoosier national Forest in southeastern Monroe County locally known as Geiger Ridge. It lies within the western mesophytic and oak-hickory climax vegetation (17) in which man has wrought many changes to the forest. Most of the wider valley bottoms and ridge tops were cleared and farmed and remaining timber was extensively logged. Now the most common species in the overstory include chestnut oak (*Quercus* spp.), black oak (*Quercus velutina* Lam.), red oak (*Quercus* spp.), white oak (*Quercus alba* L.), and hickory (*Carya* spp.). Species nomenclature follows Deam (5). In 1935 the U. S. Forest Service began buying the worked-out farms, allowing some cleared fields to revert to forest successional stages and planting some sites with pines. This history of land use has resulted in some distinct vegetation types consisting of second-growth hardwoods including a 19-year-old burn, old fields, pine

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plantations, and wildlife openings. Thurman (25) describes these and other physical and historical features of the area in detail.

Methods

To locate grouse broods, the observer made intensive searches in all cover types in early summer. Brood locations later became focal points for trapping with cloverleaf traps (4). Trapping was done primarily to gather information about age ratios, grouse movements, and to provide a basis for population estimation. Sex and age were determined for each trapped bird, which was then color-banded and released.

Throughout the study, major effort was devoted to observing behavior of grouse in their natural environment. Hens with broods and drumming males provided most such contacts. Whenever a brood was discovered, usually by flushing, the observer concealed himself to watch the behavior of hen and young as they regrouped from hiding. Ten 1/10-acre vegetation samples were taken to describe the plant communities where broods were flushed. Muehrcke (19) used a line transect method as the sampling technique.

The observer located all drumming males on the area by walking along ridge tops from ½ hour before sunrise to ½ hour after sunrise. Each ridge top was covered at least twice during the clear calm days of March and April. The sound of drumming revealed drumming log locations and offered chances to study the performing males. Certain drumming males were watched intensively for recording behavior. Drumming logs of all cocks were periodically examined for signs of use as a clue to drumming male population. Cover analyses were made of 10 drumming log sites by the method of Lindsey *et al.* (16).

Results and Discussion

The study area divided itself roughly into the part burned over in 1951 and the unburned hardwoods. The burn is an interspersed of pines, field edges, and open canopy hardwoods with a great deal of brush, saplings, and pole timber. The unburned area is predominantly oak-hickory with little understory. The burned hardwoods in the southern half of the area obviously held more grouse than the unburned portion. Even though grouse were not uniformly distributed in the burn, most field work was concentrated there. In general, most grouse appeared where brushy vegetation was densest and along ridge tops in the burn and near pine plantations. Ridge tops with older unburned timber were not used extensively except by drumming males.

From June 1968 to April 1969, 250 grouse were flushed in the study area. Since the 1968 estimated fall population based on marked birds was 42, obviously many birds were flushed more than once. Although grouse appeared to be most abundant in the burned section, when Thurman (25) more completely searched the whole area by randomized routes, his recorded flushes in unburned hardwoods led in all seasons except fall. In the present study, of all broods flushed in summer, 86%

came from burned over hardwoods, the rest from pines. Slopes and valley bottoms, as opposed to ridge tops, produced 70% of brood flushes. Temperature and humidity data from valley bottom (670-foot contour) and ridge top (850-foot contour) showed that the valley had a wider range of temperature and was more humid than the ridge. The apparent preference of grouse for the lower levels in summer may be related to temperature and moisture conditions more comfortable to the birds, especially as the same conditions associate with denser vegetation affording protection and food supplies. Crop contents from four summer juveniles were strong in occurrence of fungi and touch-me-not (*Impatiens* spp.), both abundantly found in bottoms.

In September, the first noticeable difference occurred in grouse locations with birds increasingly found on ridge tops. During the period of most movement in the first week of October, grouse often appeared on roads and in areas where previously unseen. The October movement was most frequently away from dense hardwood thickets of slopes and bottoms, the high use area of summer, to edges around pine plantations. In October, hunting pressure was associated with increased grouse use of pine plantations, the densest protective cover on the area. Thurman (25) also noted increased use of pines in fall and winter. In midwinter, grouse use in and around pines remained high, but they also spread back into dense hardwood vegetation, often feeding there on the abundant crop of sumac (*Rhus* spp.) fruit. Groups of grouse were more commonly seen in winter than in fall, indicating a tendency to concentrate at feeding sites.

During early spring, grouse again used slopes and ridge tops, males moving upward to more mature timber to establish drumming territories. Males flushed from drumming logs showed no unusual behavior. Even those flushed from logs on moonlit nights flew normally. They had no special escape routes but usually flew in a direction away from the observer.

In three summer months of 1968, a total of 80 flushed grouse gave nearly an even adult: juvenile age ratio (38 juveniles, 37 adults, 5 unknown). Of 26 different grouse captured from July to October inclusive, the age ratio was even. This is unusual as a healthy post-breeding population of small game birds should include 60-80% young of the year (1). In 1968, broods accompanying hens averaged 3.1, substantially less than the 6-8 found by Thurman (25) on the same area in 1965. Bump *et al.* (3) reported 6-8 young in other states. Obviously, 1968 was a poor year for recruitment of ruffed grouse on the study area. A few reasons of circumstantial nature suggest themselves.

Rainfall amounting to 9.4 inches occurred in 14 days in May, more than twice as much as a previous 100-year average for the period. Extreme wet conditions at the time when ruffed grouse are hatching may cause high chick mortality (7). To underline the possibility of wet weather mortality, 54% of summer trapped grouse were males. Therefore, by interpolation, 17 of 37 adult grouse flushed in summer 1968 may have been hens. There were actually eight known females with broods,

leaving a possible nine broodless hens. Torrential rains could easily destroy whole broods of young chicks, clutches near hatching, or decimate either to account for small brood size and broodless hens in 1968. (A better brood year probably occurred in 1969. In a survey for cover mapping on a nearby area, John D. Vanada found 10 broods during the period June 11-August 22. They averaged 6.9 young per brood and no broods had less than 5 chicks).

On the basis of recaptured banded grouse, the 1968 fall population of the study area was estimated at 42 ± 14.8 birds at the 95% confidence interval (18). Meager data make this only an approximation, but other methods of crude estimating give about the same number.

Composition and arrangement of forest ground cover and overstory determine ruffed grouse distribution and influence productivity (7). Variety among food producing plants is essential to counteract irregularities in food production because of weather or alternate seeding years. Because of the sedentary nature of ruffed grouse, good habitat meets food and cover requirements within a relatively small area (24). Summer brood range poses the most critical requirements. Broods must have a complex understory of woody and herbaceous plants of proper height

TABLE 1. *Vegetation analysis of canopy and shrub strata for ten 1/10-acre samples at brood locations (1968) and ten 1/25-acre samples at drumming log sites (1969), Geiger Ridge Study area. (Only the 10 highest ranking species for importance value are shown in each case.)*

Trees and shrubs	Stem density per acre	Relative stem density per acre	Basal area per acre	Relative basal area per acre	Frequency	Relative frequency	Importance value
Brood Locations							
Hickory spp.	341	9.1	5.9	22.6	100	3.5	11.7
Shortleaf pine	83	2.1	7.8	30.3	20	0.7	11.0
Sumac spp.	783	20.7			100	3.5	8.6
Black oak	176	4.6	4.8	18.5	80	2.8	8.6
White oak	74	1.9	2.8	10.8	90	3.2	5.3
Sassafras	450	11.9	0.08	0.3	100	3.5	5.2
Ironwood (<i>Ostrya</i>)	203	5.3			90	3.2	4.2
Sugar maple	101	2.6	1.5	6.0	100	3.5	4.0
Dogwood	269	7.1	0.08	0.3	100	3.5	3.6
Hazelnut (<i>Corylus</i>)	173	4.5			70	2.5	3.5
Drumming Log Sites							
Black oak	272	5.4	20.4	37.2	100	6.4	16.3
Sumac spp.	592	11.9			100	6.4	9.1
Red oak	32	6.5	9.4	17.1	30	1.9	8.5
Sassafras	627	12.6	3.4	6.2	100	6.4	8.4
Hickory spp.	462	9.2	3.1	5.8	100	6.4	7.1
Dogwood	460	9.2	1.5	2.8	90	5.8	5.9
Grape (<i>Vitis</i>)	197	3.9			100	6.4	5.1
Blue beech (<i>Carpinus</i>)	345	6.9			50	3.2	5.0
Ironwood	215	4.3			90	5.8	5.0
Tulip tree (<i>Liriodendron</i>)	27	0.5	6.1	11.1	50	3.2	4.8

and density to allow easy movement of chicks as they forage (24). The fact that grouse have persisted on the study area without any special attention indicates that the range is meeting at least the minimum requirements for their survival. It is likely that extensive interspersions of woodland successional stages on Geiger Ridge similarly provide the mixture of types found necessary for ruffed grouse in Missouri (14).

The study area supported a minimum of 8 broods, usually found in relatively open canopy situations with dense underbrush. In a comparison of basal areas of different species, hickory, black and white oaks, sugar maple (*Acer saccharum* Marsh.), and shortleaf pine (*Pinus echinata* Mill.) dominated the overstory of brood locations. In stems per acre, sumac, sassafras (*Sassafras albidum*), hickory, and dogwood (*Cornus* spp.) led in that order of understory dominants (Table 1). Ground cover consisting of grasses, greenbrier (*Smilax* spp.) tickclover (*Desmodium* spp.), cinquefoil (*Potentilla* spp.), goldenrods (*Solidago* spp.), and other species was thinner where broods were found than in other spots.

As noted by others (2, 23), the grouse brood is held together by the hen's vocalizations. When a brood is flushed, the hen typically feigns injury, attempting to decoy the intruder away from the hiding young. After a more or less intensive display, the hen flushes to rejoin the brood, responding to their shrill peeping whistle with her own rasping peep or clucking. The intensity of the bond between hen and chicks appears strongest when chicks are less than 10 weeks old (up to July 30) and gradually weakens as they mature. This was shown by timing the return of flushed hens to their broods (Fig. 1). By September, hens did not try to hold broods together, and at this time break-up of broods and wandering of some individuals occur.

A relatively small number, 26, of different grouse were trapped and marked in this study. Marked grouse were recaptured or identified by sighting their color bands 11 times. The recovery data are insufficient to suggest more than considerable variation in the tendency to move. One juvenile captured in July was recovered in August, 1,800 feet away in the same valley; and was recovered a second time in October, 1,600 feet from the last site, this time in another valley. This bird was with a brood on the first two occasions, but was alone the last time. Another member of the same brood was recaptured the same day in October as the first juvenile mentioned, but in the same trap where it was originally caught. These records from two individuals in the same brood suggest that young grouse move up and down a valley system and sometimes wander into other valleys as brood separation occurs. In 18 resightings of marked grouse from the Geiger Ridge area, Thurman (25) found 9 juveniles less than 300 yards between points of observation, although a 10th was recovered $2\frac{1}{2}$ miles away and the 11th, $5\frac{1}{2}$ miles away. Adults on the average were even more sedentary than the shorter-ranging juveniles. Although our data, and those of Thurman (25) as well, are slight by comparison, they fit the general conclusion of Hale and Dorney (11) that juvenile ruffed grouse are more mobile than adults.

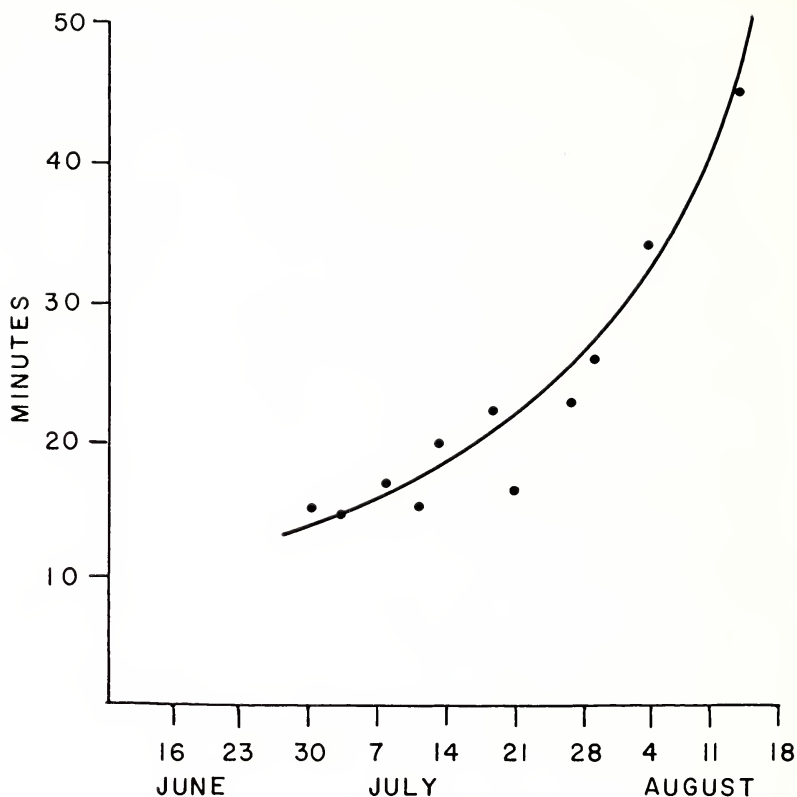


FIGURE 1. Time required for ruffed grouse hens flushed with broods to return to the broods.

In this respect, Indiana grouse resemble northern birds. The phenomenon of juvenile mobility implies a sexual difference as discussed by Gullion (10) on the basis of his extensive experience with Minnesota grouse. Young cocks evidently prefer to claim territories within the familiar brood range, whereas young hens disperse more erratically to new habitats.

Drumming Males and Breeding Populations

During the last week of March and the first week of April 1968, drumming males found on the study area totaled 12 or 1 per 70 acres. In 1969, the count was 15 or 1 per 56 acres. Thurman's (25) count for this area in 1966 was 25 males or 1 per 32 acres. Wise (personal communication) found 13 drumming logs on an 835-acre area 6 miles from Geiger Ridge. Lewis *et al.* (15) estimated 2 grouse per 100 acres in Missouri, half of them males.

The number of drumming males on an area from one year to the next is an indicator of breeding male population trends although not a

precise one (6). If a total census of drumming males can be obtained, it is often assumed that a sex ratio of 1:1 exists, hence the total spring population is at least twice the number of drumming males. This is a conservative estimate since nondrumming males are overlooked and since selective predation is heavier on males than on females in late winter and early spring (8). In spite of caution recommended in estimating breeding populations or trends by this method, the difference between Thurman's 25 drumming males and Muehrcke's 15 appears significant. As discussed above, 1968 apparently was a poor production year.

Further evidence of a reduced 1969 population is seen in the distribution of drumming males. Thurman found 13 drumming territories in the unburned hardwoods. Muehrcke found only 2 there, but found 13 territories in the burned section, which is believed to be the better grouse habitat. In 1969 the population was small enough to allow most territorial males to establish themselves in the better habitat. In view of the wet weather catastrophe in 1968, and the attachment of sexually maturing males to their brood territories, the situation also suggests better survival of young in the burn.

Drumming Log Sites

Biologists (9, 20) have observed that grouse use certain logs year after year. Gullion (9) called them perennial logs. In the present study, Muehrcke found 3 of the 25 drumming logs identified by Thurman in 1966 still used in 1968. Eight of 12 logs used in 1968 were also used in 1969. In their analyses of drumming log relationships, neither Palmer (20) nor Gullion (9) found a single site quality factor or other good explanation for the phenomenon of traditional use.

Detailed data were collected for the physical features of drumming logs in 1969. On 6 of 15 territories, alternate logs were also used. Decomposition of logs varied from moderate to very much. Their diameters ranged 9-16 inches, averaging 12.8. Total length ranged 8-38 feet, averaging 23.2. Distance the log lay from ridge top usually ranged from less than 10 to more than 600 feet, although 4 logs were fairly well down slope. Distance from field edge was less than 100 feet except those on slopes which were 210 to more than 600 feet away. Hardy (12) located 18 drumming sites on his eastern Kentucky study area, all on or near ridge tops; and Thurman (25) tabulated the exposure of 25 sites on the Geiger Ridge area, noting that some were on ridge tops and others on slopes. The distance of the latter from ridge tops is not on record but CMK remembers that many were near the tops. The higher levels for display sites may offer some survival value in permitting flushed males to fly downward quickly into denser escape cover. Otherwise, a ridge top location may play a part in natural selection to the extent that sound may travel farther from a higher than a lower level, and hence attract more distant hens.

A vegetation analysis of drumming log and brood location sites is summarized in Table 1. According to basal areas of hardwood species,

drumming male grouse use more mature timber than broods. Otherwise, stems per acre and importance values show the essential nature of young growth and shrub species in both habitats. This coincides with Palmer's (20) observation that woody vegetation over 8 feet high is more dense near drumming sites than in surrounding cover. We believe that our grouse generally inhabit dense vegetation in the valleys during inclement weather of spring, and that males move upward to drumming logs in brushy areas dominated by older trees.

1969 Drumming Season

On January 15 at least two grouse visited drumming logs as shown by tracks in snow and droppings around logs. Snow cover shortly disappeared and no further activity around logs was apparent until February 24. Droppings showed a number of logs visited, but undisturbed leaves below the stages (spots on the logs where the grouse habitually stand to drum) hinted that drumming had not yet begun. First drumming was heard February 28 after a week of mild weather when temperatures ranged from a high of 41° F to a low of 28° F. Drumming activity then increased in the following days with 4 males drumming on March 7, and droppings showing that other males were visiting their logs. From March 8 to 17 all males were silent during which time temperatures ranged from 10° F to 21° F. After that the number of different males drumming increased until April 10 when all 15 males drummed.

The peak of drumming intensity, as measured by the largest number of different active males, extended from April 7 to 12 inclusive. No less than 8 and as many as 15 of the 15 different males performed daily. Thurman (25) gives the first week in April for this intense activity period in 1966. In 1969, drumming intensity tapered off until only 2 males were heard on April 23. No observations were made after that.

As also noted by Petraborg *et al.* in Minnesota (22), Muehrcke (19) found the daily duration of drumming was longest in the period of peak activity, with drumming beginning earlier before sunrise and ending later after sunrise as the peak period approached. On April 8 one grouse started drumming at 0515 hours EST, the earliest time noted, and stopped at 0614. On April 6, grouse drummed sporadically on the study area until 1710 hours except for a silent period from 1200 to 1410 hours. Usually the early morning drumming period ended about ½ hour after sunrise, but some males returned to drum intermittently for another 2 hours. Bent (2) also reported this behavior.

During the peak period of drumming activity, Muehrcke, from a hide, observed one cock intensively to time the frequency of successive drumming performances. His raw data are less extensive and precise than those of Palmer (21) but do show that the time interval between drums is shortest just before and just after sunrise. The raw data further show that the intervals were shorter when a second grouse is present. It is to be expected that the presence of a hen stimulates an increased rate of drumming (8). The data are summarized in Table 2. They show that

drumming behavior was more erratic when a second grouse was present; drumming continued longer in the morning; the intervals between drums were extended as the cock left his log frequently to react with the visitor; and length of drums ranged up to 3 sec longer than when the cock was alone.

One aberrant cock often drummed between 1500 and 1800 hours in the same area where a grouse drummed in evenings in 1968. Gullion (8) observed that some males are predominantly afternoon or evening drummers. Night drumming apparently occurs commonly (2). On calm, moonlit nights, grouse drummed at 2200 hours on 2 occasions, and at 0345 on 3 occasions on Geiger Ridge. Thurman (25) also heard night drumming on the area.

TABLE 2. *Time data for ruffed grouse drumming performances on Geiger Ridge study area, 1969.*

	Drumming male was alone	Second grouse was present
Date	March 23	April 4
First drumming	0555 EST	0535
Last drumming	0655	0727
Number of drums	24	39
Interval between drums		
Range (minutes)	1-5	1-10
Average	2.3	2.9
Length of drums		
Range (seconds)	4-6	3-9
Average	5.3	5.3

Only certain males roosted on their drumming logs and even then uncommonly except for the week of most intensive activity. During that 7-day period, 6 logs were used 1-3 nights and 4 logs were used 4 nights, Muehrcke actually flushing grouse from these logs. One grouse flushed from a drumming log at 2100 on September 19. More intensive field work in the fall would probably show that this is not unusual. Other studies (9) have shown that many drumming logs are closely attended in summer as well as in fall. Young males, seeking to become established on logs in fall, probably cause increased activity in older, established males.

Male grouse are especially wary when drumming and react to unfamiliar sounds or movement by remaining silent or taking flight. Grouse leave their logs by walking if undisturbed, or by running or flushing apparently according to their level of fright. All drumming males habitually performed from a main log but had one or two alternative logs. At least 7 males drummed on alternate logs. If a bird ran from its main log before sunrise during the peak drumming period, it invariably drummed on an alternate log within the half hour. Males flushed from their main logs would not use alternate logs the same day but the following day.

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