RUFFED GROUSE WINTER FORAGING HABITAT

HABITAT SUITABILITY INDEX MODEL VERSION 3

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1. INTRODUCTION

Habitat Suitability Index (HSI) models predict the suitability of habitat for a species based on an assessment of habitat attributes such as habitat structure, habitat type and spatial arrangements between habitat features. This HSI model for the ruffed grouse (*Bonasa umbellus*) applies to habitats of the Foothills Model Forest (FMF) in west-central Alberta. The intended use is to predict habitat suitability at landscape scales and over long-time periods. The model will be used to determine potential changes in ruffed grouse habitat area and carrying capacity throughout an entire forest management cycle (200 years). The model was primarily developed using literature review.

2. SPECIES DESCRIPTION AND DISTRIBUTION

The ruffed grouse is a non-migratory woodland grouse with a black or reddish-brown ruff (feathers on the side of the neck), a head crest, and a fan-like tail with a dark sub-terminal tail band. Males are easily identified in the spring and early summer by their characteristic drumming, which is a mating "call" made by rapidly moving the wings (Gadd 1995). Ruffed grouse populations are associated with deciduous vegetation. Populations of ruffed grouse are cyclic with major fluctuations every 8-10 years (Gullion 1984).

Ruffed grouse are the most widely distributed Tetraonidae species in North America occurring in forested habitats from central Alaska to northern California, east across Canada to southern Labrador to northern Georgia (Aldrich 1963). Ruffed grouse are the most common grouse species in Alberta and are found throughout the province except in the south-eastern corner (Salt and Salt 1976). Ruffed grouse are not considered at risk and have stable populations with secure habitat (Wildlife Management Division 1996). In central Alberta, ruffed grouse primarily occupy aspen forests, and utilize ground, shrub, and tree canopy strata for obtaining food and cover (Rusch and Keith 1971).

3. FOOD

Ruffed grouse are omnivores and feed on buds, twigs, forbs, fruits, berries, seeds and insects (Bump et al. 1947, Korschgen 1966). Food habits are seasonally variable, reflecting changes in the availability of food (Korschgen 1966). In early summer, as berries, fruits and seeds become available, ruffed grouse prefer strawberries (*Fragaria virginiana*), raspberries (*Rubus idaeus*), cherries (*Prunus* spp.), blueberries (*Vaccinium myrtilloides*), and sedges (*Carex* spp.; Bump et al. 1947, Edminster 1947). Arthropods comprise a small percentage of adult food (4-5% of diet), but are the basic food of ruffed grouse chicks (50-75% of diet) for the first 2-5 weeks of life (Bump et al. 1947, Edminster 1947).

Fall foods for juvenile and adult birds include a variety of fruiting shrubs, such as cranberries (*Viburnum* spp.), red-osier dogwood (*Cornus stolonifera*), and roses (*Rosa acicularis*). Availability of these foods persists into winter,

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supplementing the standard winter diet of buds, twigs, and catkins of aspen (*Populus tremuloides*; Bump et al. 1947, Edminster 1954, Gullion 1977, Korschgen 1966, Svoboda and Gullion 1972).

Older stands of aspen provide the best source of male catkins (Gullion 1977). The average age of 100 aspen trees used for foraging by ruffed grouse in Alberta was 36 years (range 20 – 80; Doerr et al. 1974). One mature trembling aspen provides 8-9 days of food for one grouse (Svoboda and Gullion 1972). A single grouse would need a total of 20 mature male aspen trees over a typical Alberta winter.

In central Alberta, 80% (by volume) of the ruffed grouse winter diet was trembling aspen and willow buds (Doerr et al. 1974). Beaked hazelnut (*Corylus cornuta*), rose, balsam poplar (*Populus balsamifera*), and buffalo-berry (*Shepherdia canadensis*) were also eaten during the winter (Doerr et al. 1974). In early spring, as ground vegetation is exposed, food consumption becomes more diversified, although buds of aspen, balsam poplar, and cherry are still consumed well into May (Edminster 1947).

4. COVER

Ruffed grouse are associated primarily with deciduous or mixedwood forests, especially those with aspen present (Berner and Gysel 1969, Rusch and Keith 1971, Salt and Salt 1976, Gullion 1977, Gullion 1984, Stauffer and Peterson 1984). On a continent-wide basis, the population density of ruffed grouse corresponds to the distribution pattern of aspen (Gullion 1970).

Fire or clearcut logging in aspen stands produces good cover habitat for grouse broods 4 years after disturbance (Gullion 1977). Aspen sucker regeneration produces high density saplings that are up to 7 m tall. This dense vertical cover and open understory is good habitat for drumming males and to raise chicks in Minnesota (Gullion 1977). The summer distribution of single grouse and brooding females in Alberta were not different from the distribution of drumming males in the spring (Rusch and Keith 1971). After 10 years, stands open up due to self thinning and become too open for brood use but remain good for wintering and breeding ruffed grouse. When fairly young habitat is within 100 m of mature male aspen trees, densities of grouse can be expected to be high (Gullion 1977).

In Idaho, all sites with drumming males or broods had at least 30% deciduous trees, had at least 60% canopy cover with 3000 to 12,000 stems < 7 cm diameter at breast height (dbh at 1.3 m)/ha and were between 10-17 m high (Stauffer and Peterson 1984). In central Alberta during the breeding season, ruffed grouse were in dense aspen stands with trees < 20 cm dbh that were between 20-27 yr old (Schieck and Nietfeld 1995).

Fir and spruce with branches growing low to the ground provide thermal cover for grouse in winter where snow depths or a crusted snow layer can reduce snow-burrow roosting (Woehr 1974). Also, young spruce and fir in aspen forests were the immediate cover of male drumming sites (Boag and Sumanik 1969, McCaffery et al. 1997). However, forests that are predominately conifer, especially "high pine" conifer, tend to support lower densities of ruffed grouse because predators can hide and ambush grouse easier than in fairly open deciduous forests (Gullion and Alm 1983).

5. REPRODUCTION

In the spring male grouse display by "drumming" (Salt and Salt 1976). Individual grouse remain associated with specific drumming sites throughout their lives (Boag and Sumanik 1969, Boag 1976). Males may utilize more than one log in their territory for drumming, but one is typically favoured (Archibald 1975). The drumming log is the focal point of the activity centre, but it is not as critical in the selection of the drumming site as is the surrounding vegetation (Boag and Sumanik 1969). Ruffed grouse typically drum from a fallen log on a level stage in areas where shrub cover is sparse enough to provide a view for 20 m in most directions, but with sufficient canopy coverage and stem density to protect them from predators (Boag and Sumanik 1969, Rusch and Keith 1971, Boag 1976).

In the foothills of Alberta drumming males were in areas with the greatest density of young aspen and white spruce (Boag and Sumanik 1969). High density of small woody stems and young white spruce has also been associated with good drumming habitat in other studies (Boag and Sumanik 1969, Stauffer and Peterson 1985). In contrast, male ruffed grouse in Alberta drummed in areas that had moderate shrub canopy cover (66% on logs vs. 109% on stations), few small saplings (3 815 stems/ha at logs vs. 5 600 stems/ha at stations) and numerous trees (850 trees/ha at logs vs. 585 trees/ha at stations; Rusch and Keith 1971). The relatively open understory around drumming sites may have been compensated by the numerous trees and dense tree canopy (Rusch and Keith 1971).

Courtship and copulation takes place during a brief period in the vicinity of the drumming log (Gladfelter and McBurney 1971). Grouse nest on the ground, usually near or under a fallen log or a root, typically in open stands of older aspen that provide the female a view in all directions (Barber et al. 1989). Nine to 12 buff coloured eggs are laid

(Godfrey 1986). Once the eggs hatch (after 24 days incubation; Godfrey 1986), the hen and brood move into more dense cover (Gullion 1977), but with moderate amounts of grass and other dense low ground cover so movement of the chicks isn't impaired (Barber et al. 1989). Brood rearing habitat is thought by some as the most critical habitat type (Berner and Gysel 1969). Wet, cold spring weather may reduce brood survival even in optimum habitats (Sharp 1963).

6. HABITAT AREA

Ruffed grouse population densities are typically described by the number of breeding males. In central Alberta, densities of males ranged from 0.12-0.22 males/ha in a 3 year study (Rusch and Keith 1971). In good habitats in Minnesota, breeding ruffed grouse densities were 1.2 adult bird/ha (Gullion 1977). In the FMF, density of drumming males was 0.22 males/ha in young mixedwood forests (Rangen 1998). In the best quality habitat, it is estimated that 0.25 pairs/ha can be expected (Gullion and Svoboda 1972 as cited in Cade and Sousa 1985).

Mean estimates of fall-winter and spring-summer home ranges were 104 and 67 ha, respectively in central Missouri in cedar hardwood forests.

7. HSI MODEL

7.1 MODEL APPLICABILITY

Species: Ruffed Grouse (Bonasa umbellus).

Habitat Evaluated: Foraging habitat.

Geographic area: This model is applicable to the Foothills Model Forest in west-central Alberta.

Seasonal Applicability: This model produces HSI values for winter foraging habitat.

Cover types: This model applies to all forest and non-forest habitat areas of the Lower and Upper Foothills, Montane and Subalpine Natural Subregions (Beckingham et al. 1996) since suitability is determined from structural characteristics within stands rather than classified forest stands directly. The model should also be broadly applicable to other habitat areas dominated by vegetation similar to that in this region, including pure deciduous, mixedwood and pure coniferous forest types, as well as wetland and riparian forests, meadows, shrublands, and areas regenerating after forest harvesting.

Minimum Habitat Area: Minimum habitat area is defined as the minimum amount of contiguous habitat to which the model will be applied. The high mobility of this species should result in all suitable habitat being available to it, regardless of interspersion with other habitat types. Therefore, no minimum contiguous habitat area is specified.

Model Output: The model will produce Habitat Units (HU) of food for each stand based on the HSI values and the stand area. HU are calculated by multiplying the HSI score with the area in hectares. The performance measure for the model is potential carrying capacity (ruffed grouse per hectare). Model output should be correlated to estimates of carrying capacity to verify model performance.

Carrying Capacity (Breeding Males per ha where HSI = 1.0: The maximum number of pairs of ruffed grouse per optimal hectare of habitat is 0.25 (Gullion and Svoboda 1972 as cited in Cade and Sousa 1985).

Verification Level: The reliability of this model has not been evaluated against local data. The verification level is 4: local data was used to develop the model but model predictions have not been tested.

Application: This HSI model is designed to assess habitat suitability for relatively large forest landscapes using generalized species-habitat relationships and stand-level vegetation inventory. Its purpose is to predict relative changes in ruffed grouse habitat supply at the landscape level over long time periods (200 years), for integration with forest management planning. The model is not designed to provide accurate prediction of suitability or use at the stand level. Approximate population size can be calculated by assuming linear habitat-population relationships, but the model is not designed to provide accurate population density estimates. Any attempt to use the model in a different geographic area or for other than the intended purpose should be accompanied by model testing procedures, verification analysis, and other modifications to meet specific objectives.

7.2 MODEL DESCRIPTION

The HSI model for year round ruffed grouse habitat assumes that life requisites for winter food are the limiting factor for populations of ruffed grouse. Version 1 and 2 of the model had year round cover included as a limited resource but this was removed in the current version (Version 3) because it was assumed that cover in the FMF is abundant. This is because regenerating mixedwood stands provide good cover and are abundant throughout regions of the FMF. Older mixedwood stands were retained as a model component because they provide critical winter food and may become limiting in a managed forest.

7.2.1 Habitat Variables and HSI Components

Deciduous tree species in the overstory are important for supporting ruffed grouse populations. Coniferous species provide cover in areas where deciduous trees are absent, but pure coniferous stands provide little food for grouse. Thus, HSI component S_1 has been developed based on the proportion of the forest canopy composed of deciduous trees. Winter food is also dependent on canopy closure and mean deciduous tree height. The canopy closure variable restricts the model to forested habitats, and canopy height determines whether trees are large enough to provide winter food. These two variables define HSI components S_2 and S_3.

Table 1. Relationship between habitat variables and life requisites for the ruffed grouse HSI model.

HSI Component	Life Requisite	Habitat Variable	Habitat Variable Definition
S_1	Winter Food	Deciduous in Tree Canopy (%)	Percent composition of all deciduous tree species in the tree canopy.
S_2	Winter Food	Tree Canopy Closure (%)	Percent of ground covered by a vertical projection of tree crown areas onto the ground. Includes trees ≥ 8 cm dbh.
S_3	Winter Food	Deciduous Canopy Height (m)	Average top height of 100 deciduous trees/ha that have the largest dbh.

7.2.2 Graphical HSI Component Relationships

Winter Foraging

S_1 Forest stands with ≥ 20% deciduous species in the overstory are considered optimal for ruffed grouse winter food production. Stands with no deciduous trees are unsuitable (Figure 1a).

S_2 Tree canopy closure restricts the model output to forested habitat. Stands with no canopy closure are unsuitable; suitability increases to the optimum for stands ≥ 6% crown closure (Figure 1b).

S_3 Tree height determines whether trees are large enough to provide sufficient food. From 0-2 m, trees are unsuitable, however, from 2-10 m suitability increases to the optimum. At heights ≥ 10 m, $S_3 = 1$ (Figure 1c).

7.3 MODEL ASSUMPTIONS

1. Grouse will only occupy areas with a deciduous tree component, even if suitable food and cover exist in a coniferous area with deciduous shrubs.
2. Grouse are able to obtain water and minerals in the same area as food.
3. Cover habitat is not limiting in the FMF.
4. Summer food is not limiting.
5. Optimal winter food is provided by mature aspen stands.

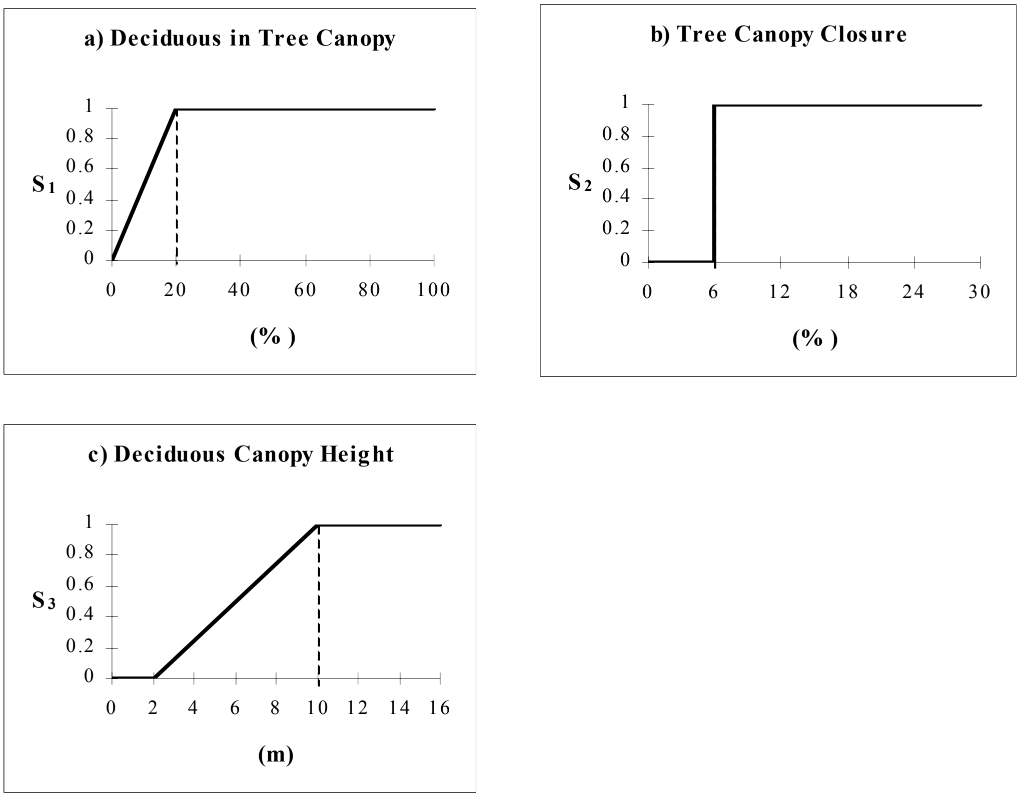

Figure 1. Graphical relationship between habitat variables and HSI components in the ruffed grouse model.

7.4 EQUATIONS

The HSI equation for winter foraging considers of all three components (S_1, S_2, and S_3) to be equal in importance, and none is able to compensate for a lack of any of the others. Best winter foraging is provided by deciduous or mixedwood sites with > 20% deciduous tree composition, > 6% tree canopy closure, with trees > 10 m tall.

HSI (winter foraging) = $S_1 \times S_2 \times S_3$

8. SOURCES OF OTHER MODELS

An HSI model for ruffed grouse (Cade and Sousa 1985) has been developed by the USFWS. This model is intended for application within the region where aspen is a predominant component of the forest ecosystem (Cade and Sousa 1985).

Model History

All of the HSI models for the Weldwood Forest Management Area have undergone several revisions, and they will be revised again as new information becomes available. Contact Rick Bonar for information about the most current version.

- Version 1 (1995) was written by Warren Schaffer for a special topics course in habitat modelling at the University of Alberta.
- Version 2 (1996) was edited and reformatted by Wayne Bessie.
- Version 3 (1999) was revised by Karen Graham, Rick Bonar, Barb Beck, and Jim Beck to information from recent literature.

9. LITERATURE CITED

Aldrich, J. W. 1963. Geographic orientation of American Tetraonidae. Journal of Wildlife Management 27:529-545.

Archibald, H. L. 1975. Temporal patterns of spring space use by ruffed grouse. Journal of Wildlife Management 39:472-481.

Barber, J. L., R. Chambers, R. Kirkpatrick, J. Kubisiak, F. A. Servello, S. K. Stafford, D. F. Stauffer and F. R. Thomspon III. 1989. Cover. Pages 294-319 *in* S. Atwater, and J. Schnell, editors. Wildlife Series – ruffed grouse. Stackpole Books, Harrisburg, Pennsylvania.

Beckingham, J. D., I. G. W. Corns and J. H. Archibald. 1996. Field guide to ecosites of west-central Alberta. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta, Special Report 9.

Berner, A. and L. W. Gysel. 1969. Habitat analysis and management considerations for ruffed grouse for a multiple use area in Michigan. Journal of Wildlife Management 33:769-778.

Boag, D. A. 1976. The effect of shrub removal on occupancy of ruffed grouse drumming sites. Journal of Wildlife Management 40:105-110.

Boag, D. A. and K. M. Sumanik. 1969. Characteristics of drumming sites selected by ruffed grouse in Alberta. Journal of Wildlife Management 33:621-628.

Bump, G., R. W. Darrow, F. C. Edminster, and W. C. Crissey. 1947. The ruffed grouse: life history, propagation, management. New York State Conservation Department, Holling Press, Buffalo.

Cade, B. S. and P. J. Sousa. 1985. Habitat suitability index models: ruffed grouse. United States Department of the Interior, Fish and Wildlife Service. Biological Report 82 (10.86).

Doerr, P. D., L. G. Keith, D. H. Rusch, and C. A. Fischer. 1974. Characteristics of winter feeding aggregations of ruffed grouse in Alberta. Journal of Wildlife Management 38:601-615.

Edminster, F. C. 1954. American game birds of fields and forest; their habits, ecology and management. Charles Scribner's Sons, New York.

Edminster, F. C. 1947. The ruffed grouse: its life story, ecology and management. Macmillan, New York.

Gadd, B. 1995. Handbook of the Canadian Rockies, 2nd Edition. Corax Press. Jasper, Alberta.

Gladfelter, H. L., and R. S. McBurney. 1971. Mating activity of ruffed grouse. Auk 88:176-177.

Gullion, G. W. 1984. Managing northern forests for wildlife. Minnesota Agriculture Experiment Station, St. Paul. Misc. Journ. Ser. Publ. No. 13442.

Gullion, G. W. 1977. Forest manipulation for ruffed grouse. Transactions of the North American Wildlife and Natural Resources Conference 42:449-458.

Gullion, G. W. 1970. Factors influencing ruffed grouse populations. Transactions of the North American Wildlife and Natural Resources Conference 35:93-105.

Gullion, G. W. and A. A. Alm. 1983. Forest management and ruffed grouse populations in a Minnesota coniferous forest. Journal of Forestry 81:529-532, 536.

Korschgen, L. J. 1966. Foods and nutrition of ruffed grouse in Missouri. Journal of Wildlife Management 30:86-100.

McCaffery, K. R., J. E. Ashbrenner, W. A. Creed and B. E. Kohn. 1997. The aspen-ruffed grouse connection. Journal of Forestry 95:16-19.

Rangen, S. 1997. Songbird abundance, distribution, and reproductive success in two age classes of mixedwood stands in the Foothills Model Forest. Unpublished report submitted to the Foothills Model Forest, Hinton, Alberta.

Rusch, D. H. and L. B. Keith. 1971. Ruffed grouse vegetation relationships in central Alberta. Journal of Wildlife Management 35:417-429.

Salt, W. R. and J. R. Salt. 1976. The birds of Alberta. Hurtig Publishing, Edmonton, Alberta.

Schieck, J. and M. Nietfeld. 1995. Bird species richness and abundance in relation to stand age and structure in aspen mixedwood forests in Alberta. Pages 115-157 *in* J. B. Stelfox, editor. Relationships between stand age, stand structure and biodiversity in aspen mixedwood forests in Alberta. Alberta Environmental Centre, Canadian Forest Service and Alberta Land and Forest Service.

Sharp, W. M. 1963. The effects of habitat manipulation and forest succession on ruffed grouse. Journal of Wildlife Management 27:664-671.

Stauffer, D. R., and S. R. Peterson. 1984. Ruffed and blue grouse habitat use in southeastern Idaho. Journal of Wildlife Management 49:459-466.

Stauffer, D. R., and S. R. Peterson. 1985. Seasonal micro-habitat relationships of ruffed grouse in southeastern Idaho. Journal of Wildlife Management 49:605-610.

Svoboda, F. J. and G. W. Gullion. 1972. Preferential use of aspen by ruffed grouse in northern Minnesota. Journal of Wildlife Management 36:1166-80.

Thompson, R. R. and E. K. Fritzell. 1989. Habitat use, home range, and survival of territorial male ruffed grouse. Journal of Wildlife Management 53:15-21.

Woehr, J. R. 1974. Winter and spring shelter and food selection by ruffed grouse in central New York. Thesis, State University, New York, College of Environmental Science and Forestry, Syracuse, New York.

Wildlife Management Division. 1996. The status of Alberta wildlife. Alberta Environmental Protection, Natural Resources Service, Wildlife Management Division.