Ruffed grouse density and habitat relationships in Wisconsin. No. 118 1980

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RUFFED GROUSE DENSITY and HABITAT RELATIONSHIPS in WISCONSIN

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COVER: *Intensive searches were made between mid-April and mid-May to locate all active drumming male grouse on the study areas. Though grouse typically drum from logs or stump roots, many Stone Lake grouse drum from boulders.*

ABSTRACT

Ruffed grouse (*Bonasa umbellus*) populations were studied in central and northern Wisconsin beginning in 1968 to determine drumming grouse densities by forest types and age classes, and to develop guidelines for maintaining or improving habitat quality for grouse. Areas surveyed included 1,700 ha (4,200 acres) on the Stone Lake Experimental Area in Oneida County and 972 ha (2,400 acres) on a portion of the Sandhill Wildlife Area in Wood County. An additional 405 ha (1,000 acres) were surveyed on nearby Wood County Forest lands and combined with Sandhill for purposes of analysis.

Grouse populations peaked in 1970-71 on Sandhill and in 1972 on Stone Lake, and crashed between 1972 and 1973 on both areas. The lowest, mean, and highest densities on Sandhill were 1.1, 2.7, and 4.1 drumming grouse/40 ha (100 acres), respectively. In contrast, the lowest, mean, and highest densities on Stone Lake were only 0.5, 1.0, and 1.8/40 ha, respectively. Generally, proportional increases and declines occurred in all major forest types and aspen age classes. Our data suggest that a major value of better habitat is the prospect of maintaining higher average grouse densities through both population highs and lows: e.g., grouse densities in the best habitat (aspen-alder) on Sandhill declined from a high of 14.3/40 ha to 4.3, whereas densities in a poorer habitat (aspen of all ages without alder) ranged from 3.3 to 0.8. Grouse densities in the best Sandhill habitat were also 4 to 10 times greater than the worst habitat (oak), during low and high populations, respectively. Highest grouse densities on Sandhill were observed in aspen, and lowest densities in oak. Within the aspen type at Sandhill, highest densities were found in aspen-alder habitat and in the 6-25 year class. Lowest densities occurred in aspen stands without alder understories, particularly in stands more than 25 years old. Highest densities on Stone Lake occurred in habitats dominated by balsam fir (aspen was a major component of about half of this acreage); second highest densities occurred in alder.

Selection of drumming sites on both areas appeared to be influenced by the presence of adequate understory cover and older aspen trees. At Sandhill, alder dominated at drumming logs located along lowland edges, and American hazel at logs on upland sites. Balsam fir and alder were predominant cover species at drumming logs on Stone Lake.

The potential for high grouse densities appears to lie in the maintenance of aspen and aspen-alder habitats, and in the interspersion of aspen ages. Young and old stands can be maintained in close proximity by manipulating the distribution and size of sales or treatments, and by leaving older aspen trees within cutover stands that are scheduled for postsale clearing.

Ongoing research at Sandhill and Stone Lake will permit evaluations of three intensity levels of aspen age-class management: traditional large clearcuts at Stone Lake; modified commercial cutting at Stone Lake; and more intensive strip and block cutting at Sandhill. These three levels of management will also be compared with optimum management as suggested by Gullion (1972). Recommendations will then be formulated for use on private and public forests.

RUFFED GROUSE DENSITY AND HABITAT RELATIONSHIPS IN WISCONSIN

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INTRODUCTION

Knowledge of distribution and numbers of drumming ruffed grouse in relation to forest types and age classes is important for planning improvement of forest habitat for grouse. Since aspen forests provide the greatest potential for improving habitat quality for ruffed grouse (Gullion 1972), it is important to demonstrate the impact of habitat management on grouse populations in aspen and associated habitats.

Opportunities for forest habitat manipulation are especially abundant in Wisconsin, since large tracts of aspen forests are being regenerated through commercial cutting and wildlife management programs. During the 1971-75 period, 162,000 ha (400,000 acres) of aspen were commercially clearcut; 24,000 ha (59,300 acres) of those clearcut were additionally treated through the Forest Wildlife Habitat Management Program to improve aspen regeneration.

Previous studies in the Great Lakes region (Eng 1959, Gullion et al. 1962, Palmer 1963, Berner and Gysel 1969) and in Alberta (Rusch and Keith 1971) have described habitats used by drumming ruffed grouse. However, most of the data were compiled and interpreted in general terms, with no discussion of grouse density by forest type. Most of the studies were also short-term (3 years or less). Thus, more information is still needed on grouse use of various forest types and age classes to develop effective management programs.

This is an interim report which discusses results of 10 years of grouse research on two study areas. Densities and distribution of drumming grouse by forest type and age class are presented, and factors thought to influence populations and habitat use are related to management of grouse. These studies are continuing in order to permit full evaluation of the effects of the recent habitat manipulation on grouse densities and distribution 10 years after treatment.

STUDY AREAS

Distribution and densities of drumming grouse were monitored in Wood County on the Sandhill Wildlife Area and nearby county forest and in Oneida County on the Stone Lake Experimental Area (Fig. 1) as part of long-term habitat evaluation studies.

The Sandhill Wildlife Area, a 3,705 ha (9,150 acre) state-owned wildlife area, is located within former glacial Lake Wisconsin. Plainfield sand and sedge peat overlying very fine sands are the major soil types, with silt loam locally distributed on some uplands. Topography is generally flat, with extensive marshes and low sandy islands. Uplands comprise 52% of the Sandhill area; 48% is wetlands. The upland forest is dominated by aspen and oak. Scattered stands of pine occupy less than 1% of the uplands.

Pole-sized stands more than 40 years old occupy 57% of the upland forest. The remaining 43% of the upland forest was cut over or treated following guidelines in the Sandhill Long Range Plan (Department of Natural Resources 1970). These guidelines were designed to maintain aspen and oak types, and to improve the interspersion of young and old stands. Most stands with volumes greater than 20 m^3/ha (3 cords/acre) were commercially logged, with harvesting procedures modified to benefit ruffed grouse. The size of commercial sales was restricted to 8 ha (20 acres) or less, and some stands were cut before or after they reached rotation age. In addition, aspen is being clearcut in scattered strips from a 160-ha (395-acre) experimental tract to achieve greater age interspersion. Trees remaining after commercial sales were made were removed with chain saws, by dozers with cutter blades, or through controlled burning to obtain improved aspen regeneration. Manipulations on Sandhill were designed primarily to improve the habitat for wildlife.

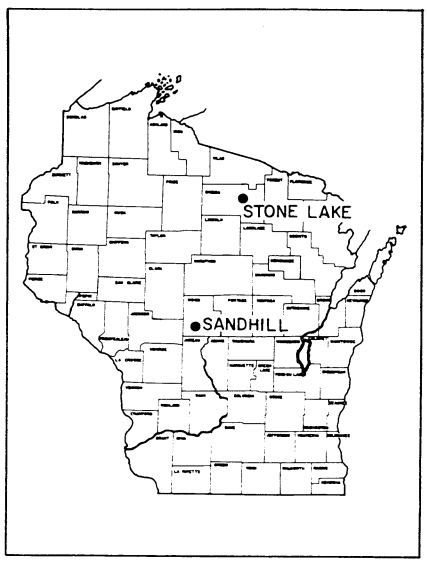
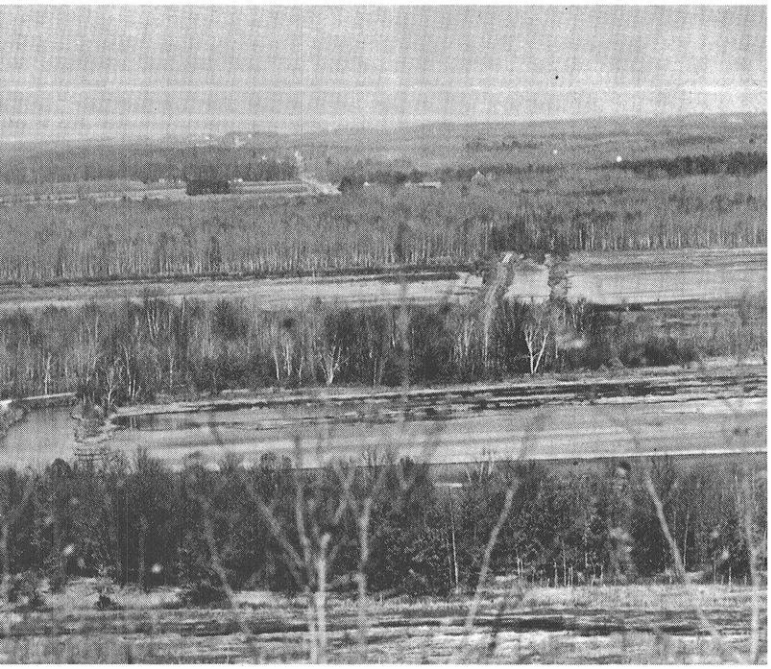
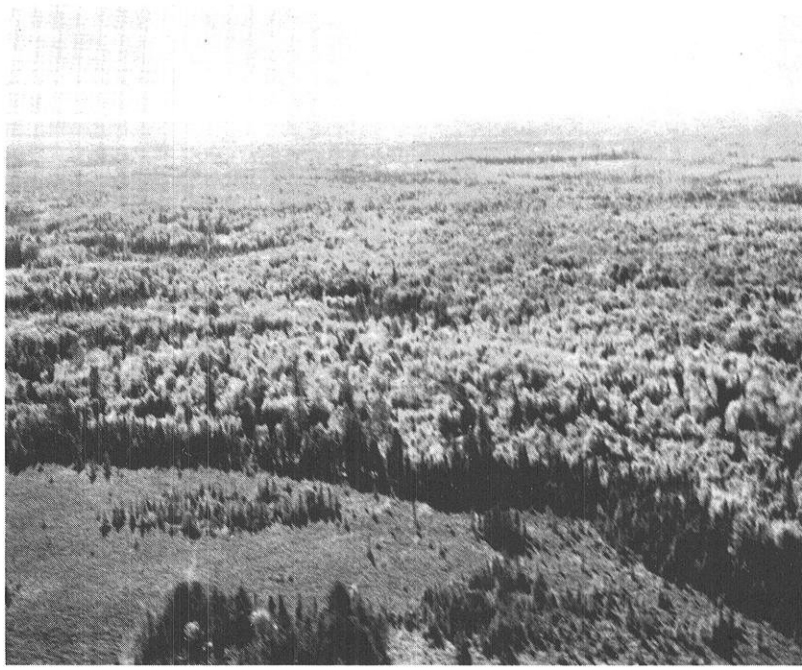


FIGURE 1. *Location of ruffed grouse habitat study areas—Stone Lake Experimental Area and Sandhill Wildlife Area.*



Aspen occupies two-thirds of the upland forest on the Sandhill area and is about equally divided betweeen saplings and poles. Most of the uplands occur as islands separated by open marsh and flowages.



The Stone Lake area is more nearly continuous forest comprised primarily of aspen, balsam fir and white birch.

The Wood County Forest tract includes 405 ha (1,000 acres) of upland forest, dominated by aspen and oak, interspersed with 45 ha (111 acres) of sedge-willow marsh (Table 1). Uplands occupy 90% of the area, and 90% of the upland forest was stocked with pole-sized stands more than 40 years old. No habitat treatments were made on this area during the study.

In contrast, the Stone Lake Experimental Area, located in the American Legion State Forest, is managed primarily for forest products. The Stone Lake Area includes 1,695 ha (4,200 acres) within the heavily glaciated conifer-hardwood forest (Curtis 1959) (Table 1). Upland topography is level to rolling, and loamy sand soils are predominant. Upland forest is dominated by aspen, fir, and birch either in nearly pure stands or in variable mixtures. Pole-sized stands more than 40 years old occupy 64% of the upland forest.

Management on the Stone Lake Area is primarily oriented toward economical production of pulpwood. The research goal is to improve the density and harvest of ruffed grouse within this timber production framework. This goal does not imply or require the production of maximum grouse numbers; rather it strives for higher grouse densities and harvests through minor modifications of forest management practices. Two important modifications that have been instituted are the setting up of smaller timber sales to promote interspersion of stands of different ages, and forced maintenance of the aspen type where the site may have converted to northern hardwoods or balsam fir. Other practices include maintenance of existing herbaceous forest openings, clover-seeding logging roads for hunter walking trails, and promoting a shrub edge on selected walking trails.

TABLE 1. *Habitat composition of Sandhill, Wood County, and Stone Lake study areas.*

Habitat Type*	Sandhill**	Wood County	Stone Lake[1]
Aspen	1,046	160	490
Aspen-alder	190	69	
Oak	553	173	
White birch			135
Pine	10	3	70
Balsam fir			177
Northern hardwoods			204
Lowland brush (alder)			127
Lowland brush (willow/bog birch)	440	20	
Black spruce			97
Marsh/muskeg	949	25	277
Swamp conifers/white cedar			58
Swamp hardwoods/ash			8
Tamarack			19
Nonproductive black spruce			18
Upland grass and brush	81		
Other (cropfields, gravel pits, water)	437		
Total (ha)	3,706	450	1,695

* Types described in Appendix B.
** Based on 1977 reconnaissance.
[1] Based on a 1975 reconnaissance subject to 1980 revision.

METHODS

This report covers work conducted from 1968 through 1977 on a study continuing through 1982 at Sandhill and 1986 at Stone Lake. Areas surveyed included 1,700 ha (4,200 acres) on Stone Lake, 972 ha (2,400 acres) on Sandhill and 405 ha (1,000 acres) on the Wood County Forest. The Wood County tract provides comparative data on central Wisconsin grouse densities and population trends from an area within the same general geographic range as Sandhill. Wood County and Sandhill data were combined for purposes of analysis.

Study areas were surveyed two or more times each year during the intensive drumming period of April and May. Drumming grouse were located following procedures described by Gullion (1966) and were generally found by listening for drumming and following the sound to the occupied site. Previously used drumming sites and other likely habitats were searched for presence of droppings. Only those primary logs (Gullion 1969) positively identified as being active on the basis of dropping accumulations, drumming, and flushing were tallied and used in subsequent analyses.

Forest type, age class, and other habitat parameters within a 400-m^2 (0.1-acre) area around primary logs were used to determine preference by grouse. Habitat measurements at each primary log were recorded once for each year in which that log was occupied. Densities of grouse were compared between forest types and age classes to determine relative habitat use. Comparisons were expressed as numbers of drumming grouse/40 ha (100 acres) of habitat.

On the Stone Lake Area, measurements of each drumming stage were compared with similar measurements from 140 random locations within the study area to determine more precisely factors affecting grouse use of forest types and age classes. At each log and random point, basal area was measured with the 5-factor angle gauge. Species of trees or shrubs were recorded to describe the predominant overstory and understory cover. Distances were estimated from the drumming stage to the closest pole-sized (mature) aspen tree (>13 cm, 5 in., dbh) and to the closest conifer >60 cm (2+ ft) in height. Distances from primary logs to the closest adjacent forest type, logging road, and clover-seeded trail were measured on aerial photos. Data for all logs were averaged and compared with the mean measurements from the randomly located points.

At Sandhill all woody vegetation of <13 cm dbh and >60 cm in height was counted on 40-m^2 (0.01-acre) circular plots centered on the drumming stage of 135 primary logs. Forty sites were sampled in pole-sized aspen (more than 25 years old) with alder understories, 15 in sapling aspen (0-25 years) with alder understories, 40 in sapling aspen (0-25 years) with upland shrub understories, and 40 in pole-sized oak (more than 25 years) with upland shrub understories. In addition, the number of mature aspen within 30 m (100 ft) of the drumming stage, and distance from the stage to nearest mature aspen and closest adjacent forest type, were recorded at 175 primary drumming logs. Randomly located points were not sampled at Sandhill.

Annual grouse densities on the study areas were compared with annual indexes to the amount of available roosting snow. The number of nights with roosting snow was tallied annually from 1 December through 15 March. Nights with roosting snow were defined as nights when snow was at least 18 cm (7 in.) deep and, in our opinion, soft enough for ruffed grouse to use for undersurface roosting. Snow roosting conditions were monitored on the study areas, and snowfall measurements were obtained from the nearby Meadow Valley and Rhinelander weather stations. Statistical tests are according to Snedecor (1956).

RESULTS AND DISCUSSION

GROUSE POPULATIONS

Annual grouse densities at Sandhill were consistently higher than at Stone Lake (Fig. 2). The lowest, mean, and highest densities on Sandhill were 1.1, 2.7, and 4.1 drumming grouse/40 ha. In contrast, densities on Stone Lake were only 0.5, 1.0, and 1.8, respectively. Thus, drumming grouse were more than twice as abundant on the Sandhill Area. Density differences in any one year ranged from 10% in 1973 to more than 240% in 1970.

Grouse population changes on the areas were not totally synchronous. Peak density on Sandhill occurred in 1970, followed by a peak in 1972 on Stone Lake. In addition, the Sandhill grouse density increased slightly during 1974 and 1975, whereas the Stone Lake density continued to decline. Thereafter, populations increased on both areas, but more dramatically on Sandhill.

Changes of grouse densities on the two areas were generally proportional in amplitude. Densities declined 73% on Sandhill (1970-73) and 74% on Stone Lake (1972-75) from high to low population levels. The largest annual change on both study areas occurred between 1972 and 1973, when densities plummeted 69% and 47% on Sandhill and Stone Lake, respectively.

FACTORS INFLUENCING POPULATION CHANGES

Regional Factors

Differences in grouse densities and trends between study areas were probably caused by variations in habitat quality and weather. The Sandhill Area is located approximately 160 km (100 miles) south of Stone Lake. At Sandhill, winter temperatures are generally milder and the period of snow cover is shorter than at Stone Lake, but the major decline in grouse density which occurred between 1972 and 1973

was apparent on both the Sandhill and Stone Lake areas as well as in the northern forests of both Wisconsin and Minnesota. Drumming indexes from the Stone Lake Area were significantly correlated (r=0.96, P<0.01) with the drumming indexes for all of northern Wisconsin. Decreases from the highest to the lowest annual index were 74% for both Stone Lake and the northern forest (Fig. 3). Between 1972 and 1973, grouse indexes declined 47% in the Stone Lake Area and 43% in the northern forest. Moulton and Thompson (in prep.) found that population indexes for northern forested portions of Wisconsin and Minnesota both showed a decline from 1972 to 1973 (Fig. 4). Indexes for Wisconsin and Minnesota were significantly correlated (r=0.67, n=22), suggesting general agreement in trends between the two similar ranges. Similarity in trends both on the study areas and regionally suggests that regionwide factors have an overriding effect on grouse population levels.

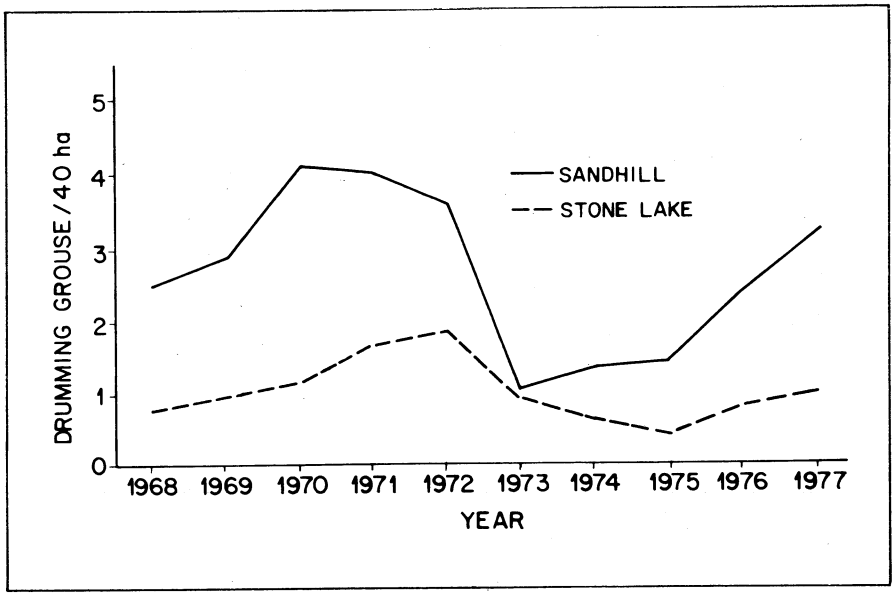


FIGURE 2. *Comparison of drumming grouse densities, Sandhill Wildlife Area and Stone Lake Experimental Area, 1968-77.*

Snow Conditions

Weak correlations (Fig. 5) between number of nights of roosting snow and subsequent ruffed grouse numbers were observed on the Sandhill Area (r=0.62, P<0.10) and the Stone Lake Area (r=0.49, P<0.10). A drop in the number of suitable roosting nights from 75 to 33 at Stone Lake preceded the drastic population decline first evident during the spring of 1973. At Sandhill, the number of suitable roosting nights went from 76 in 1971 to 22 in 1972, but spring populations declined only 12%. However, when the number of suitable roosting nights declined again in 1973 (to only 7), spring population indexes declined 73%.

The adverse effect of crusted snow upon grouse populations was first suggested by Larsen and Lahey (1958). Gullion (1970) further hypothesized a relationship between roosting snow and Minnesota grouse densities, believing that poor roosting conditions resulted in decreased reproductive success. Roosting snow appears to be one potential factor regulating grouse densities in Wisconsin, but other environmental factors must also be important and function in combination with roosting snow.

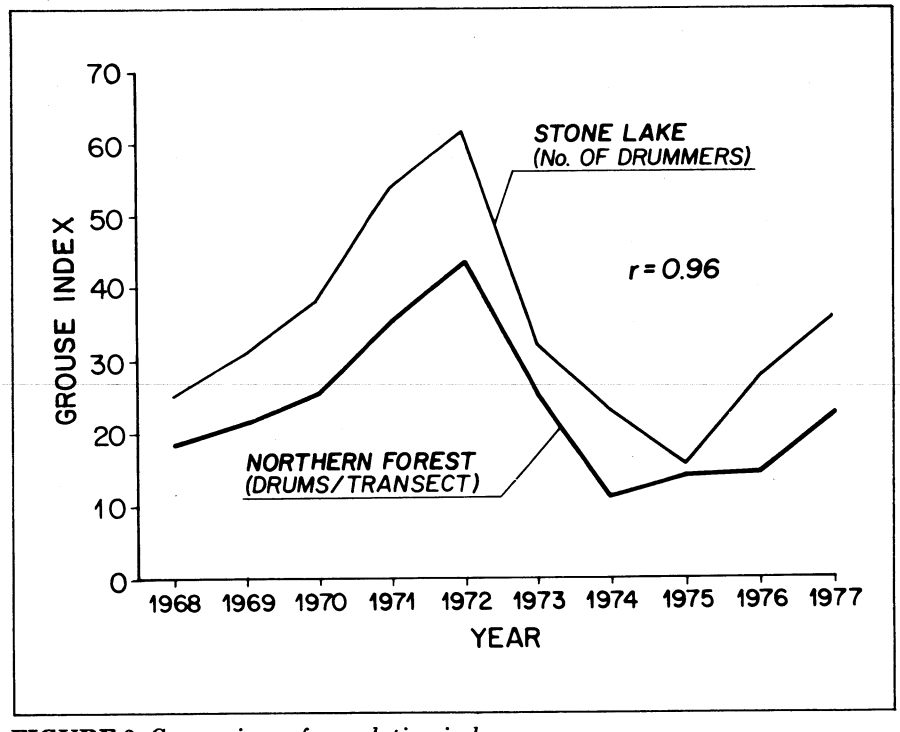


FIGURE 3. *Comparison of population indexes from the northern forest and the Stone Lake Experimental Area, 1968-77.*

General Habitat Quality

Habitat quality accounted for some of the difference in grouse densities on the two study areas. Grouse habitat at Sandhill was considered of higher quality because of the better distribution and composition of the aspen-alder habitat and greater interspersion of young and old aspen. Furthermore, acorns and an abundance of ground layer foods were available to Sandhill grouse during portions of most winters. Prime ground layer foods were dewberry and wintergreen, which provide leaves and fruits.

At Stone Lake most alder stands lacked an aspen overstory, except along lowland edges, and most aspen was either too old or still too young to be prime habitat. Furthermore, aspen reproduction stands exceeded 20 ha (50 acres). Conversely, the area of most aspen sucker stands at Sandhill was less than 8 ha (20 acres).

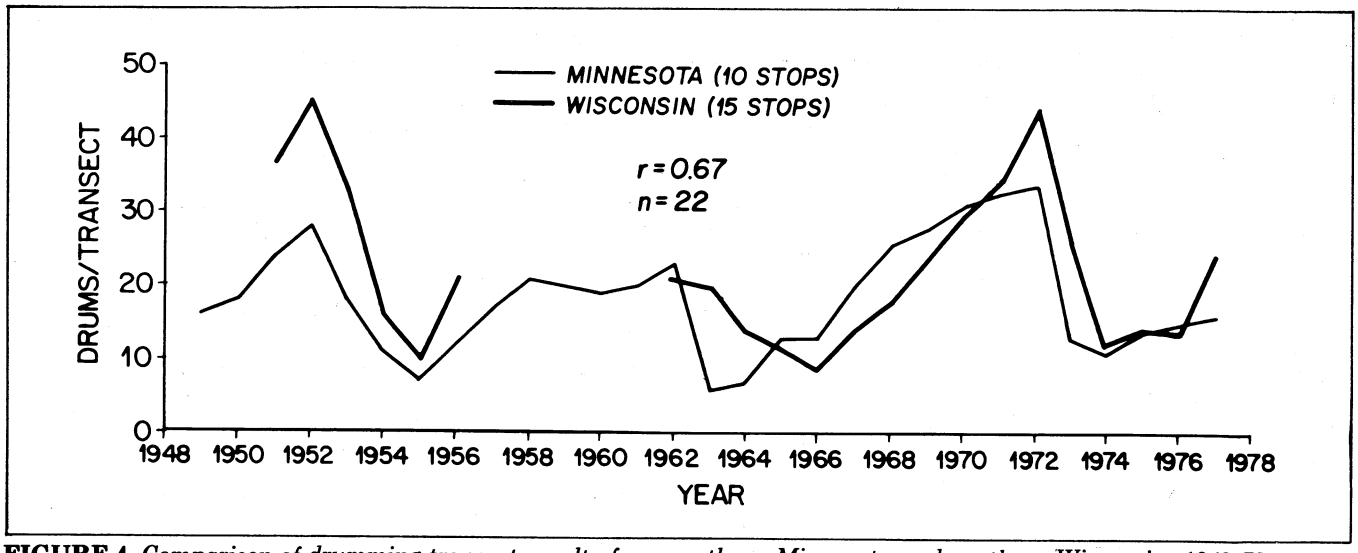


FIGURE 4. *Comparison of drumming transect results from northern Minnesota and northern Wisconsin, 1948-78.*

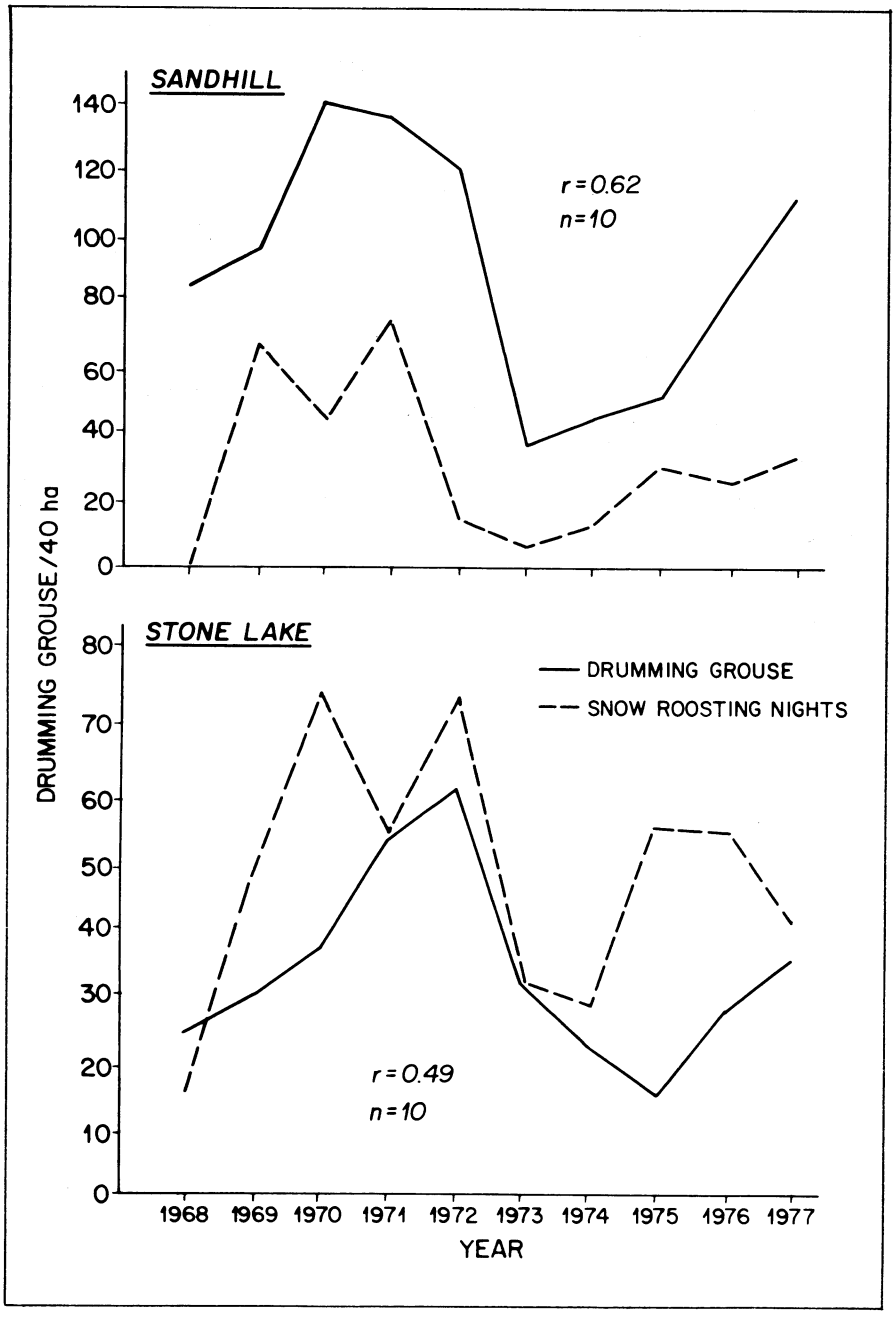


FIGURE 5. *Comparison of number of snow roosting nights and number of drumming grouse on the Sandhill and Stone Lake study areas, 1968-77.*

POPULATION CHANGES BY HABITAT

Changes in population density were proportional in all major habitats at Sandhill. The decrease from the highest to the lowest density was 72% in aspen and 76% in oak (Fig. 6), and 67% in aspen-alder and 76% in aspen without alder (Fig. 7). Similar declines of 75% and 74% were found in the 6-25 and the 26+ year aspen age classes (Fig. 8). The 1-year change that occurred between 1972 and 1973 also appeared to be proportional in all major habitat types.

Similar population changes were also observed between all major types at Stone Lake, although the greatest decline was in fir habitats (Fig. 9). Grouse densities declined in almost all habitats to about 1 drummer/40 ha in 1972. The only exception was in the 11-to-20-year-old aspen, where 3 drumming grouse were active on the 39.7 ha of this type each year from 1970 to 1975.

Although the grouse population decline of 1972-73 appeared to be proportional in all habitat types, the better habitats on Sandhill had higher grouse densities after the decline than did poorer habitats. For Stone Lake, one might speculate that even the best habitats were only mediocre during this period. Improved habitat is expected at Stone Lake as 330 ha of cutover aspen enter the 11-to-20-year age class while only 29 ha will go into the 26+ year age class.

DENSITIES BY HABITAT

Habitat Types

At Sandhill, aspen annually supported higher grouse densities than did the oak type. Mean density was 3.9

grouse/40 ha in aspen and 0.9 in oak. Within the aspen type, the aspen-alder habitats supported a mean annual density of 9.8 drummers. Aspen stands of all ages devoid of alder, however, supported a mean density of only 2.0 drummers/40 ha. In aspen stands where alder was not present, grouse appeared to prefer young, dense sapling-sized stands or habitats with a brushy understory cover.

The highest grouse density at Stone Lake occurred in balsam fir habitats, averaging 3.0 drumming grouse/40 ha (Fig. 10). At least half of the fir acreage also included aspen as a major habitat component, and about 30% of the drumming site selections in fir appeared to be influenced by the presence of alder. Alder occurred as a lesser component of many habitats, but where it was the dominant cover type, it was the second most preferred type, with an average of 1.8 drummers/40 ha. Swamp conifer and birch habitats averaged about 1 drummer/40 ha. Aspen averaged less than 1 drummer/40 ha, presumably because most aspen stands were too old or too young to be prime habitat. Densities of <0.5 drummers/40 ha were found in pine and habitats dominated by northern hardwoods. No drummers were located on 107 ha of northern hardwood where aspen was virtually absent. Black spruce and open marshes were also essentially unused habitats. Dorney (1959) reported somewhat different results at Cedar Rapids, Wisconsin in 1956-57. The highest grouse density occurred in aspen, averaging 2.5 drumming grouse/40 ha followed by 2.1 in alder and 1.4 in northern hardwoods. Lesser densities were found in spruce-fir, swamp hardwoods, and poorly stocked uplands. Dorney's aspen and northern hardwood types were mostly (63%) in the sapling-sized (<13 cm dbh) class, however.

Aspen-alder habitats were the most productive coverts, averaging nearly 10 drumming grouse per 40 ha on Sandhill. Management favoring maintenance of aspen-alder habitats should receive high priority.

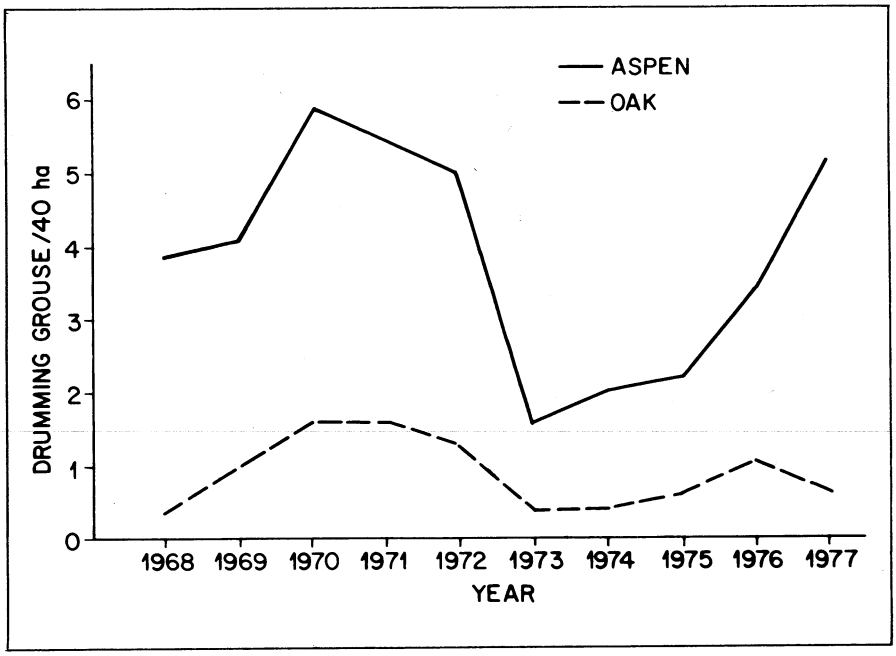


FIGURE 6. *Fluctuations of drumming grouse density by forest type on the Sandhill Wildlife Area, 1968-77.*

Aspen Age Classes

Both mean and annual densities were greater in sapling-sized aspen at Sandhill than in the older aspen. The 1969-77 mean density was 6.7 drumming grouse/40 ha in the 6-to-25-year class, compared with a mean of 1.7 in 0-to-5-year stands and 3.5 in stands more than 25 years old.

At Stone Lake, only 1 drummer was located in 0-to 5-year aspen, and that was in an area of considerable uncut residual overstory. Birds appeared to begin using cutover aspen at Stone Lake after age 10. The acreage of the 11- to-25-year age class was too small to adequately estimate drumming density, but 3 drumming centers were active on 39.7 ha (98 acres) in each year from 1970 to 1975. Use of all other types except fir habitats was much lower during that period.

At Sandhill, drumming which began in aspen during the first five years after commercial clearcutting was done occurred primarily in stands with good residual shrub understories, since residual tree canopy cover was inadequate. Occupancy rates increased dramatically in 6-to-25-year-old stands as sapling growth reached or exceeded 3 m and aspen stem densities ranged from 2,000 to 12,000/ha. Stone Lake aspen stands were poorly stocked with understory shrubs. This appears to delay reestablishment of drumming following aspen harvests.

Implications

Generally, population trends were similar at Sandhill and Stone Lake regardless of forest type or age class. However, forest types or age classes with the highest mean density usually supported the highest density of grouse each year. Thus our data suggest that the major value of better

Young aspen stands in the 6-25 year class were very productive grouse habitats averaging nearly seven drummers per 40 ha on Sandhill. These habitats are a byproduct of commercial timber sales or shearing. Improved drummer densities are expected at Stone Lake as relatively large areas of aspen enter the 11-25 year class.

Use of aspen stands beyond 20 years of age by drumming grouse depended on the composition and density of understory cover. Most stands in this age class have naturally thinned or "opened up" reducing their attractiveness to grouse.

habitat is its ability to maintain higher average grouse densities through both population highs and lows.

Grouse densities at Sandhill were consistently higher in certain habitats, exceeding 9.0 drumming grouse/40 ha through population highs and 3.0 through population lows. Grouse density in aspen at Sandhill was consistently higher but varied from nearly 4 to almost 10 times the density found in the oak type. Greatest differences in density among habitats were usually found during high, rather than low, population periods. These differences in densities were probably the result of differences in cover, which provided differing degrees of protection against severe weather and predators. Higher grouse densities and longer survival of individual birds in better-quality habitats were documented in Minnesota (Gullion 1972). It appeared to us that annual densities were mainly dependent on habitat quality, although from year to year quite drastic changes in grouse density occurred in all habitats.

All habitats appeared incapable of preventing a general population decline from 1971-72 to 1975. Percentage declines in grouse density were similar among forest types on both areas. Generally, proportional declines in grouse density occurred in both poor and good habitats on both areas. These data are not in agreement with prior conclusions that "a cyclic population in perfect habitat does not drop in the same percentage as does a similar population in deficient habitat, even at the

FIGURE 7. *Fluctuations of drumming grouse density within aspen forest type on the Sandhill Wildlife Area, 1968-77.*

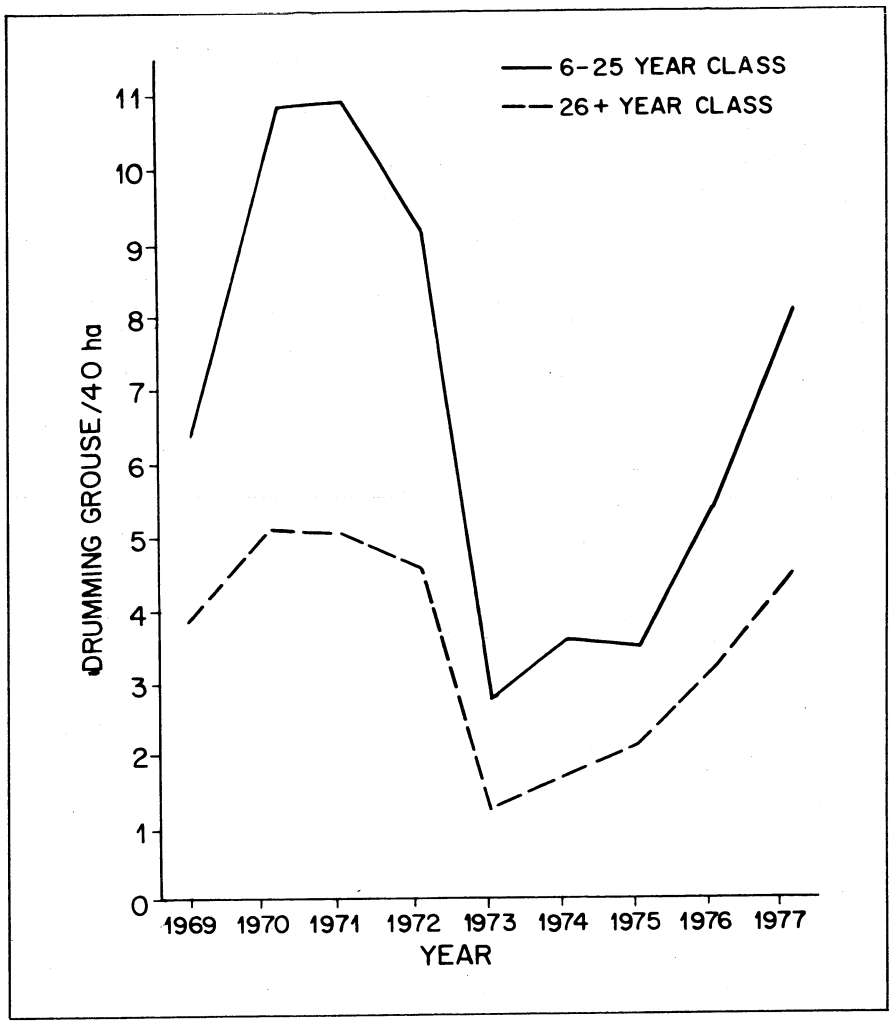


FIGURE 8. *Fluctuations of drumming grouse density by age class of aspen on the Sandhill Wildlife Area, 1969-77.*

low," and that "the amplitude of the small game cycle is greatly reduced in perfect habitat" (Grange 1948). The area of "perfect" habitat on Sandhill and Stone Lake is perhaps not quantifiable, but better quality habitats were assumed to be those which supported higher long-term densities of ruffed grouse.

FACTORS INFLUENCING SELECTION AND DISTRIBUTION OF DRUMMING SITES

Upland-Lowland Edge

At Sandhill, most drumming sites were concentrated in the upland-lowland edge where alder occurred as an understory of aspen (Fig. 11). At Stone Lake, most alder occurred in narrow strips between upland and lowland types. The few large alder swamps there had drumming grouse only along the perimeter. All drumming sites in alder occurred within 40 m of an adjacent type, and 39 of 43 sites were within 20 m.

The concentration of drumming sites in the upland-lowland edges was also reported by Eng (1959), Meslow (1966), and Berner and Gysel (1969). Ideal grouse habitat was described by Dorney (1959) as areas where alder and aspen were intermixed. Based on site descriptions reported from northern Minnesota (Gullion et al. 1962) and northern Michigan (Palmer 1963), most drumming grouse were located on the upland-lowland edges or in alder thickets. But in Alberta, alder occurred throughout the upland aspen stands and, in these areas, Rusch and Keith (1971) found a generally even distribution of drumming sites.

Dense Cover

The presence of adequate understory cover is apparently one of the major factors influencing selection of drumming sites on both Sandhill and Stone Lake. Relatively high densities of grouse were probably maintained in most habitats because of the occurrence of key cover species. These cover species sometimes occurred throughout a stand, but more often were irregularly clumped within it. Our measurements indicated that the prevalent understory cover species at the primary drumming log differed from the dominant overstory species in most of the occupied habitats.

At Sandhill, alder was the predominant understory cover at 44 of 55 drumming sites in aspen stands located along lowland edges. Nine sites were dominated by winterberry. In Michigan pole stands, Palmer (1963) also found grouse concentrated in alder thickets with alder predominant at logs. In the remaining upland sites at Sandhill, American hazel was the predominant species. American hazel was dominant at 32 of 40 sites in oak stands, and 14 of 40 drumming sites in sapling aspen 0-25 years old. Aspen was the dominant log cover at 11 other sites in sapling aspen.

At Stone Lake, selection of more than half of the active drumming centers each year appeared to be influenced by the presence of low-growing fir boughs, and more than one-third by the presence of alder. Balsam fir provided significantly greater overstory cover ($P<0.01$) at drumming sites (47%, n=117) than at random locations (19%, n=139) and was also the dominant understory cover species, but no significant difference ($P>0.05$) was observed between drumming sites (53%, n=117) and random locations (44%, n=139).

The distance to the nearest short-needled conifer from drumming log stages at Stone Lake averaged 2.7 m (9 ft), in contrast to 5.4 m (18 ft) from random locations. Drumming sites protected by balsam fir and/or spruce appeared to be used in preference to nearby aspen stands less than 10 years old. Bump et al. (1947:280) reported that drumming logs on their New York study areas were associated with conifers. Boag and Sumanik (1969) also found that 79% of the drumming log cover in Alberta was provided by white spruce.

Aspen Food Source

Another factor that appeared to influence selection of drumming sites on both areas was the presence of aspen trees more than 25 years old. A male aspen tree of over 13 cm dbh has been reported to provide 8-9 grouse-days of winter feeding on flower buds (Gullion 1972). During a typical arboreal (win-

On Stone Lake, the presence of fir appears to cause some drummers to use pole-sized and larger aspen and birch stands even though deficient in understory shrubs.

This stand of mature aspen mixed with white birch and an understory of balsam fir is typical of many uncut stands on Stone Lake.

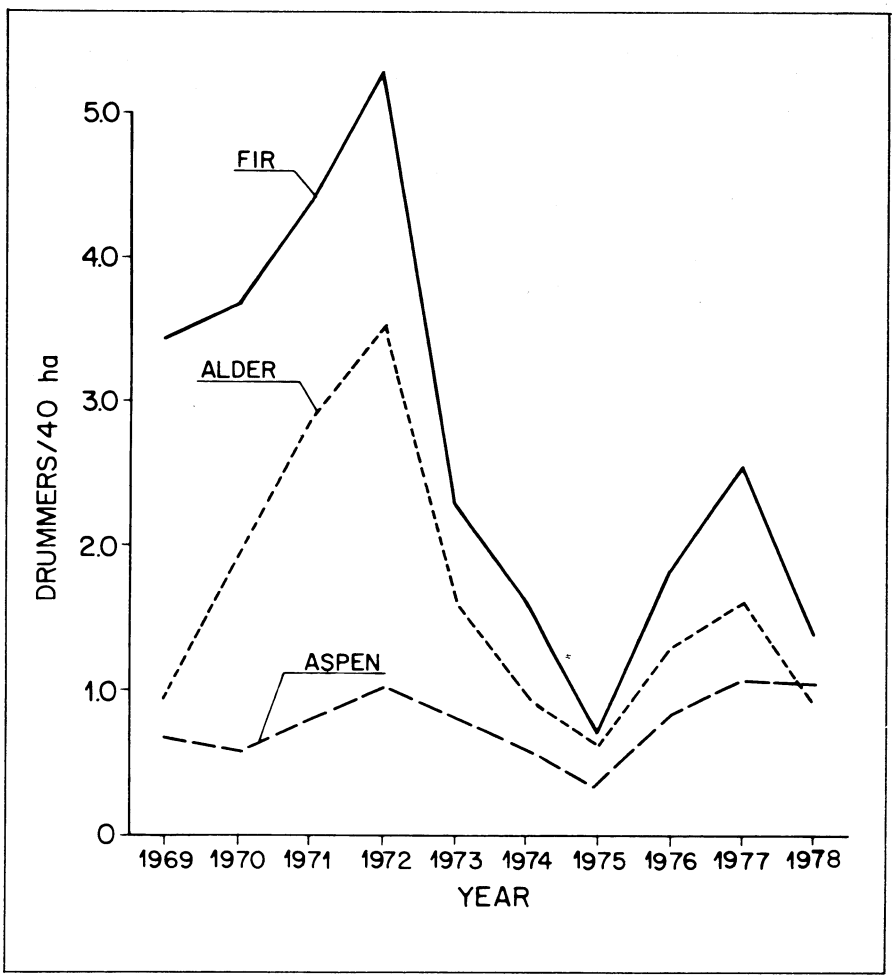


FIGURE 9. *Annual densities of drummers in three habitats of the Stone Lake Area, 1969-78, based on type acreages as of 1975.*

ter) feeding period of 180 days, the number of older male trees required would total only 20-23 trees per grouse. Because a drumming grouse typically occupies about 4 ha (10 acres), its requirement for male aspen trees would be approximately 5 trees/ha (2/acre). Additional trees would be required for female grouse.

At Sandhill, 98% of the (175) drumming sites measured were located within 40 m of at least one mature aspen tree. Additional mature aspen trees, providing overwinter food, occurred in close proximity to most drumming sites. We found that 50 of 58 sites in aspen stands 0-25 years old, all 77 sites in pole-sized aspen more than 25 years old, and 32 of 40 sites in oak stands had more than 5 mature aspens within 30 m of the drumming stage. No estimate was made of how much area existed without the presence of mature aspen trees.

At Stone Lake, drumming sites also appeared related to the presence of older aspen trees. Ninety-two percent of the drumming sites in alder were located within 20 m of a mature aspen tree, and 24 of the 25 measured drumming sites located in white birch were within 30 m of a mature aspen. Mature aspen were common throughout most birch stands, but the several birch

Most drumming sites were concentrated along lowland edges where alder was the predominant species providing understory protective cover.

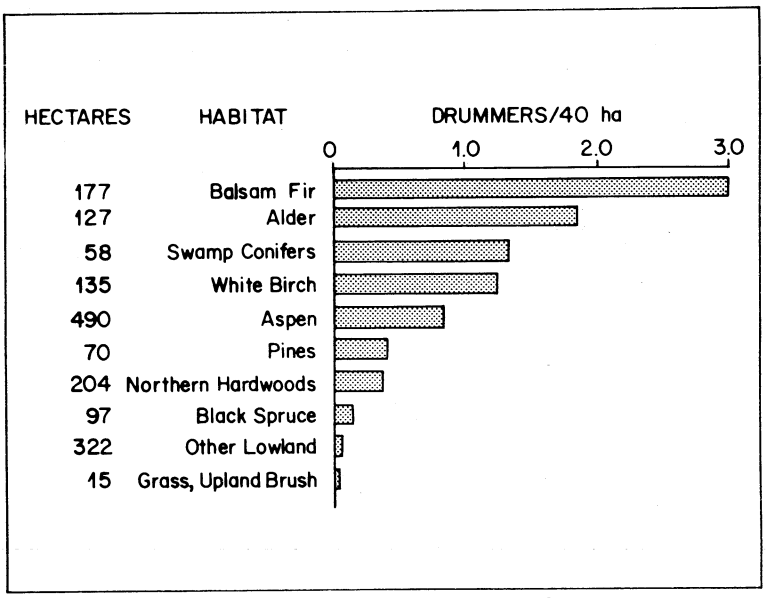


FIGURE 10. *Mean density of drumming grouse by habitat on the Stone Lake Area.*

stands and other forest types without older aspen were devoid of drumming males. The occurrence of mature aspen at drumming sites was higher ($P<0.01$) than at random locations. Ninety-one percent (n=109) of the drumming sites, compared to 66% (n=139) of the random locations, were located within 40 m of mature aspen trees.

As a greater proportion of the aspen is harvested on the study areas, the availability of mature aspens will decrease. Although Moulton (1974) found adequate supplies of aspen flower buds in large clearcuts on residual mature trees (12/ha) and on damaged reproduction, improving timber utilization standards are expected to result in much cleaner clearcutting, reducing availability of residual mature trees.

Other Factors

Basal area of overstory trees, proximity to unseeded woods trails, and closeness to the adjacent forest type were apparently unrelated to drumming site selection except in the case of alder. Use of alder was always near an adjacent forest type.

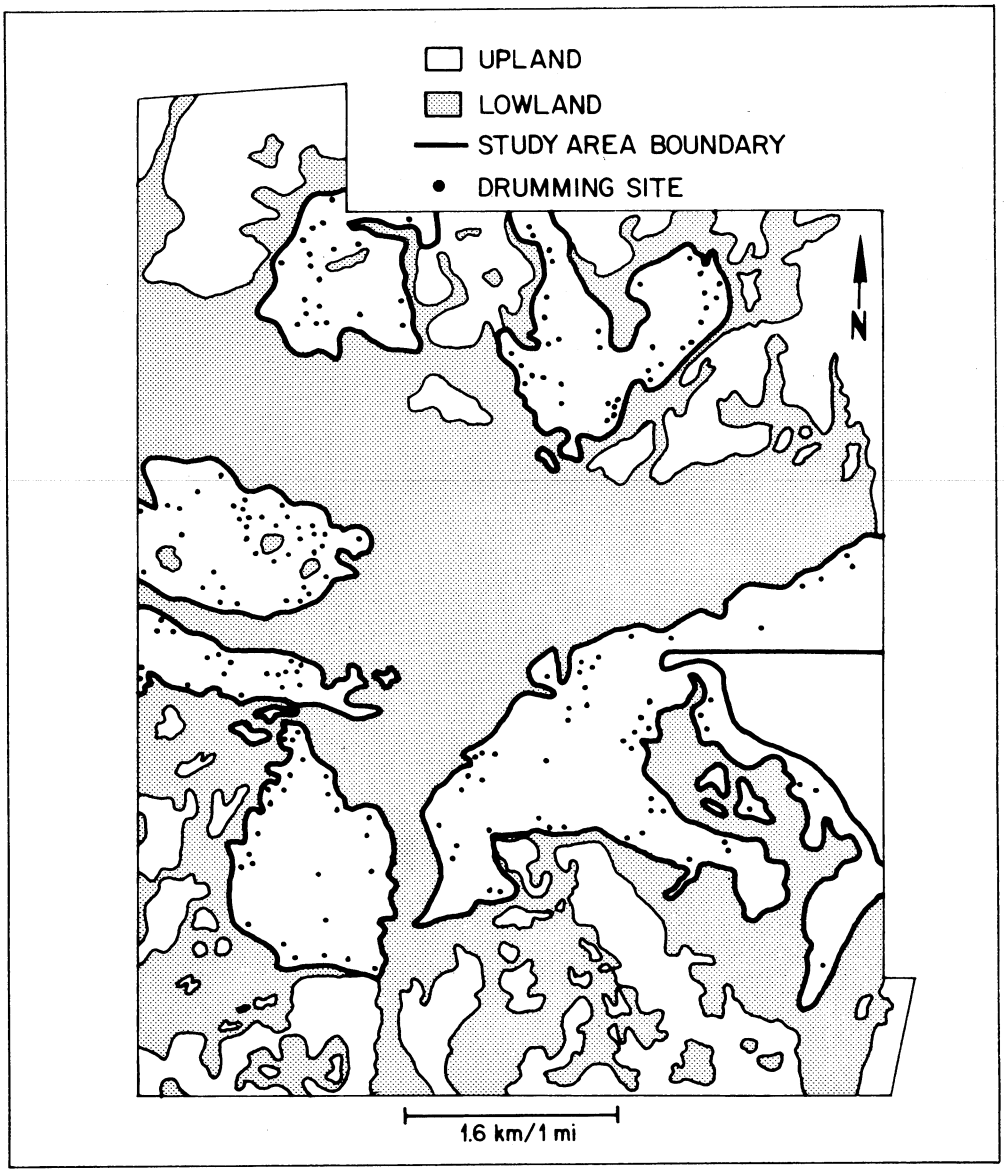


FIGURE 11. *Distribution of drumming sites in relation to the upland-lowland edge on the Sandhill Wildlife Area, 1968-77.*

CONTINUING RESEARCH

Gullion (1972) has indicated that much higher grouse densities can be produced by cutting aspen in small blocks so as to produce an interspersion of age classes. His recommendation was modified and applied on both the Sandhill and Stone Lake areas.

At Sandhill, interspersion of aspen stand ages on the Deer Island tract is being improved through cutting small blocks and strips 100 m wide (Fig. 12). Cut stands will range from 5 ha to 61 ha, averaging 9.7 ha. Though this is perhaps more intensive land management than is practical on other lands devoted primarily to timber production, it will achieve better age-class distribution on Sandhill and will almost create the optimum interspersion recommended by Gullion (1972). About half of the cutting schedule has been completed. Studies are continuing to evaluate the impact of this management on subsequent grouse distribution and density.

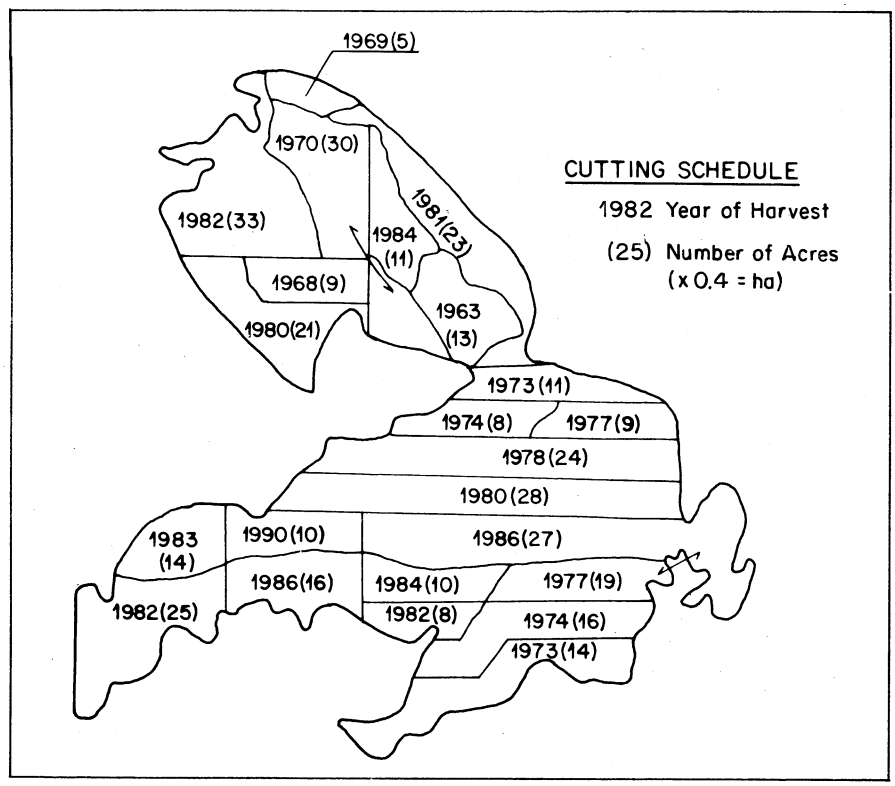
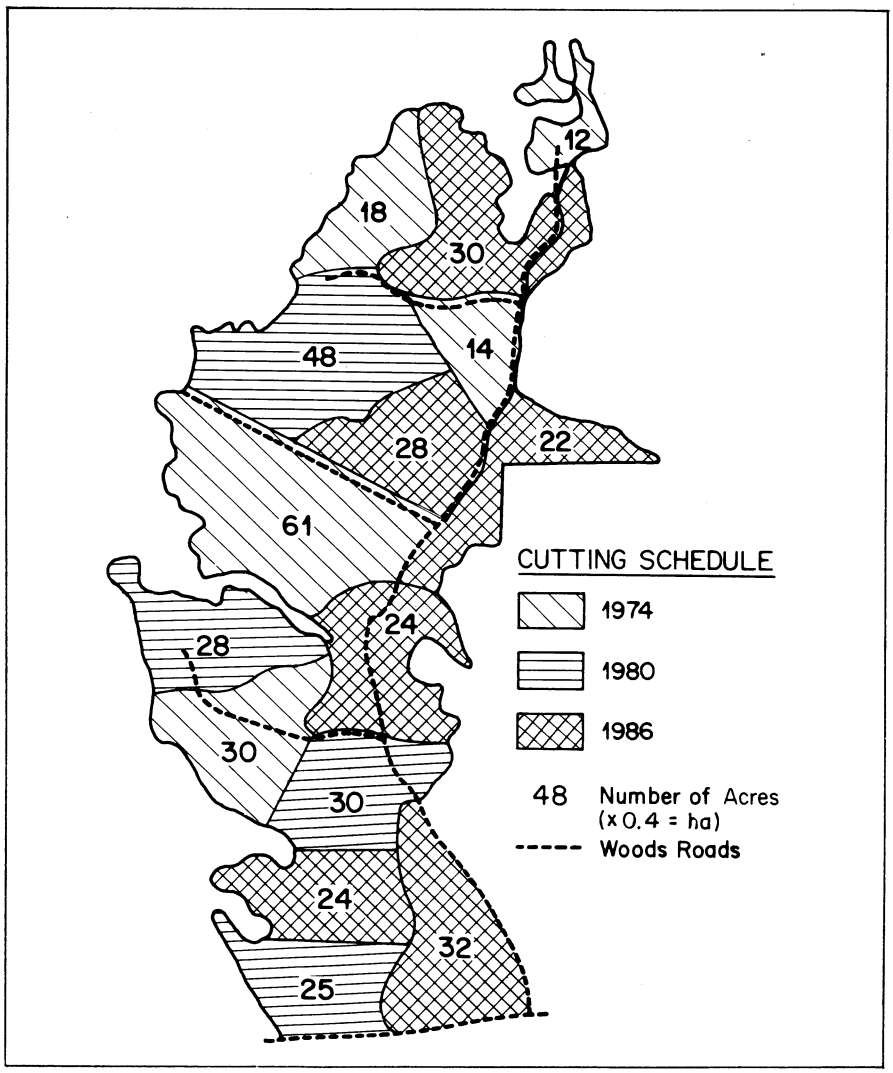


FIGURE 12. *Design of timber harvest units to improve the interspersion of aspen age classes on Deer Island, Sandhill Wildlife Area.*

FIGURE 13. *Design of timber harvest units to improve the interspersion of aspen age classes on compartment 79, Stone Lake Experimental Area.*



On portions of the Stone Lake Area, less intensive modifications of timber sales were applied (Fig. 13). Instead of cutting all aspen within a compartment (100+ ha), as has been general practice and was also done on 2 of 5 Stone Lake compartments, aspen stands were divided into 3 timber sales to be cut at 6-year intervals. Each sale within the compartment included several units of about 12 ha each. This modification is practical within the timber management framework. Aspen will be regenerated in commercial-sized stands while the greatest possible age difference will exist between adjacent cutting units within the limits of the present rotation. About one-third of the cutting schedule has been completed. The impact of this cutting on grouse numbers should become manifest as an increasing area of young aspen enters the 11-to-20-year age class.

Ongoing research at Sandhill and Stone Lake will permit evaluations of 3 levels of intensity of aspen age-class management: traditional large clearcuts at Stone Lake; modified commercial cutting at Stone Lake; and more intensive strip and block cutting at Sandhill. These 3 levels of management will also be compared with optimum management as suggested by Gullion (1972). Recommendations will then be formulated for use on private and public forests.

MANAGEMENT RECOMMENDATIONS

1. Maintenance of the aspen forest type appears essential for preserving huntable ruffed grouse populations in both northern and central Wisconsin. Although aspen acreage has been decreasing, it still comprised 29% of Wisconsin's commercial forest in 1968 (Spencer and Thorne 1972). Relatively high densities of grouse can be supported in aspen, but it is likely that these densities would be reduced by 80% or more if aspen were converted to pine or northern hardwood. Pole or saw-timber stages of northern hardwoods, oak, spruce, and pine types, without well-developed understories, have significantly lower potential as grouse habitat.
2. The aspen-alder habitat is highly productive for ruffed grouse and should be maintained. Alder provides a consistently good source of cover, and aspen provides a nutritious year-round food. This habitat is most common on areas of high water table or poor soil drainage.
3. Management efforts to achieve greater age-class interspersion should continue on the public forests insofar as is practical in existing mature and overmature aspen. Opportunities for even better age-class interspersion will be available during the next rotation of aspen.
4. Some noncommercial residual (12+/ha) mature aspen trees should be retained in large aspen sales when postsale treatments are prescribed to remove unwanted competition.

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APPENDIX

A. SCIENTIFIC NAMES OF PLANTS CITED*

Alder (*Alnus rugosa*)
Ash (*Fraxinus* spp.)
Aspen, bigtooth (*Populus grandidentata*)
Aspen, trembling (*P. tremuloides*)
Balsam fir (*Abies balsamea*)
Basswood (*Tilia americana*)
Birch, bog (*Betula pumila*)
Birch, white (*B. papyrifera*)
Cedar, white (*Thuja occidentalis*)
Dewberry (*Rubus* spp., mainly *R. hispidus*)
Hazel, American (*Corylus americana*)
Hazel, beaked (*C. cornuta*)
Hemlock, eastern (*Tsuga canadensis*)
Maple, red (*Acer rubrum*)
Oak, northern pin (*Quercus ellipsoidalis*)
Oak, northern red (*Q. rubra*)
Oak, white (*Q. alba*)
Pine, jack (*Pinus Banksiana*)
Pine, red (*P. resinosa*)
Pine, white (*P. Strobus*)
Sedge (*Carex* spp. and *Scirpus* sp.)
Spruce, black (*Picea mariana*)
Tamarack (*Larix laricina*)
Willow (*Salix* spp.)
Winterberry (*Ilex verticillata*)
Wintergreen (*Gaultheria procumbens*)

*Plant reference: Gleason and Cronquist (1963).

B. HABITAT TYPES FOUND ON STUDY AREAS

Habitat Type	Description	
	Sandhill/Wood County	Stone Lake
Aspen	Upland stands dominated by trembling aspen with scattered white birch, red maple, or oak. American hazel is common in understory. "Off-site" stands are open grown on wet soils with scattered shrubs.	Upland stands dominated by trembling or bigtooth aspen with variable mixtures of white birch and/or balsam fir. Beaked hazel is a common shrub.
Aspen-Alder	Trembling aspen on upland and wet sites with alder and winterberry understories.	
Balsam Fir		Stands of nearly pure fir, but most commonly mixed with aspen and/or birch.
Black Spruce		Lowland stands of nearly pure black spruce.
Lowland Brush (alder)		Stands dominated by alder in large stands with scattered black spruce or on upland-lowland edges.
Northern Hardwoods		Stands dominated by sugar maple with variable mixtures of basswood, white ash, aspen, white birch, and eastern hemlock.
Oak	Pin, white, and northern red oak with scattered bigtooth aspen, white birch, or pine in the overstory and American hazel or scattered pine in the understory.	
Other Lowland		Primarily open marshes dominated by sedges or muskeg, but including small amounts of tamarack and stagnant black spruce.
Pine	Natural and planted stands of jack, red, and white pine.	Natural stands of predominantly red or jack pine.
Swamp Conifers		Mixed stands of black spruce, balsam fir, and white cedar, usually with alder in the understory.
White Birch		Stands of nearly pure white birch or mixed with aspens and/or balsam fir.

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John Kubisiak and Keith McCaffery are project leaders with the Forest Wildlife Research Group in the Bureau of Research at the Sandhill Wildlife Area and at Rhinelander, respectively. John Moulton was formerly with the Research Group in Rhinelander.

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