RUFFED GROUSE

(Bonasa umbellus)

Source: Salt and Salt (1976)

Prepared for Millar Western Forest Products' Biodiversity Assessment Project

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1.0 CONSERVATION AND THE EFFECT OF FOREST ACTIVITIES

1.1 Introduction

The Ruffed Grouse (*Bonasa umbellus*) inhabits a variety of forested habitats throughout Canada and across the United States as far south as California and Georgia (Aldrich 1963). Because of its strong preference for aspen woodlands, its geographic range coincides with the distribution of aspen-dominated forests (Gullion 1990a; McCaffery *et al.* 1997).

1.2 Effects of Forest Management Activities

Since the Ruffed Grouse depends on aspen forests in various successional stages, forestry activities have the potential to influence its habitat by causing shifts in both the species composition and the age-class distribution of the stands. Grouse require some developing, some young, and some immature-mature-old aspen forests in proximity to each other. For this reason, they do not respond favourably to timber harvesting practices that encourage landscape uniformity (McCaffery *et al.* 1997). If managing only for Ruffed Grouse, Gullion (1990a) suggested that aspen should be harvested every ten to 12 years in small blocks of less than 4 ha. This practice, though not as economically attractive as the traditional system, would be beneficial for Ruffed Grouse, as the range of age classes that constitute its habitat would be maintained indefinitely (McCaffery *et al.* 1997).

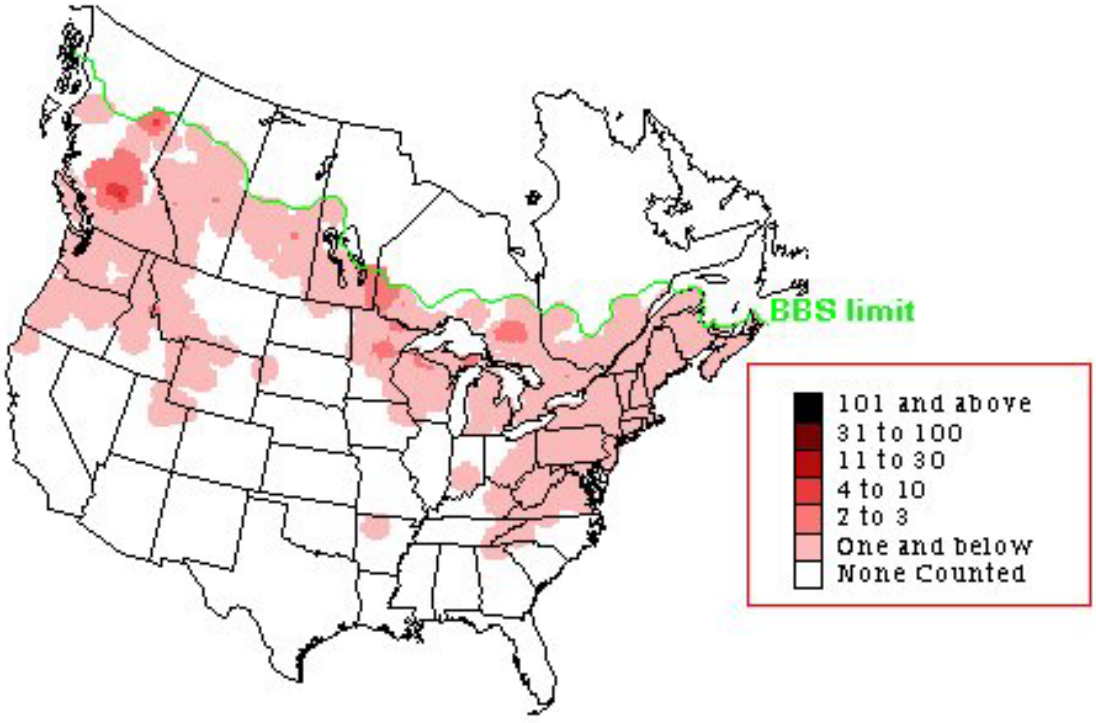

Figure 1. Breeding distribution of the Ruffed Grouse in North America, BBS data (Gough *et al.* 1998).

2.0 HABITAT USE INFORMATION

2.1 Food Requirements

The preferred foods of the Ruffed Grouse are the buds, catkins, and leaves of aspen species (Gullion and Svoboda 1972; Doerr *et al.* 1974; Brinkman and Roe 1975; Jakubas *et al.* 1987; Rickers *et al.* 1995). In particular, it is the aspen bud that is most desirable (Gullion 1990a; McCaffery *et al.* 1997). It has been shown that aspen is used as food by Ruffed Grouse six times as often as all other species combined (Gullion and Svoboda 1972). It is an important food source throughout the bird's range (Brown 1946; Phillips 1967; Schemnitz 1970; Doerr *et al.* 1974; Gullion 1977; Gullion 1981; Kubisiak *et al.* 1980; Stoll *et al.* 1980; Schulz *et al.* 1983). In Alberta, the preferred species after aspen is willow (Doerr *et al.* 1974). Preferred food material is readily available in immature, mature, and old aspen forests (*i.e.,* those older than 25 years of age).

In areas where aspen is scarce, the bird will supplement its diet with the fruits, nuts, twigs, leaves, and flowers of a variety of tree, shrub, forb, and grass species including willow, elm, hazel, birch, oak, dogwood, huckleberry, blueberry, current, viburnum, sumac, cherry, rose, serviceberry, greenbriar, mountain-laurel, wintergreen, strawberry, dandelion, clover, and wild lily-of-the-valley (Swenson 1957; Gullion and Marshall 1968; Gullion 1971; Brinkman and Roe 1975; Perala 1977; Crowder and Taylor 1984; Webb 1986; Burger 1987; Barber *et al.* 1989). Since the foods chosen by this species contain significant quantities of moisture, grouse need not reside close to water (USDI 1985).

While adults consume almost exclusively plant material, chicks depend heavily on insects and other small invertebrates during the first two weeks of their lives (Semenchuk 1992). As this food source is both available and accessible in recently clearcut and regenerating stands, young grouse prefer to inhabit these areas during their first summer. In particular, the very young (< 10 years old) aspen stands are most suitable as chick summering habitat (Gullion and Svoboda 1972). Hannon (pers. comm. 1999) mentioned that it may be the cover characteristics of these stands, in addition to their ample food supplies, which chicks require. Though no literature was found to support this suggestion, it is feasible.

Optimal foraging conditions are typically found within (Brinkman and Roe 1975; Perala 1977; Arthaud and Rose 1996):

- Clearcut and regenerating aspen forest for young birds; and
- Immature, mature, or old aspen forest for adults.

2.2 Cover Requirements

The Ruffed Grouse is able to inhabit a variety of different plant communities, such as the mixed-conifer forests of spruce, fir, pine, and larch as well as deciduous stands of aspen and willow (Grange 1948; Hungerford 1951; Dorney 1959; King 1969). Survival rates have consistently been shown to be higher in deciduous-dominated (particularly aspen) forests than in stands supporting predominantly coniferous trees (Gullion 1967; Gullion 1968; Gullion 1970; Gullion 1971; Gullion 1972; Stauffer and Peterson 1986; Gullion 1990a; Gullion 1990b; Peterson 1990).

Winter Cover

Grouse prefer young deciduous-dominated forests to carry out over-wintering activities (Gullion 1972). During winter, Ruffed Grouse frequently burrow beneath the snow to hide from predators and for insulation against low temperatures. To successfully complete this behaviour, deep snow accumulations are required. Since coniferous stands better intercept snow, snow depth tends to be greater within deciduous stands.

In particular, grouse seek effective winter thermal and hiding cover in:

- Deciduous-dominated stands; and
- Young stands of 10 to 25 years of age (immature).

Hiding Cover

The major predators of Ruffed Grouse in Alberta are the Great Horned Owl, Canada Lynx, and Northern Goshawk (Rusch and Keith 1971; Doerr *et al.* 1974; Small *et al.* 1991). Grouse prefer to inhabit stands in which shrubs exist in sufficient abundance to provide hiding cover. Shrubs of height 2.5 to 3.4 m (Gullion 1967; Gullion 1968; Gullion 1972; USDI 1985) provide optimal hiding cover. While sites with shrubs of only 0.9 m height may be used, the plants should be at least 1.5 m tall to provide sufficient protection. Though this habitat feature is most important during the courtship and breeding season, for reasons described in the following section, it is thought to be beneficial for the Ruffed Grouse to be surrounded by suitable hiding cover at all times (USDI 1985).

Sufficient hiding cover is typically found within young stands (ten to 25 years old) with:

- A dense shrub layer; and
- A minimum shrub height of 0.9 m, but preferably > 1.5 m, and optimally between 2.5 to 3.4 m.

2.3 Reproduction Requirements

During courtship, which begins in April, males 'drum' on prominent downed logs or other materials in an attempt to attract a mate (Gullion 1967; Gullion 1968; Gullion 1972). The upper surface of the chosen drumming position is generally between 29.5 and 34.4 cm above ground. An elevated drumming location allows the male to survey his surroundings. Shrub height and density in the vicinity of the drumming log is of great importance since the bird is exposed and vulnerable to predation while drumming and shrubs may provide appropriate hiding cover. Therefore, during the breeding season Ruffed Grouse are attracted to young forest stands with abundant shrubs. Additional security is provided by a stand with relatively high stem density (Brinkman and Roe 1975; Perala 1977; USDI 1985; Arthaud and Rose 1986).

Female grouse construct nests near the base of a tree or stump on the forest floor in areas with slightly less shrub cover than the drumming site (Gullion 1967; Gullion 1968; Gullion 1972; USDI 1985; Anonymous 1986). A clutch of eight to 14 eggs is laid about three weeks following mating. Incubation generally lasts between 23 and 26 days. The young are precocial and leave the nest very shortly after hatching, becoming independent of the female at about eight to ten weeks of age (Gullion 1967; Gullion 1968; Gullion 1972). Typically, only three to four chicks survive the first summer (Gullion 1967; Gullion 1968; Gullion 1972).

Breeding and nesting habitat generally occurs within stands that:

- Are aspen-dominated;
- Are between ten and 25 years of age;
- Have canopy closure > 50%;
- Have tree height > 4.6 m;
- Have dense shrub cover; and
- Have shrub height > 0.9, optimally between 2.5 and 3.4 m high.

2.4 Habitat Area Requirements

The home range size of both males and females is variable and changes drastically with season and activity (USDI 1985). A male's range can be as small as 2.4 ha during the drumming season and as large as 9 ha while foraging. A female can range from 0.9 ha during incubation to 50 ha when moving her brood in search of optimal habitat (Gullion 1968; Gullion 1972; Gullion and Svoboda 1972; Pietz and Tester 1982; Kubisiak 1985; USDI 1985). Godfrey (1975) found that the maximum distance moved by a brood in one day

was 966 m. Average daily movement was estimated at 377 m. Therefore, to ensure that each family will have enough space, the minimum area used for the development of the HSM is ~50 ha (a circular section of forest with radius of 400 m) or the average distance travelled by a brood of grouse (USDI 1985).

2.5 Landscape Configuration Requirements

As discussed above, the most important aspect of Ruffed Grouse habitat is the presence of aspen-dominated stands in various stages of succession (USDI 1985). Rickers *et al.* (1995) suggested that equal proportions of aspen should be present in regenerating, young, and immature-mature-old stages. It has been recommended by Kubisiak (1985) that the proper mosaic of habitat types will be provided if each developmental stage comprises 2 to 8 ha. Gullion (1990a) stated that 10% of the habitat should be young forest (ten to 25 years old) and that these stands will optimally be within 90 m of mature aspen forest. In areas where coniferous vegetation dominates, Ruffed Grouse will be given appropriate foraging opportunities if relatively pure aspen sites of at least 0.4 ha are present. These islands of aspen will successfully support Ruffed Grouse populations if at least one exists for every 4 ha of coniferous forest (Gullion 1990a) or as long as 10% of the area consists of aspen stands.

Following the suggestions of the authors noted above, the proportions of each habitat type to be present within the 50 ha home range to provide optimal conditions for HSM development are:

- 10% clearcut-regenerating aspen forest (5 ha);
- 10% young aspen forest (5 ha);
- 10% immature, mature, and/or old aspen forest (5 ha);
- Minimum 10% aspen within a coniferous stand; and
- All present within 50 ha area (circular window of radius 400 m).

For the young birds to successfully disperse, the spatial configuration of aspen stands within the landscape must be suitable. Small patches of suitable habitat scattered throughout the landscape will not be as suitable for this purpose as contiguous aspen forest (Hannon pers. comm. 1999).

2.6 Sensitivity to Human Disturbance

Ruffed Grouse are known to avoid human contact in the natural environment (Sharpe *et al.* 1998). Human activity can negatively impact grouse populations through the habitat alteration resulting from forestry and agriculture or through hunting and road kills (USDI 1985). Studies by Fischer and Keith (1974) in Alberta suggested that the territorial male, in particular, is susceptible to hunting mortality since its drumming behaviour notifies hunters of its location. This research revealed that loss of these males to hunting decreased significantly with distance from roads. Of the birds banded, 48, 13, 5, and 1% were shot within < 101, 101 to 200, 201 to 301, and > 302 m, respectively of roads. In addition to notifying hunters of the presence of grouse, there is a greater opportunity for the paths of grouse and humans to cross since both human and grouse activity may be higher along roadways. Grouse frequent roads to sun themselves on cool mornings and evenings and to eat the herbaceous vegetation along roadsides.

3.0 MODEL

3.1 Envirogram

There are three elements that influence Ruffed Grouse selection of habitat: acquisition of food resources, shelter from cold, and escape from predators and hunters. The forest attributes thought to affect the ability of the grouse to achieve these goals are displayed in the envirogram below (Figure 2). Appropriate forest cover is provided by aspen stands in a range of developmental stages. During the courtship season, male Ruffed Grouse use large-diameter downed woody debris and possibly other materials on the forest floor as drumming sites. This resource does not appear to be limiting, and is, therefore, not further considered in the HSM. Additionally, the habitat must provide suitable hiding cover composed of a dense shrub layer of appropriate height and/or trees with low height to crown. Protection from hunters and vehicular traffic is enhanced with distance from roads.

3.2 Application Boundaries

Season: This model produces SI values for year-round use.

Habitat Area: Home range size used for home range smoothing is 50 ha for a family.

Model Output: The model assigns a SI value for cover and hiding cover habitat suitability to each 25 m pixel of forested habitat.

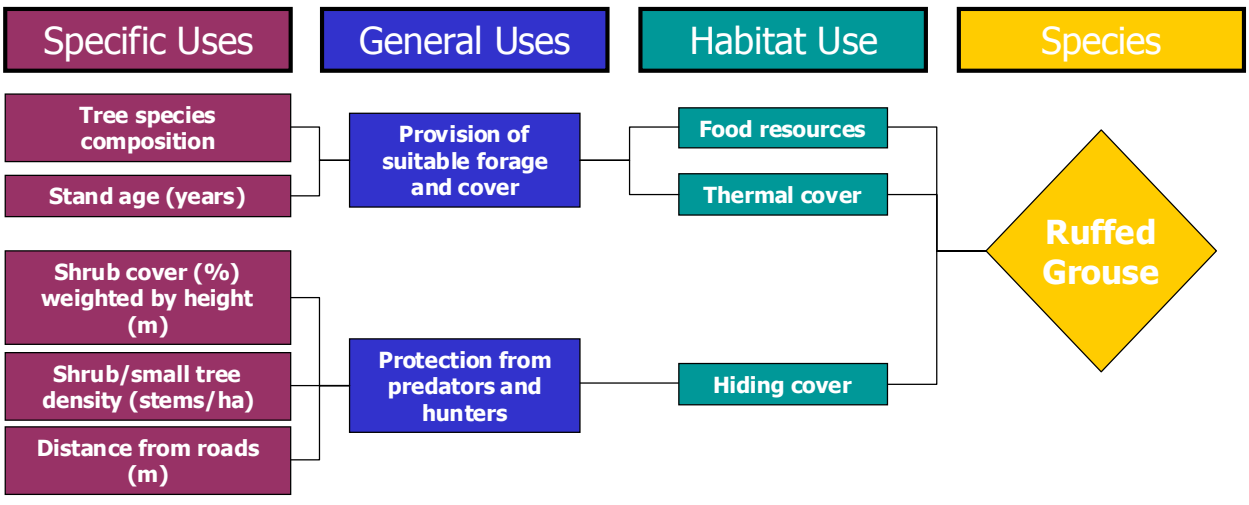

Figure 2. Envirogram of the Ruffed Grouse based on available habitat information for HSM development.

3.3 Model Description

The HSM structure for Ruffed Grouse habitat follows the envirogram (Figure 3). As the forest attributes required for foraging/thermal cover (referred to below as cover) are all critical and needed at the same time, no compensation is allowed between them.

The SI_{cover} involves an evaluation of the tree species composition and the proportion of each developmental stage within the stand.

Ruffed Grouse require protection from predators during all daily activities but especially during the drumming season when males are extremely vulnerable to predation. The SI_{hiding} is composed of variables indicating shrub cover and small tree density. Since either of these variables can provide hiding cover, they are fully compensatory. Also included in this equation is an indication of vulnerability to hunting mortality, assessed by distance to roads.

3.4 Habitat Variable SIs

Cover

The habitat variables comprising the SI_{cover} are the tree species composition of the stand (S_{c1}) and its developmental stage (S_{c2}, S_{c3}, and S_{c4}). As shown in Figure 4, at least 10% of the stand must be composed of aspen to be appropriate habitat. A greater percentage of aspen in the stand provides better cover conditions for grouse to a maximum at 30% representation. As recommended by several authors, the home range will optimally consist of an area of 2 to 5 ha within each developmental stage (Figure 5).

Hiding

The variables considered in SI_{hiding} are shrub cover weighted by height (S_{h1}), small tree density (S_{h2}), and proximity to roads (S_{h3}). Ruffed Grouse require significant vertical and horizontal concealment cover to protect them from predators. The shrub canopy should be dense (optimally > 50% cover, Figure 6). Figure 7 shows that habitat suitability increases with small tree density. Shrubs and small trees suitable as horizontal hiding cover are identified as those that have height to live crown < 1 m and dbh > 5 cm. As seen in Figure 8, habitat distant from roads is most suitable.

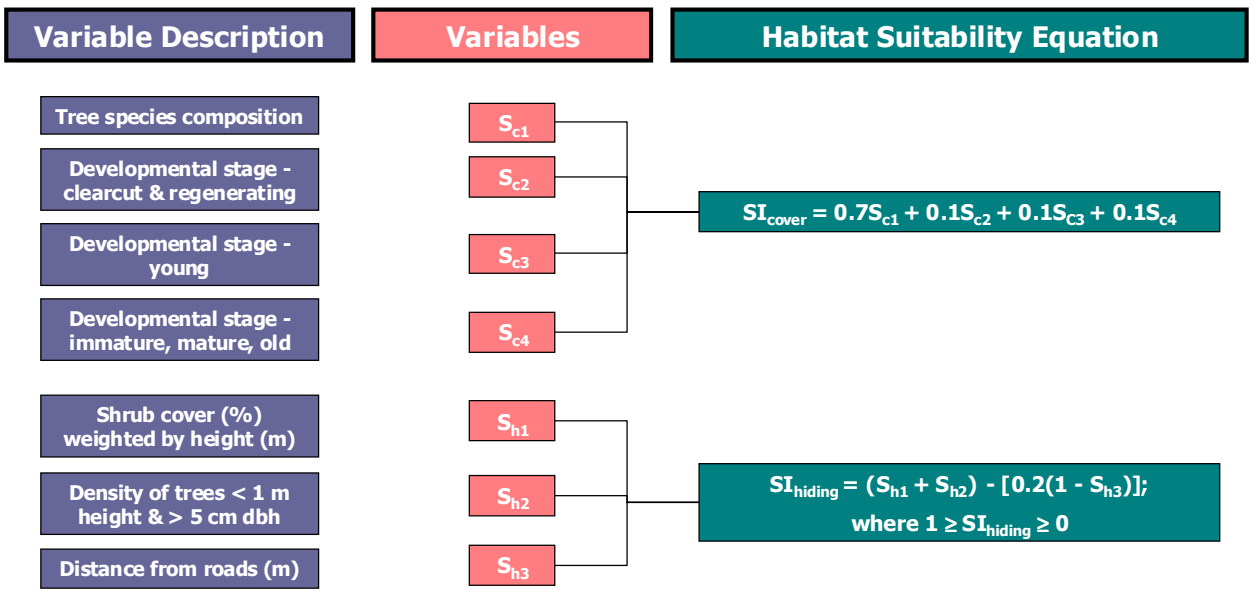

Figure 3. HSM structure for the Ruffed Grouse within Millar Western' s FMA area.

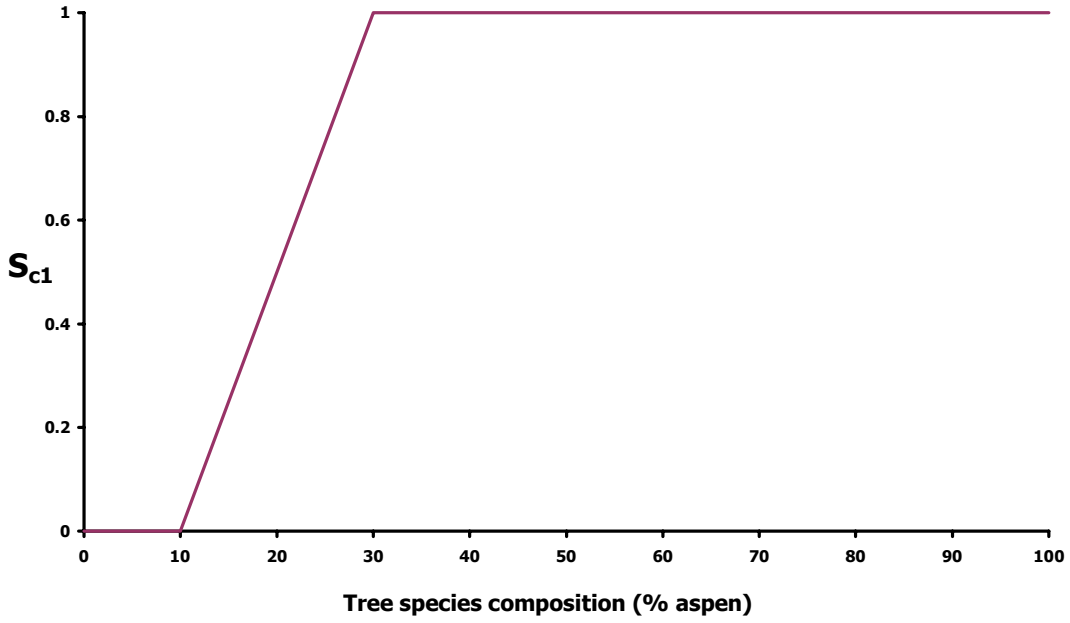

Figure 4. Ruffed Grouse cover habitat suitability in relation to tree species composition within Millar Western's FMA area.

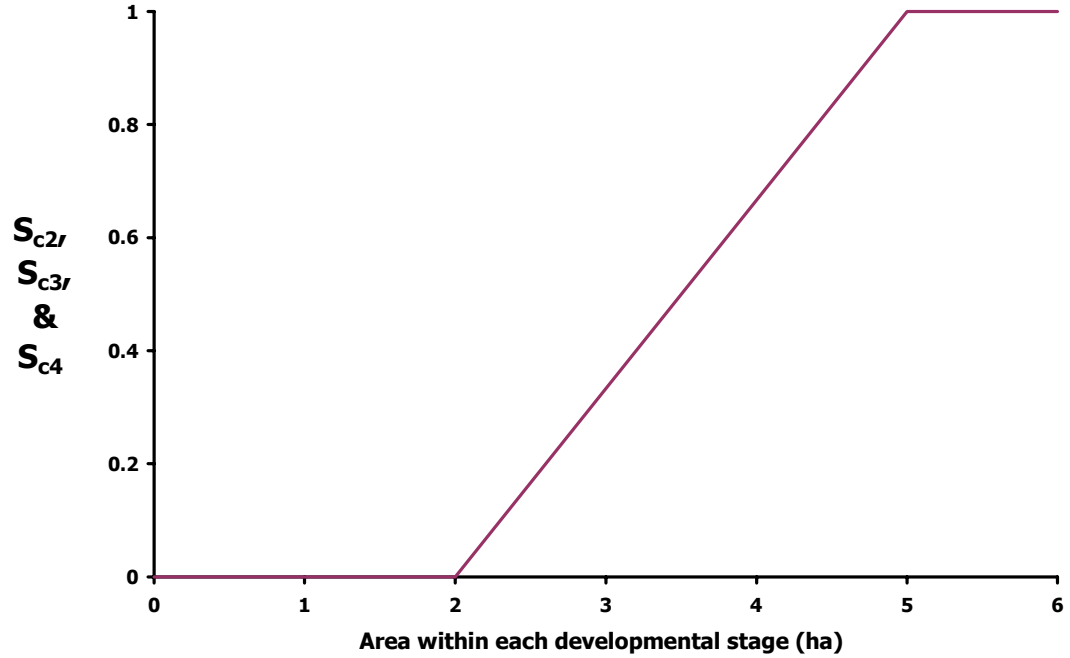

Figure 5. Ruffed Grouse cover habitat suitability in relation to the area of forest in each developmental stage within Millar Western's FMA area.

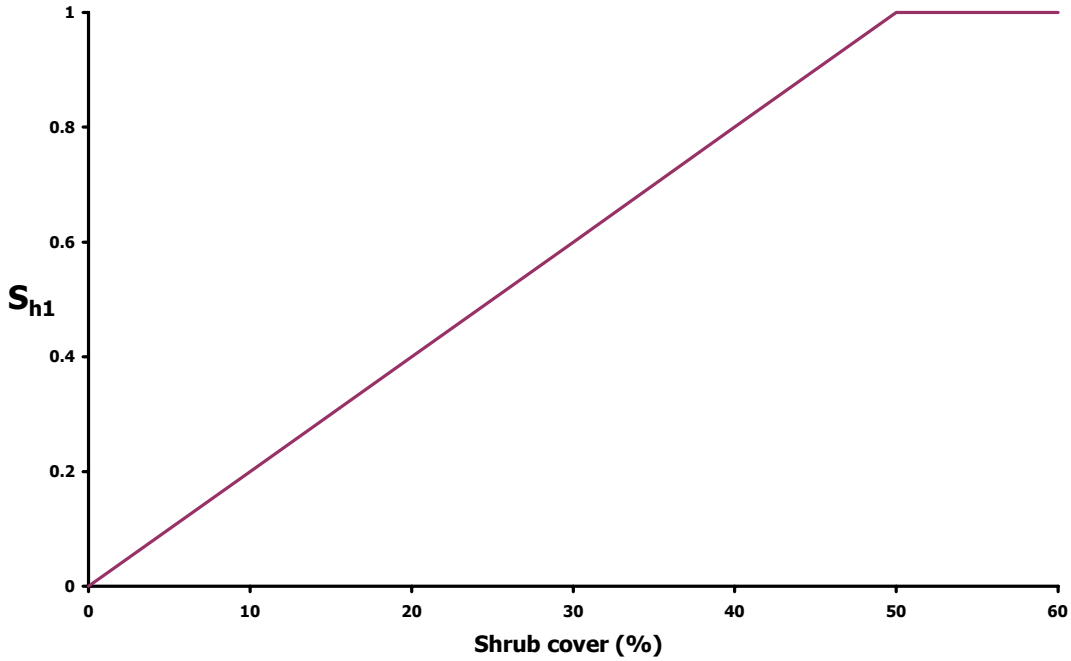

Figure 6. Ruffed Grouse hiding cover habitat suitability in relation to shrub cover within Millar Western'sFMA area. Weighting: 0 - .25 m = 0, .26 - .50 m = .25, .51 - 1 m = .65, 1.1 - 3 m = 1, > 3 m = 0.2.

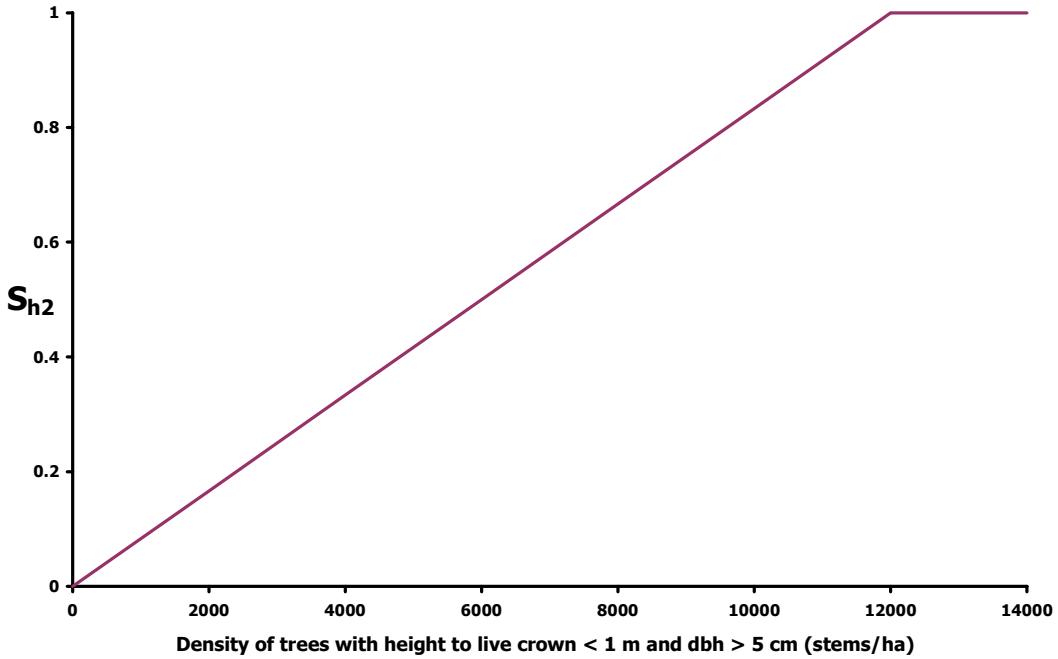

Figure 7. Ruffed Grouse hiding cover habitat suitability in relation to shrub/small tree density (density of trees with height to live crown < 1 m and dbh > 5 cm) within Millar Western's FMA area.

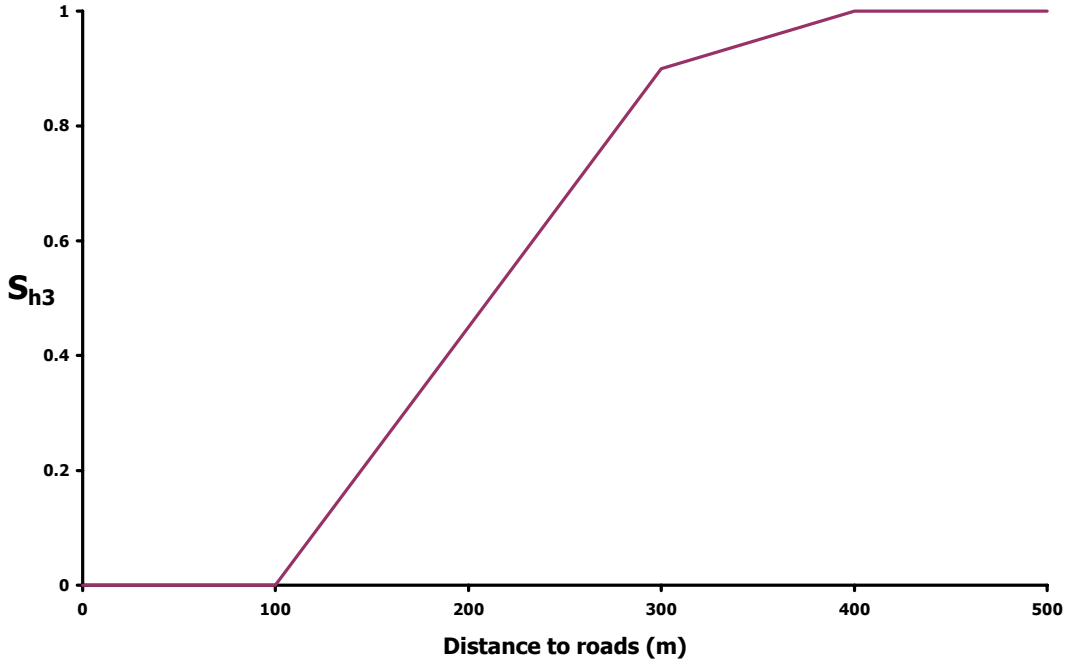

Figure 8. Ruffed Grouse hiding cover habitat suitability in relation to proximity to roads within Millar Western's FMA area.

3.5 Computation

Our goal is to create HSMs that allow the user to identify the potential impacts of proposed management strategies on cover and hiding cover habitats. Therefore, the outputs of the SI_{cover} and SI_{hiding} calculations are considered individually to display trends in habitat availability.

Cover Habitat Index

First, the model applies a value to each pixel of forested habitat based on its tree species composition, using the calculation:

$$0.7 * S_{c1}$$

Therefore 70% of the pixel's SI value is determined by the percentage of aspen. The remainder is added during the home range smoothing process described below.

Hiding Cover Habitat Index

Part of the equation for SI_{hiding} is then calculated for each pixel:

$$(S_{h1} + S_{h2}) \leq 1$$

Following this, suitability relating to proximity to human access routes is assessed. All roads are buffered to a distance of 400 m. Each pixel within the buffered area receives a suitability rating based on the distance-dependent relationship shown in Figure 8. All pixels outside the buffer area receive a suitability rating of 1. This variable is included in the overall hiding cover suitability rating by the following equation:

$$SI_{hiding} = S_{h1} + S_{h2} - [0.2(1-S_{h3})];$$

$$\text{where } 1 \geq SI_{hiding} \geq 0.$$

Home Range Smoothing

The model must ensure that sufficient area exists within the Ruffed Grouse' 50 ha home range of clearcut and regenerating, young, and immature to old habitats. Additionally, it must assess the quality of each potential home range as hiding cover habitat.

A circular window of radius 400 m (50 ha) moves over the grid representing Millar Western's FMA area in such a way that centres are located 400 m (one full radius) apart. First, the SI_{cover} values derived above are averaged within the circle. Then, the area of forest in each developmental stage (clearcut and regenerating, young, and immature to old stands) within the window is determined. The presence of aspen in the stand need not be determined at this point since it has already been taken into account in the preliminary SI_{cover} calculation above. Depending on the area in each developmental stage, a bonus of up to 0.3 is applied to the suitability of the entire window as cover as shown in Figure 5 and the following equation:

$$\mathbf{SI_{cover} = 0.7(S_{c1}) + 0.1S_{c2} + 0.1S_{c3} + 0.1S_{c4}}$$

Next, the model provides an indication of the quality of hiding cover habitat present within each potential home range. The SI_{hiding} values of all pixels within the circle of radius 400 m are averaged. This average value becomes the SI_{hiding} rating of the circle's centre pixel.

4.0 EXTERNAL REVISION

Arlen Todd, wildlife biologist with Alberta Environment, Fisheries and Wildlife Management Division in Whitecourt, Alberta reviewed a draft of the HSM for Ruffed Grouse on April 30, 1999 and supplied comments. The following revisions were made based on his advice:

1) Todd supplied references for several articles that could be used to make the document more 'Alberta-specific'. These were incorporated into the literature review.

2) From his experience, Todd believes that the drumming logs used by males are larger than the 25 cm diameter we had specified. He recalled that they were at least 30 cm and possibly up to 45 cm in diameter. He suggested that we contact an expert on Ruffed Grouse in Alberta to confirm this. Later, it was decided that for the present time, the SI_{mates} index that predicted the supply of drumming sites would be removed from the HSM because they did not appear to be limiting.

3) Todd suggested that more information on Ruffed Grouse mortality from hunting activity should be included in the document. We have reviewed the references he supplied and have incorporated this information. This literature led us to include another variable in the SI_{hiding}: distance to road.

Dr. Susan Hannon from the University of Alberta reviewed a draft of the HSM for Ruffed Grouse on June 30, 1999. The following changes were made in response to her comments:

1) Hannon suggested that though she was not aware of any studies that have looked into the value of overmature forest for Ruffed Grouse, the break up of overmature aspen canopy could provide both the young and mature forest characteristics needed by chicks and adults, respectively.

2) She was concerned with the fact that the model did not consider the importance of dispersal habitat for chicks. The original model assumed that a home range would suffice if it contained at least 5 ha of forest in each of the three required successional stages, and if the stand contained at least 30% aspen trees. Hannon felt that this would allow isolated patches of suitable habitat within the home range to contribute to a high suitability rating though they may not be useful for the grouse. Therefore, the optimal percentage of aspen in the stand was changed to 70%. We believe that the "moving window" procedure will allow us to identify isolated pockets of suitable habitat and make predictions concerning Ruffed Grouse dispersal. Discussion with local residents prompted us to subsequently return the maximum suitability index to 30% aspen since the birds tend to be found in more diverse habitat types than only pure aspen stands.

3) Hannon also expressed concern that the spatial context of reproductive habitats was not discussed in the document. She wondered about the maximum suitable distance of drumming logs from prime female home ranges. The literature review did not reveal any information on this topic, but it is likely an important issue to consider in the model. As research results become available, this portion of the model should be updated.

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