Ruffed grouse (Bonasa umbellus), a forest-dwelling gamebird whose range stretches across much of the northern tier of the United States, has a particular association with aspen. The birds prefer dense stands of saplings and tall shrubs—about 8,000 stems per acre—as wintering, breeding, and brood habitat. Males use fallen trees, boulders, or large roots in such stands as stages for "drumming," by which they define their territories and attract mates in spring; the females prefer stands of aspen poles for nesting. And for both sexes, the male flower buds on mature aspen are a principal winter food.

Following years of ruffed grouse research at the Cloquet Forest in Minnesota, Gullion (1972, 1977) developed recommendations for grouse habitat management. Because grouse home ranges encompass only about 10 acres, Gullion suggested, among other things, frequent clearcutting of systematically spaced patches of 1 to 5 acres to provide young aspen close to mature aspen. Such small patches, however, are not ideal for standard commercial logging. How would ruffed grouse respond to cutting units larger and more economically feasible than those suggested by Gullion?

**Study Description**

The Stone Lake study area is a 4,200-acre tract of five cutting compartments within the Northern Highland-American Legion State Forest in north-central Wisconsin. About 3,300 acres is forested and could be considered potential grouse habitat. The area contains a variety of forest types representative of Wisconsin's extensive northern forest. Most of the area is surrounded by water or wetlands; hunters therefore enter and exit via a dead-end road, which facilitated interviews.

Habitat types were classified by the predominant overstory species in the stand. Of the upland types, aspen-dominated habitats (mostly Populus tremuloides) occupied about 29 percent of the area, followed by white birch (Betula papyrifera, 9 percent), balsam fir (Abies balsamea, 9 percent), northern hardwoods (mainly sugar maple, Acer saccharum, 8 percent), pines (Pinus sp., 4 percent), and eastern hemlock (Tsuga canadensis, 2 percent). Generally, understory shrubs were uncommon, the principal species being beaked hazel (Corylus cornuta) in upland stands. Of the lowland types, unproductive marsh types occupied 21 percent of the area, along with lowland conifers, primarily black spruce (Picea mariana, 6 percent), northern white cedar (Thuja occidentalis, 3 percent), and lowland brush, mostly speckled alder (Alnus rugosa, 8 percent). Upland soils were mainly stony sandy-loams.

When the study began in 1967, two of the five forest compartments had already been scheduled for timber cutting. Essentially all commercial hardwood was cut or thinned within a six-year period, including 188- and 283-acre areas of regeneration-cut aspen. In the remaining three compartments, smaller, dispersed patches of aspen were scheduled for cutting over a longer period to improve aspen age-class interspersion. The average size of these demonstration patches or cutting blocks was 22 acres. A sale often included two or more cutting blocks.

The initial plan was to have three cutting periods with at least a four-year
interval between adjacent cuttings in the demonstration compartments. We feared that the existing age of the mature aspen (some approaching 50 years) precluded an optimal 10-year interval in this rotation. In practice, the temporal spacing of cuts was seven or eight years because of delays caused by fluctuating pulp markets.

A hunter check station was located at the entrance to the study area. Periodic interviews were conducted to document hunting methods and success and to calibrate voluntary responses received when the station was not occupied. Hunters were given maps of the area and briefed on what would be asked of them when exiting the area. Times were recorded when vehicles entered and exited. In most years a voluntary check station enabled hunters to record numbers of grouse seen and numbers harvested. A pneumatic counter was used to record traffic volume each year during the hunting season. Many of the access trails were seeded with clover and mowed after timber cuttings to increase trail attractiveness to grouse and hunters during early years of the study.

A complete census of active drumming males was conducted each spring by ground searches and listening (Gullion 1966). All active drumming stages were marked and the locations recorded by pinpricks on aerial photographs. Each drumming site and adjacent habitat were described. Drummer census trends on the study area were compared with regional roadside drumming counts (Thompson and Moulton 1981). Fall grouse populations were approximated by multiplying spring drummer counts times six, similar to Gullion (1981) and Kubisiak (1984). Hunter effort and reported harvests were used to calculate harvest exploitation, as done at the Sandhill Wildlife Area (Kubisiak 1984).

Habitat Preferences

The study period included three peaks in the cyclic abundance of ruffed grouse (fig. 1, p. 18). These cycles of relative abundance and scarcity in the northern Lake States seem to be driven by invasions of boreal raptors every 10 years or so (Keith and Rusch 1989). For the first 13 years of our study, the drummer census correlated very well with the regional roadside drumming index ($r = 0.96$, $P < 0.001$). Beginning in about 1981, the indices diverged. We attributed this divergence to the increase in prime-age (eight- to 24-year-old) aspens on the study area.

Early in the study, the majority of drummers were associated with lowlands, especially in white cedar with an understory of alders. Many other drumming sites were associated with upland-lowland edges. In both habitats, drummers were found in habitat types used earlier in the study—lowland and edges of upland. Though the alder habitat was still available, its stem density— and thus quality—was lower in places because of self-thinning.

Of 12 habitats rated, only aspen saplings, swamp conifers, and balsam fir had drummer densities that exceeded the average for the study area (fig. 3, p. 19). Drummer densities in all other habitats, including older aspen habitat, were below the average. Pine habitats had the lowest use by drumming grouse, and no drummers were found in mature hemlock stands.

An analysis of drummer locations by aspen age class indicated that the highest use occurred between eight and 24 years. Well-stocked aspen had to reach 15 to 20 feet (usually at seven or eight years) before it became preferred drumming habitat. The period that an aspen stand was preferred by drumming grouse appeared to vary with site index and understory shrubs. Its attractiveness to drummers at Stone Lake appeared to decline rather suddenly after age 25 as aspen stem densities declined through self-thinning.

A comparison of drummer density trends on the traditionally cut and demonstration compartments was initially a bit disappointing. We had expected disproportionate increases in

**Mature aspen stands provide seasonally important food for ruffed grouse, and dense, young stands provide breeding, brood, and winter cover.**

Although research indicates that harvesting large stands of aspen has an insignificant effect, the overall decline of aspen habitat in the Lake States could affect many such early-succession wildlife species.
Table 1. Drummer densities in prime-aged aspen by treatment and compartment during two periods of high grouse populations on the Stone Lake Area.

<table>
<thead>
<tr>
<th>Treatment and Compartment</th>
<th>Aspen saplings</th>
<th>Total drummers</th>
<th>Drummers per 100 acres per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78</td>
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<td>80</td>
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<td>367</td>
<td>46</td>
</tr>
<tr>
<td>Demonstration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>82</td>
<td>167</td>
<td>10</td>
</tr>
<tr>
<td>85</td>
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<td>6</td>
</tr>
<tr>
<td>Total or average</td>
<td>143</td>
<td>318</td>
<td>31</td>
</tr>
</tbody>
</table>

These periods were chosen because they seemed to coincide with regional high populations and gave some temporal spread. An intercyclic high population in 1985-86 exceeded densities from 1980-82.

ruffed grouse in the demonstration compartments, but there has been virtually no difference to date. The amount of aspen sapling habitat in the traditionally cut compartments is now at its peak and will decline for the remainder of the aspen rotation, whereas in the demonstration compartments, a continuous flow of sapling habitat will occur throughout the aspen rotation. Thus, we expect disproportionately higher densities of ruffed grouse in the demonstration compartments during the next decade, and planned counts of spring drummers will test this hypothesis.

A compartment-by-compartment analysis of aspen cuttings found some differences of potential significance to managers (table 1). Compartments 78 and 80 were traditionally cut when relatively poor aspen markets resulted in a two-stick limit (loggers were not required to cut trees with fewer than two merchantable 8-foot sticks). This resulted in variable amounts of residual overstory: basal area ranged from 7 to 78 square feet. Many stands in compartment 80, including a 243-acre contiguous tract, were subsequently cleared of residual trees. Modest numbers of grouse soon occupied stands containing residual trees in compartment 78, but drummer densities remained relatively low and even declined in the next decade as aspen stocking was reduced by competition. Grouse response in the clean clearcuts of compartment 80 was initially delayed during the 1970s but appeared stronger and lasted longer than in compartment 78 once higher aspen stem densities were achieved and maintained, in the 1980s. Despite the large-scale cutting in compartment 80, subsequent drummer densities in aspen saplings, though lower, compared favorably with densities in patch-cut aspen in the demonstration compartments.

Clearcuts with minimal or no residual overstory appeared to create habitats attractive to ruffed grouse. The highest densities of grouse were found in the demonstration patch-cut aspen saplings. If 10 drummers per 100 acres is an indication of optimal grouse habitat (Gullion 1990), patch clearcuts averaging 22 acres appeared to be 83 percent as effective as 10-acre patches.

Grouse Harvest Management

Though overharvest was not a concern at Stone Lake, there is evidence that no more than 40 to 50 percent of a grouse population should be taken (Rusch et al. 1984). The reported grouse harvest at Stone Lake was correlated with counts of spring drummers ($r = 0.65, P < 0.001$). However, neither harvest nor hunting effort was measured precisely. By pooling data from several years, we attempted to gain some insight into exploitation rates (percent of population harvested per unit effort (hunting hours per square mile)).

When clover-seeded mowed trails were provided, birds seemingly were attracted to the trails, thereby increasing their vulnerability to hunters. The proportion of hunters who hunted from vehicles declined when mowed trails became available. It appeared that the grouse population could have sus-
tained about 250 hunting hours per square mile.

When mowed trails lost their clover component, the exploitation rate decreased; we project that 330 hunting hours per square mile could have been sustained. In recent years, trails have not been mowed, further reducing their attractiveness to both birds and hunters. Under these conditions more than 600 hours per square mile could have been allowed without imperiling the grouse population. However, the quality of the hunting experience, defined by flush and harvest rates, has suffered, and it is likely that fewer hunters leave their vehicles.

Those results illustrate two significant findings: (1) exploitation rates per unit effort vary with each area’s access and habitat characteristics, and (2) regulating trail development (and parking areas) could have a much greater effect on grouse exploitation than altering bag limits or season lengths. For example, the daily bag limit at Stone Lake was five birds, but only one of 519 hunters interviewed during two years of high grouse population bagged more than two grouse. Reducing the bag limit would therefore have had negligible effect. Moreover, because most grouse are harvested in the first half of the hunting season in the upper Lake States (Gullion 1983), shortening the season would likewise have only minor effect on harvest. Management practices that increase hunter success should be implemented with caution if high hunting pressure is anticipated.

Options for Aspen Management

Our findings corroborate what other investigators have learned: that the future of ruffed grouse abundance and hunting in the Lake States is closely tied to the future of aspen. The amount of aspen habitat in Wisconsin has declined considerably from 5.1 million acres in 1936, following the initial logging and fires early in this century, to about 3.3 million acres in 1983 (Spencer et al. 1988). Forest succession and type conversion continue to erode this acreage.

Consensus is that aspen in Wisconsin will continue to decline. What is debated is whether the rate of this decline should be resisted or assisted. Ruffed grouse are not the only species to be affected: many other early-succession species—e.g., shrub-dependent warblers, American woodcock (Scolopax minor), and snowshoe hares (Lepus americana) and the predators that prey on them—depend on aspen stands. We therefore argue for maintaining aspen management options for the future. Once lost from the landscape, aspen stands will not likely be reestablished. Few areas in North America are so amenable to the maintenance of early-succession deciduous forest as the Lake States, and maintaining aspen communities in this region may be essential to preserve important components of biological diversity.

Literature Cited

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