

# Deriving Wildlife Habitat Values From Ecosystem Maps

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## ABSTRACT

A provincial standard for assessing wildlife habitat has been developed for British Columbia. This paper outlines the standard definitions and habitat rating criteria used in BC Wildlife Habitat Rating Standards. Wildlife habitat capability and suitability ratings can be applied to ecological mapping at scales from 1:250,000 to 1:20,000. Ratings indicate the value of a habitat to support a particular wildlife species for a specified habitat use compared to the best habitat in the province (the provincial benchmark). Rating criteria are defined for different map scales and different levels of detail. A wildlife habitat capability and suitability assessment project requires development of species-habitat models that are ground-truthed and refined through field sampling.

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**Key words:** habitat capability, habitat suitability, mapping.

For the past 30 years, the province of British Columbia has been mapping wildlife habitat that is based on ecological mapping (Blower 1973, Demarchi et al. 1983, RIC 1999). During that time the methodology evolved from mapping ungulate winter range capability at a single scale to applying habitat capability and suitability ratings for a diversity of species at scales from 1:250,000 to 1:20,000. Wildlife species for which habitat maps are most commonly produced include bears, ungulates, and species at risk. The criteria for developing and applying the wildlife habitat ratings have been standardized to maintain reliability and consistency across the province. This paper discusses the standard definitions, habitat rating criteria and procedures outlined in *BC Wildlife Habitat Rating Standards* (RIC 1999). Anyone undertaking a habitat capability and suitability assessment project should read the standards document in its entirety and complete the associated Resources Inventory Committee training course.

## CAPABILITY AND SUITABILITY RATINGS

A habitat rating is the value assigned to a habitat for its potential to support a particular species of wildlife. There are 2 aspects to habitat ratings: suitability and capability. Suitability is defined as the ability of the habitat *in its current condition* to provide the life requisites of a species. Capability is defined as the ability of the habitat, under optimal natural conditions to provide life requisites of a species—irrespective of its current habitat conditions.

Terrestrial Ecosystem Mapping uses a 3-level classification hierarchy of ecological units (RIC 1998, Demarchi et al. 2000). Ecoregion and biogeoclimatic units are broad-level delineations portrayed on provincial-level maps. Within these broader units, site-level polygons describe ecosystem units composed of site series, site modifiers, and structural stages (RIC 1998). The structural stage category describes the existing dominant stand appearance based primarily on stand age and species composition. The structural stages range from nonvegetated to old forests.

The predictive ability of terrestrial ecosystem mapping (at the site series level) is particularly valuable for describing the value of wildlife habitat; even if the current structural stage is not suitable for an animal species, it may have the capability to become suitable with successional changes in the plant community over time or through specific management activities.

Figure 1 shows the different structural stages of the Biogeoclimatic Ecosystem Classification system (Meidinger and Pojar 1991) used in Terrestrial Ecosystem Mapping. This illustration represents 1 particular site series or habitat over time. Using food and cover requirements for black-tailed deer in the winter as an example:

1. the shrub/herb stage would have a low suitability, due to lack of cover and available food under the snow; and
2. the older forest stages would have a high suitability for winter food and cover habitat, due to the deer's ability to walk on top of the snow to feed on litter fall.

Assume that at present this site is a clearcut that is several years old, currently in the shrub/herb stage (structural stage 3). The clearcut has a low suitability as deer winter habitat. However, this site does have a high capability,

because, given the right conditions (i.e., enough time), it will produce a forest that will provide deer winter habitat with a higher suitability. At the mature/old forest stages, if a particular site provides high quality deer winter habitat, then the suitability is equal to the capability of the site.

**DENSITY MEASURE**

Animal density represents a (theoretical) measure for the value of habitat ratings. For the purposes of the capability/suitability ratings, density is: a species' response to a particular habitat expressed as the amount of time an animal may spend in the habitat within the season of use being evaluated (number of animals/unit time/unit area).

It is recognized that animal density measures are not always an accurate reflection of habitat quality. But the concept that the best habitats have the highest densities or the highest amount of use is still the guiding principle when applying wildlife habitat ratings in British Columbia.

The animal density measurement should ideally be based on actual measurement of animals in the habitat that is being evaluated, but this kind of data is rarely available. Thus, the densities used in the habitat ratings do not reflect actual or real numbers of animals. The animal density

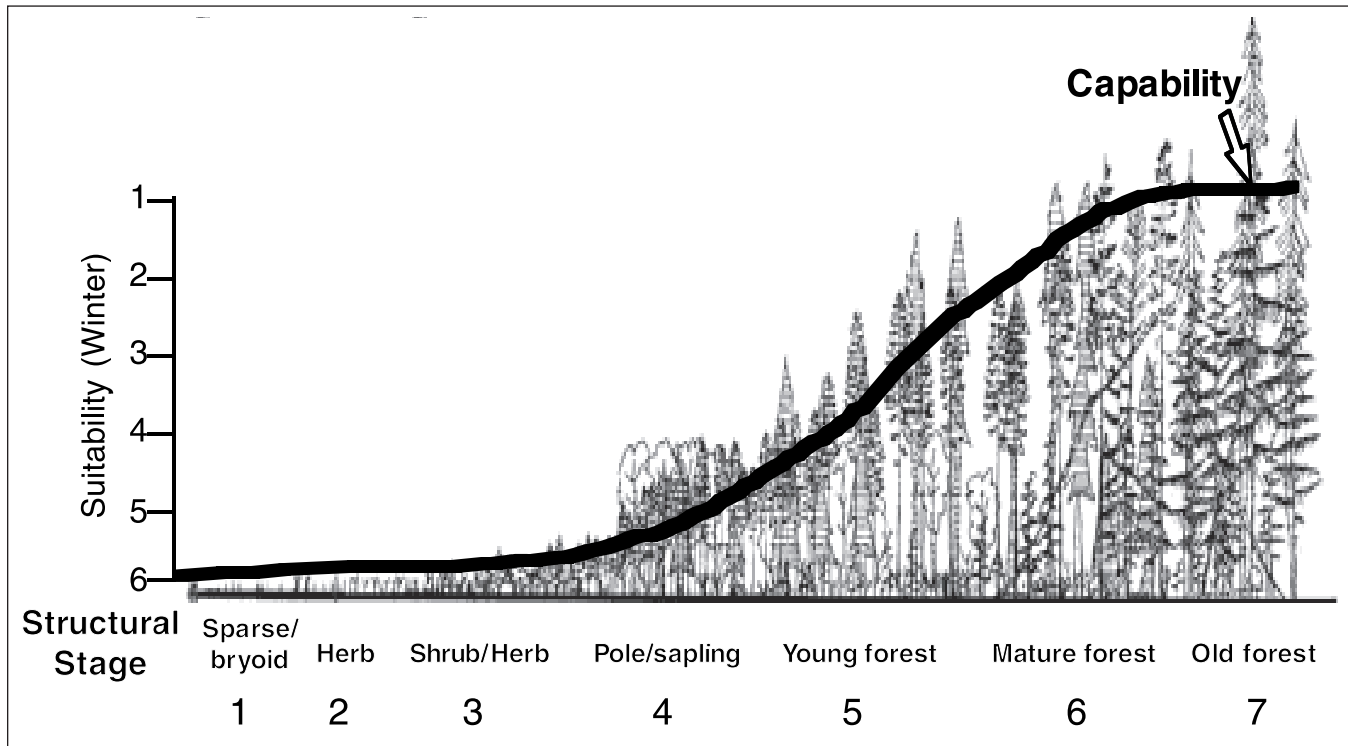
measure provides a conceptual framework for expressing expected use of a habitat.

**PROVINCIAL BENCHMARK**

The dictionary defines a rating as "a relative estimate or evaluation." A habitat suitability or capability rating is relative to the provincial benchmark, which is the highest capability habitat for the species in the province, against which all other habitats for that species are rated. Therefore, a capability or suitability rating is the potential value of a habitat to support a species, compared to the best habitat for the species in British Columbia.

Provincial habitat benchmarks standardize habitat values to ensure land-use decisions are based on an accepted methodology. They ensure that adjacent ecosystems are rated consistently and that habitat ratings are uniformly applied from 1 administrative unit to the next, from 1 mapping project to the next, and from 1 species to the next.

For example, the winter benchmark habitat for mountain caribou is in the Cariboo Mountains ecosection, in seral stage 6 of the Englemann Spruce–Subalpine Fir broad ecosystem unit. When rating winter habitat for mountain caribou you would rate it in comparison to the Englemann Spruce–Subalpine Fir ecosystem.



**Figure 1.** Habitat suitability for black-tailed deer in winter for a particular site over time. Suitability is the current ability of the habitat to support deer in winter. Capability is the ability of the habitat in its optimal condition (i.e., structural stage) to support deer in winter.

**Table 1.** Habitat capability and suitability rating schemes for 3 levels of knowledge about a species' use of habitat (RIC 1999).

% of provincial best	Substantial knowledge of habitat use (6-class)		Intermediate knowledge of habitat use (4-class)		Limited knowledge of habitat use (2-class)	
	Rating	Code	Rating	Code	Rating	Code
100–76	High	1	High	H	Habitat Useable	U
75–51	Moderately High	2	Moderate	M	“	“
50–26	Moderate	3	“	“	“	“
25–6	Low	4	Low	L	“	“
5–1	Very Low	5	“	“	Likely No Value	X
0	Nil	6	Nil	N	“	“

## RATING CRITERIA

Planning needs and ecological mapping in the province range from the broad, strategic level (e.g., 1:250,000 map scale) down to a more detailed, operational level (e.g., 1:20,000 map scale). There are also varying levels of information available on species-habitat relationships for the diversity of wildlife species in the province. The standard methods for deriving habitat values from ecosystem maps require a great deal of flexibility to meet this range of map scales, information needs, and knowledge.

### RATING SCHEMES

Three rating schemes have been developed to reflect the knowledge available on the species and how it relates to its habitat (Table 1). The appropriate rating scheme is the one that reflects our knowledge<sup>1</sup> of a given species' habitat use and the scale at which that knowledge is applied. The highest provincial rating is assigned to habitats of greatest concentration or importance to each species, based on previous measures or estimates in benchmark areas. All other habitats are evaluated in comparison to these benchmark habitats.

The 6-class scheme, used where there is a substantial knowledge of a species' habitat use, has ratings of high (1), moderately high (2), moderate (3), low (4), very low (5), and nil (6) for defined seasons and life requisites. This rating system is most useful at medium map scales (1:50,000 to 1:100,000) where seasonal habitat use can be readily depicted, and at large map scales (1:5,000 to 1:20,000) for many species where specific habitat uses can be identified.

The 4-class scheme is used for species for which there is an intermediate knowledge of habitat use. This scheme employs high (H), moderate (M), low (L), and nil (N) ratings for defined seasons and life requisites. The 4-class approach is most effective at medium (1:50,000 to 1:100,000) to small

(1:250,000 to 1:500,000) map scales where seasonal information is available.

The 2-class scheme is used for species for which there is little information about their habitat use. Species in this category are assigned capability or suitability ratings of “habitat useable” (U) or “likely no value” (X). This scheme can be applied in most areas for almost any species, even with very limited information on habitat attributes, although the range of values is so broad that it is of limited value for species that we can map at greater detail.

### SEASONS OF USE

When describing the seasons of habitat use, we can also go from the general to the detailed, depending on the species, map scale, and planning needs. For some species for which habitat use between seasons cannot be easily differentiated (e.g., most amphibian and reptile species), only 1 year-round season should be rated. At the other end of the scale, up to 6 seasons can be differentiated, such as early and late winter or spring.

Seasons can be described at 4 levels of detail (Table 2): 1-, 2-, 4-, and 6-season. Detailed seasonal information cannot be depicted for the broad habitat units that are shown at small map scales (e.g., 1:250,000). A 1- or 2-season rating must be used at these scales, regardless of the species. With larger map scales and a more detailed knowledge level of the species, seasonal use of habitats can be described in greater detail. A 4-season rating is then the minimum required. The 6-season rating subdivides winter and spring into early and late periods, a level of detail that is only used for grizzly bear, black bear, and ungulates. For example, skunk cabbage sites are very important as early spring habitat for bears, so it is often useful to rate this particular habitat use at larger map scales. Most commonly, though, only 2 seasons need to be rated: winter and growing. Note that the growing season is an amalgamation of spring, summer, and fall.

### LIFE REQUISITES

Along with the season, ratings are applied to a particular life requisite (Table 3). Life requisites are the special

<sup>1</sup>Note that “knowledge level” refers to the provincial knowledge base on the species and, in particular, to the collective knowledge we have on how the species relates to its habitat, and what ecosystem attributes are important to the species.

**Table 2.** Four levels for describing seasons of habitat use (RIC 1999).

Level	Code	Description	Application
1-season	A	All seasons	<ul style="list-style-type: none"> <li>when habitat use between seasons cannot be differentiated (small map scales and/or species with low mobility)</li> </ul>
2-season	W	Winter <sup>a</sup>	<ul style="list-style-type: none"> <li>when seasonal habitat use can only be roughly differentiated</li> <li>small map scales</li> </ul>
	G	Growing (spring, summer, fall)	
4-season	W	Winter <sup>a</sup>	<ul style="list-style-type: none"> <li>when 4 distinct seasons of habitat use can be differentiated (medium to large map scales)</li> <li>species for which there is an intermediate or substantial knowledge level</li> <li>when species occur in B.C. only part of the year (migratory species: only 3 of the 4 seasons rated)</li> </ul>
	P	Spring	
	S	Summer	
	F	Fall	
6-season	WE	Early Winter	<ul style="list-style-type: none"> <li>when distinguishing detailed seasons for grizzly bear, black bear, and ungulates (for most of these species, only 4 or 5 of the 6 seasons will be rated; e.g., food habitat for bears may be rated for Early Spring, Late Spring, Summer, and Fall.)</li> </ul>
	WL	Late Winter	
	PE	Early Spring	
	PL	Late Spring	
	S	Summer	
	F	Fall	

<sup>a</sup> Winter can be used for either a 2-season or a 4-season rating; in both cases, it is the same period of time.

requirements of an animal for sustaining and perpetuating the species. These requirements are supplied by the species' habitat, and include food, cover, reproduction, migration, hibernation, etc.

Generally, the food/cover life requisites can be rated separately, or combined into the more general "Living" life requisite. "Living" is the default for capability and suitability ratings. For more detail, the specific life requisites can be used to rate particular activities such as reproducing or hibernating.

#### COMBINING SEASONS AND LIFE REQUISITES

"All capability and suitability ratings are expressed as a value for a particular season and life requisite for the species of concern, compared to the best habitat in the province used for the same season and life requisite for that species." (RIC 1999)

With the numerous levels of detail in the rating criteria just described, there are many possible combinations of seasons and life requisites to rate. However, because the rating criteria depend on the animal species, the map scale, and the project

**Table 3.** Life requisites used in capability and suitability ratings (RIC 1999).

Life requisite	Code	Definition
FOOD/COVER		
Food	FD	habitat used for consuming food items, including searching for and consuming food simultaneously (such as done by grazers, browsers, flying insectivores, ducks, etc.)
Security	SH	habitat used for protection or hiding from predators
Security/Thermal	ST	habitat used for security and/or thermal values (this category used when differentiation between thermal and security values is difficult or impossible)
Thermal	TH	habitat used for protection from heat, cold, precipitation, or wind
SPECIFIC		
Courtship/Mating	CO	habitat used for courting, pair-bonding, or mating (when separate from reproducing habitat)
Living	LI	habitat used for general living activities
Migrating (seasonally)	MS	habitat used for regular, annual travel (e.g., habitat used by elk for spring and fall migrations)
Reproducing (birthing)	RB	habitat used specifically for giving birth to live young (mammals); may or may not include courtship/mating, depending on the animal species
Reproducing (eggs)	RE	habitat used for building a nest, laying eggs, incubation, hatching, and feeding non-mobile young (amphibians, birds, and reptiles); may or may not include courtship/mating, depending on the animal species
Staging	SG	habitat used for staging during spring and fall migrations

**Table 4.** Wildlife habitat rating criteria for a diversity of wildlife species at 3 map scales, showing rating scheme (RS; 2-, 4-, or 6-class), and minimum required and optional habitat use (adapted from RIC 1999).

Species	1:250,000		1:50,000			1:20,000		
	RS	Min. required habitat use	RS	Min. required habitat use	Optional habitat use	RS	Min. required habitat use	Optional habitat use
tiger salamander	2	Living -All seasons	4	Living -All seasons	Living -Winter -Growing Reproducing	4	Living -All seasons	Living -Winter -Growing Reproducing
sharptail snake	2	Living -All seasons	2	Living -All seasons		4	Living -Growing Hibernating	
spotted owl	2	Living -All seasons	4	Living -All seasons	Living -Winter -Growing Reproducing	4	Living -All seasons	Living -Winter -Growing Reproducing
marbled murrelet	2	Reproducing	4	Reproducing		4	Reproducing	
Pacific water shrew	2	Living -All seasons	2	Living -All seasons		4	Living -All seasons	
pallid bat	2	Living -All seasons	4	Living -Growing	Hibernating Reproducing	4	Living -Growing	Food Security/Thermal -Growing Hibernating Reproducing
Vancouver Island marmot	2	Living -All seasons	4	Living -Growing	Hibernating	4	Living - Growing	Hibernating
caribou	6	Living -Winter -Growing	6	Living -Winter Growing	Food -Winter -Growing -Early Winter -Late Winter  Security/Thermal -Winter -Growing	6	Living -Winter -Growing	Food -Winter Growing -Early Winter -Late Winter -Early Spring  Security/Thermal -Winter -Growing Reproducing

objectives, the possibilities can be narrowed down to a few minimum requirements for particular species or species groups. Minimum requirements have been developed for ungulates, bears, and “Identified Wildlife” for 3 map scales (RIC 1999). Table 4 provides an example of the minimum required rating criteria for a number of species at risk.

### SPECIES-HABITAT MODELS

For every species that is mapped, for every project, a Species-Habitat Model must be developed (or an existing model may be revised for the new project). It is particularly important to document the information on which the habitat

ratings are based so that other biologists can assess and replicate the model.

Every model includes a written species account and a ratings table. The species account describes the species’ habitat needs and the ecosystem attributes that supply those needs. It identifies the rating criteria and all the assumptions that go into the ratings table. The ratings table provides habitat ratings for all the unique ecosystems in the project area (i.e., it is the “look-up” table used with a GIS [global information system] to produce a habitat map from an ecosystem map).

A species account and a preliminary ratings table is developed for each species being rated prior to field sampling. Field sampling is undertaken in conjunction with the terrestrial

**Table 5.** Part of a Columbian black-tailed deer ratings table for one unique ecosystem in an example project in an example project in the Lake Cowichan area, showing food ratings for 3 seasons (RIC 1999).

Ecosystem description					Wildlife habitat ratings		
Ecosection	BGC <sup>a</sup> zone	BGC subzone	Site series	Structural stage	Food - Winter	Food - Early Spring	Food - Growing
LIM	CWH	xm	HK	2 - Herb	5	2	3
Leeward	Coastal	very dry	Western	3 - Shrub/Herb	5	2	3
Island Mtns.	Western	maritime	Hemlock	4 - Pole/Sapling	3	3	4
			Hemlock	5 - Young Forest	3	3	4
			Kindbergia	6 - Mature Forest	1	5	4
				7 - Old Forest	1	5	4

<sup>a</sup> BGC = biogeoclimatic

ecosystem mapping field work in order to ground-truth the preliminary ratings for each ecosystem in the project area. With this information, the ratings are finalized in the final ratings table.

Table 5 shows part of a ratings table for a unique ecosystem in an example project in the Lake Cowichan area. The 5 columns on the left describe 1 ecosystem in the project area—repeated for each structural stage. The 3 columns on the right are food ratings for Columbian black-tailed deer during 3 seasons. Compare the winter food ratings to the structural stage diagram in Figure 1 described earlier, where suitability for deer in winter increases with the age of the stand. Structural stages 6 and 7 (mature forests and old forests) are rated high (class 2) and very high (class 1), while structural stages 2 and 3 (the herb and shrub stages) are rated nil (class 5) to very low (class 5). Structural stage 7 is the capability for this site.

### FURTHER INFORMATION

Additional information on wildlife habitat ratings criteria and the procedures for developing the ratings are provided in *BC Wildlife Habitat Rating Standards* (RIC 1999). This manual can be accessed at:

<http://www.elp.gov.bc.ca/rib/wis/wildinterps>. Printed copies can be purchased from the Queen's Printer in Victoria, B.C.

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