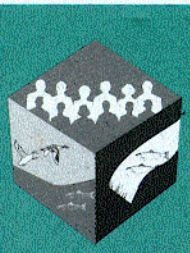

FRASER RIVER ACTION PLAN

A-47

Ecology and Management of Woodpeckers and Wildlife Trees in British Columbia

M. Nyhof

Environment Canada
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Ecology and Management of Woodpeckers and Wildlife Trees in British Columbia

The neatly excavated, oval-shaped Pileated Woodpecker[1] cavity was located about half way up the trunk of a large trembling aspen. Last year, a pair of Pileated Woodpeckers chiselled out the cavity over a period of one week and later raised three chicks in it. As we stood beside the tree in early June, the face of a Northern Saw-whet Owl suddenly appeared at the entrance hole. The little owl had adopted the cavity as its day roost and had perhaps raised its own brood in it earlier on that spring.Trees such as this aspen, located at the edge of an old-growth cedar-hemlock stand, are known in British Columbia as wildlife trees. Wildlife trees provide valuable habitat for wildlife. They may be alive or dead, and are defined by special features such as old age, favorable location, or characteristic defects such as a broken top, sloughing bark, or presence of decay fungi or parasitic insects. In British Columbia, wildlife trees support approximately 90 species of birds, mammals, and amphibians, comprising 16 percent of the province's vertebrate fauna. These trees are critical for woodpeckers which are referred to as "primary cavity nesters" and those species that habitually occupy woodpecker cavities, the "secondary cavity nesters".

E. Walters

Red-naped Sapsucker

Among cavity-nesting birds that inhabit forest ecosystems, woodpeckers are some of the most specialized and tree-dependent species. They usually nest in mature coniferous or deciduous trees that have some degree of fungal infection. Many woodpecker species prefer trees infested by wood-boring beetles, bark beetles, or carpenter ants for feeding. Trees are also used for drumming, a technique used for broadcasting messages during courtship or territorial disputes. Drumming trees have excellent resonance and are characteristically hard snags or live trees with spiked tops. Dead and diseased trees with stem rot, insects, spiked tops and other defects of value to wildlife are abundant in unmanaged mature forests, but are often absent or rare in the managed younger stands (or tree plantations) that have become a prominent feature of forested landscapes.

[1] *Scientific names of all species mentioned in text and tables are given in Appendix 1.*

In an intensively managed forest, dead and diseased trees have traditionally been considered as either dangerous to workers, or useless for timber production. These trees are being removed from the forest, with unknown consequences to the future viability of woodpecker and other wildlife populations. In response to this forest management issue, several provincial and federal agencies have jointly established a wildlife tree management program. Its goal is to help preserve the biological diversity of British Columbia's forest ecosystems while maintaining high standards of timber production and worker safety. However, many unanswered questions remain. What kinds of trees should be retained during forestry operations in order to preserve wildlife or biological diversity? Do woodpeckers play a prominent role within forest ecosystems and how are they, in particular, impacted by intensive timber management? What kinds and how many trees do woodpeckers require for survival and successful reproduction?

M. Nyhof

Lewis' Woodpecker on a wildlife tree

This publication summarizes the current state of knowledge on the ecological associations between woodpeckers and their habitat in British Columbia. It includes information on the general ecology of woodpeckers, their roles within forest ecosystems, and their potential utility as biological control agents for forest insects. The relationship between woodpeckers and their habitat is explored with special reference to three field studies in the Kamloops (Fraser River Basin) and Nelson (Columbia River Basin) Forest Regions. Wildlife tree management options for land managers and private landowners are also provided.

Ecology of British Columbia Woodpeckers

Woodpeckers are distributed throughout British Columbia's forests. Twelve species belonging to the family Picidae breed in the province (pages 10–11). With the exception of the alpine tundra, woodpeckers reside in every biogeoclimatic zone, although some species are restricted to certain ecosystems or parts of the province (Steeger and Machmer 1994). The Williamson's Sapsucker, for example, occurs only in the Thompson-Okanagan Plateau and Kootenay Trench regions where it inhabits interior Douglas-fir forests. The Yellow-bellied Sapsucker is restricted to the sub-boreal and boreal spruce forests of northeastern British Columbia. Conversely, species such as the Downy and Hairy Woodpecker are widely distributed throughout the province in all forested regions. Forest stands of the interior of British Columbia may support up to eight species, which approaches the maximum woodpecker species diversity reported for northern temperate forests (Short and Horne 1990).

Woodpeckers belong to a group of forest birds known as primary cavity nesters which excavate their own nest and roost cavities in dead or live trees. These trees usually have some degree of heartwood decay which facilitates cavity excavation, and are surrounded by a firm sapwood shell which provides protection from inclement weather and terrestrial predators (Winkler *et al.* 1995).

C. Steeger

Pileated Woodpecker excavations

Both males and females participate in excavation, although the males do the majority of the work. Woodpeckers often initiate and sometimes complete more than one cavity during a breeding season. Trees used for nesting and roosting are usually located in close proximity to one another and the same tree or even the same cavity may be used for nesting, roosting, as well as refuge from predators and from poor weather. Most woodpeckers roost in cavities at night but there are some known exceptions. Goggans *et al.* (1989) discovered that Black-backed Woodpeckers in Oregon use special features for roosting including stem cankers, deep trunk scars, forked branches and mistletoe brooms. Red-naped Sapsuckers in the Hat Creek area of British Columbia roost within the foliage of coniferous and deciduous trees.

Throughout the year, woodpeckers search for food primarily in trees. They use a variety of foraging techniques including bark scaling, excavating, probing, pecking, surface gleaning, sapsucking, flycatching, and ground foraging. However, species differ with respect to the types of trees (e.g., species, size, and degree of decay) they feed on, as well as their feeding location and diet content. For example, Pileated Woodpeckers feed to a large extent on carpenter ants in dead standing trees or downed logs (Bull *et al.* 1992) whereas Three-toed Woodpeckers scale the trunks of recently dead trees for bark and wood-boring beetles. Sapsuckers drill rows of small holes into deciduous and coniferous trees to feed on sap and on insects attracted to these sap wells. Northern Flickers have a variable diet and search for insects by probing and digging in the ground of open forests and grasslands, and by pecking and gleaning the surface of dead and live trees, downed logs, and stumps. They also eat fruits and seeds.

Woodpeckers communicate frequently, especially at the beginning of their breeding season. They call or drum from prominent trees and the messages are believed to be directed at mates and territory intruders. Certain calls and drummings may serve to discourage competitors.

Clearly, woodpeckers use trees to perform most of their daily and seasonal activities. However, trees differ in their suitability for wildlife and certain features of trees greatly enhance their habitat value for woodpeckers. These features include colonization by insects, internal decay, and other defects caused by disease, animals and weather. In unmanaged forests, dead, diseased and deformed trees are interspersed with live healthy trees and a diversity of tree species, ages, sizes, and growth forms are present. Such forests provide woodpeckers and other forest dwelling animals with the special features they need to survive and reproduce. In managed forests, dead, diseased and deformed trees are removed during stand management activities (e.g., spacing, pruning, brushing, pre-commercial thinning, etc.). Trees remaining in even-aged stands are similar in age, size, and species composition. These forests are uniform in structure and are therefore less likely to contain the diversity of habitat features required by woodpeckers. In northern Europe, for example, timber farms devoid of wildlife trees have replaced vast areas of once natural boreal forest. Large scale declines in woodpecker populations and elimination of species from such forests have accompanied these changes (Angelstam and Mikusinski 1994). Are British Columbia's woodpeckers faced with a similar future? If so, serious and unanticipated repercussions to forest health and biodiversity could result.

British Columbia Woodpecker Species

General information on the distribution, habitat, breeding chronology, description and behaviour of woodpeckers can be found in Cannings *et al.* (1987), Ehrlich *et al.* (1988), Campbell *et al.* (1990), and Winkler *et al.* (1995). Here, we summarize some pertinent information on the 12 species, (shown on pages 10–11) occurring in British Columbia.

Red-breasted Sapsucker – The Red-breasted Sapsucker occurs along the coast, in the central interior and in northwestern parts of British Columbia. It breeds and forages in both coniferous and deciduous forests and in riparian woodlands. Deciduous trees measuring greater than 30 cm d.b.h. (diameter measured at breast height) are preferred for nesting. Red-breasted Sapsuckers drill rows of holes into hardwoods and conifers and feed on sap and on insects attracted to sap wells. The breeding period extends from early May to late July.

Red-naped Sapsucker – The Red-naped Sapsucker is found in the south and central interior and in southeastern portions of British Columbia. It breeds and forages in a variety of deciduous and mixed woodlands. Red-naped Sapsuckers excavate nest cavities mainly in hardwoods greater than 17 cm d.b.h., often located adjacent to open areas. They drill rows of holes into hardwoods and conifers and feed on the sap and insects that collect at these sap wells. They also catch flying insects. The breeding period extends from late April to early August.

Yellow-bellied Sapsucker – The Yellow-bellied Sapsucker occurs in the northeast and north central portions of British Columbia where it breeds and forages in deciduous, mixed or riparian woodlands. It excavates nest cavities in hardwoods greater than 30 cm d.b.h., often located in edge habitats near water. Yellow-bellied Sapsuckers drill sap wells into live conifers and hardwoods which they defend from other species. Insects comprise over half of the diet during the breeding season, which extends from late May to early August.

Williamson's Sapsucker – This sapsucker is confined to the southern portions of the Thompson Okanagan Plateau and the Kootenay Trench regions where it breeds mainly in western larch, Douglas-fir and ponderosa pine forests, and occasionally in aspen groves. The Williamson's Sapsucker excavates cavities in live or dead conifers measuring greater than 30 cm d.b.h. It feeds mainly on insects that are gleaned from sap wells and extracted from under loose bark. The breeding period extends from May to late July. It is considered a vulnerable species in British Columbia due to habitat loss and low population numbers.

Lewis' Woodpecker – The Lewis' Woodpecker breeds and forages in ponderosa pine forests and in deciduous and riparian woodlands of the southern interior of British Columbia. It often nests in ponderosa pine or black cottonwood with internal wood decay. Nest trees usually measure greater than 40 cm d.b.h. The Lewis' Woodpecker differs in its foraging behaviour from other British Columbia woodpeckers, feeding mainly on flying insects which it catches on the wing, similar to flycatchers. Critical habitat features are an open canopy and an abundance of snags for nesting, roosting and perching. The breeding period extends from early May to late July. This species is considered vulnerable in British Columbia due to declining populations and loss of habitat.

Downy Woodpecker – This small woodpecker is widely distributed throughout southern and central British Columbia where it breeds and forages in a variety of deciduous, mixed, and riparian forest habitats. It also uses forest burns, logged areas, orchards and gardens. The Downy Woodpecker excavates cavities in hardwoods that are dead or softened by decay fungi and that are usually greater than 25 cm d.b.h. It feeds mainly on bark-dwelling insects, supplemented by fruit, seeds, and sap. Downy Woodpeckers may be common in urban areas and often visit bird feeders. The breeding period extends from mid-April to early August.

Hairy Woodpecker – This woodpecker is a widespread resident throughout British Columbia where it breeds in mixed forests or forest edges. It excavates cavities in hardwoods and occasionally in conifers with a minimum d.b.h. of 25 cm. The Hairy Woodpecker forages in mature coniferous, deciduous and mixed forest, feeding mainly on insects which it scales from the bark of live or dead trees. It occasionally eats fruits and seeds and visits bird feeders, especially in winter. The breeding period extends from early April to early July, with south coast birds breeding up to one month ahead of interior populations.

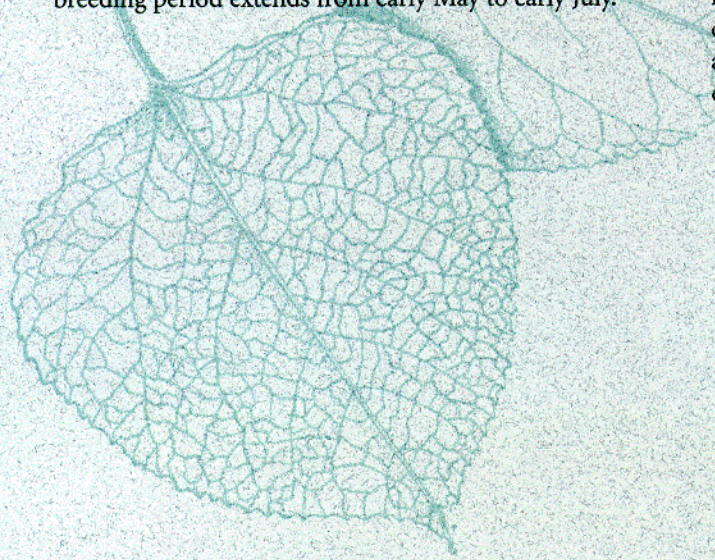
Black-backed Woodpecker – The Black-backed Woodpecker occurs locally throughout British Columbia east of the coast ranges. It breeds in coniferous forests and excavates its own nest cavities in large, live or dead conifers greater than 35 cm d.b.h. Black-backed Woodpeckers feed almost exclusively on wood-boring beetle larvae in mature and old-growth conifer stands. This species is often associated with recently burned forest stands that are vulnerable to wood-boring beetle infestations (Hutto 1995). The breeding period extends from late April to early July.

Three-toed Woodpecker – The Three-toed Woodpecker is found throughout British Columbia primarily east of the coast ranges. It breeds in middle to upper elevation mature coniferous forests and excavates cavities mainly in large dead or live conifers greater than 30 cm d.b.h. Three-toed Woodpeckers feed almost exclusively on larvae and pupae of bark and wood-boring beetles which they scale from the bark of trees in spruce, true fir, or mixed forests with a lodgepole pine component. Similar to the Black-backed Woodpecker, this species uses diseased and insect-infested trees in mature and old-growth forests. The breeding period extends from early May to early July.

White-headed Woodpecker – The White-headed Woodpecker occurs in Canada only in British Columbia where its range extends from the Thompson-Okanagan Plateau to the West Kootenay region in the southern interior. It breeds only in open stands of mature and old-growth ponderosa pine and forages exclusively on large ponderosa pine trees in open pine or mixed pine-fir stands. Trees used for nesting usually measure greater than 40 cm d.b.h. White-headed Woodpeckers eat seeds extracted from pine cones in fall and winter and glean insects from bark in spring and summer. The breeding period extends from mid May to early July. This species is considered threatened in British Columbia due to low population levels (likely fewer than 100 pairs) and reduction in mature ponderosa pine habitat.

Pileated Woodpecker – This largest of all North American woodpecker species is found throughout southern British Columbia and sparsely in the central interior and northeast portions of the province. It breeds in a variety of forest habitats from open deciduous forest to mature coniferous forest. The Pileated Woodpecker excavates its own cavities in large hardwoods and conifers greater than 45 cm d.b.h. and feeds primarily on carpenter ants which it extracts from large diameter logs, stumps or standing dead trees. This species requires large territories with an abundance of large size trees. The breeding period extends from early April to early July.

Northern Flicker – This common woodpecker is found throughout British Columbia. It breeds and forages in open and semi-open habitats such as parkland, mixed, deciduous and riparian woodlands, forest edges, burns, logged areas, gardens, rangeland, pasture, orchards, and alpine meadows. The Northern Flicker nests in old cavities or excavates new cavities in trees greater than 40 cm d.b.h. It feeds on or near the ground for insects and also eats nuts, grains and fruits. The breeding period extends from April to early July.



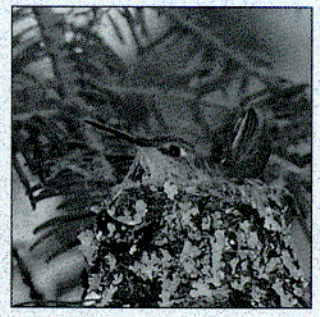
The Ecological Roles Woodpeckers Play In The Forest Community

The Nest Web – Most woodpeckers excavate at least one nesting cavity as well as one or more roosting cavities each year. Consequently, they create a large number of cavities during their lifetimes. These cavities are used by secondary cavity nesters (e.g., ducks, owls, swallows, bluebirds, bats and squirrels) that require them for nesting and roosting, but are unable to excavate their own. These animals could breed in suitable tree cavities created by natural processes other than woodpecker excavations (e.g., broken off branches or limbs, split or cracked trunks, hollow trees). However, such cavities are very limited in number and without woodpecker cavities, it is likely that secondary cavity nester populations would decline. For example, densities of breeding Tree Swallows and Violet-green Swallows in Colorado depend on the availability of Red-naped Sapsucker cavities (Daily *et al.* 1993). Bull and Snider (1993) report on the use of Pileated Woodpecker nest cavities by several species of owls, bluebirds, and chickadees, and the use of the woodpeckers' roost cavities by swifts, Northern Flickers, bats, squirrels and woodrats. Overall, at least 31 species of secondary cavity-nesting birds and several cavity-using mammal species occur in British Columbia. Some examples of known associations among primary and secondary cavity nesters are given in Box 1.

M. Nyhof

Northern Saw-whet Owl

The Food Web – Through their feeding activities, woodpeckers also provide other insectivorous and herbivorous species with access to food resources. The sap that flows from wells excavated by Red-naped Sapsuckers provides important nourishment for a diverse group of species including hummingbirds, songbirds, other woodpeckers, chipmunks, squirrels, hares, wasps, and butterflies. Moreover, this resource is available at a time when consumers are reproducing and storing fat for fall migration or hibernation. The migration schedules and limits of the northern breeding range of Ruby-throated and Rufous Hummingbirds appear to be determined by the availability of sap from Yellow-bellied Sapsucker wells (Miller and Nero 1983). Strong excavators, such as the Pileated Woodpecker, provide feeding opportunities for other bark foragers (e.g., Red-breasted Nuthatch, Brown Creeper) by creating access routes to beetles, ants and exposed grubs. Some species, including Hairy and Downy Woodpeckers, are attracted to these feeding holes because they allow them to forage more deeply than the woodpeckers could by their own efforts.



M. Nyhof

Female Rufous Hummingbird

We have discussed how woodpeckers prey upon insects and how they provide food resources for other species. However, woodpeckers themselves are also prey items for predatory species living in the forest. Northern Goshawks and Great Horned Owls, for example, prey upon juvenile and adult woodpeckers while woodpecker eggs and/or nestlings are taken by squirrels, chipmunks, mice, weasel, marten, raccoon, and bears. Interestingly, some species that prey on woodpecker eggs and offspring take up residence or raise their own young in the cavities excavated by their prey.

M. Nyhof

Mountain Chickadee

The following examples demonstrate how nesting and feeding activities of woodpeckers can subtly but profoundly affect populations of secondary cavity nesters and other dependent species. There is considerable evidence supporting the role of woodpeckers as "keystone species" in forest ecosystems. Keystone species are species whose presence in an ecosystem is vital to the integrity of the community. Through their nesting and feeding activities, woodpeckers influence the composition and dynamics of entire forest wildlife communities, thereby contributing to ecosystem health and stability.

Box 1. Selected examples of the use of woodpecker cavities by secondary cavity-nesting bird and mammal species.

Primary Cavity Nesters	Tree Species	Secondary Cavity Nesters
Pileated Woodpecker	Trembling Aspen	Northern Saw-whet Owl
	Grand Fir	Northern Flying Squirrel
	Ponderosa Pine	Vaux's Swift
		Flammulated Owl
		Common Goldeneye
Red-naped Sapsucker	Paper Birch	Red Squirrel
	Trembling Aspen	Northern Flying Squirrel
		Flammulated Owl
		Mountain Chickadee
		House Wren
		Tree Swallow
		Violet-green Swallow
		Rough-winged Swallow
		Red Squirrel
Yellow-bellied Sapsucker	Trembling Aspen	Northern Flying Squirrel
		European Starling
		Tree Swallow
Northern Flicker	Trembling Aspen	Northern Flying Squirrel
	Douglas-fir	Mountain Bluebird
		Bufflehead
		Northern Flying Squirrel
Black-backed Woodpecker	Lodgepole Pine	Northern Flying Squirrel
Three-toed Woodpecker	Western Larch	Northern Flying Squirrel

Woodpeckers as Biological Control Agents of Bark Beetles

Woodpeckers are important predators of bark beetles and other wood-boring insects that cause significant tree mortality and economic losses in British Columbia forests. Bark beetles periodically reach epidemic population levels and there is growing interest in the potential role of woodpeckers in regulating the abundance and distribution of beetle populations (Machmer and Steeger 1995).

Several British Columbia woodpecker species consume bark beetles (e.g., mountain pine beetle, spruce beetle, or Douglas-fir beetle). Woodpeckers of the genus Picoides (Three-toed, Black-backed, Hairy, Downy, and White-headed Woodpeckers) may consume large numbers of beetle larvae and pupae which they excavate from under the bark of trees. Three-toed Woodpeckers are highly specialized predators that consume bark beetles at impressive rates: one study conducted during a beetle outbreak (Koplin 1972) reported a mean of 915 spruce beetle larvae in the stomachs of Three-toed Woodpeckers. Since individuals fill their stomachs several times daily, a single Three-toed Woodpecker may consume many thousands of beetle larvae per day.

As beetle densities increase in an area, woodpeckers change their feeding behaviour and increase the proportion of beetles in their diet, and/or modify their territorial and social organization by aggregating in beetle outbreak areas. Winter woodpecker densities have increased up to 85-fold during infestations with up to 12 individuals feeding amicably in the same tree. Even during the breeding season when woodpeckers establish

and defend nesting territories, woodpecker densities have increased seven-fold during beetle outbreaks (Koplin 1972).

Natural Resources Canada

Spruce beetle larvae

Management of insects, wildlife, and timber in British Columbia should be integrated as these three factors play important roles in shaping forest ecology. Bark beetles infest many thousands of hectares of forest each year, resulting in extensive salvage logging operations and harvesting of susceptible host trees. On the other hand, bark beetles constitute a significant portion of the diet of several woodpecker species and, in combination with other beetle predators and parasites, woodpeckers can contribute significantly to the regulation of beetle populations. Most avian beetle predators are primary or secondary cavity nesters that depend on wildlife trees (including trees infested and killed by bark beetles) for nesting, roosting and feeding. Many of the details on the ecological interrelationships among trees, beetles, and woodpeckers are lacking, and studies should be conducted to fill existing knowledge gaps.

Woodpecker Habitat

Trees that are suitable for use by woodpeckers are continuously created in forests through the actions of tree disturbance and mortality agents such as fire, disease fungi, insects, and abiotic factors. These forest health agents may differ considerably in their effects on trees, and in turn, create a variety of habitats to which wildlife species are adapted. The death of a mature tree *per se* does not mean that it creates valuable wildlife habitat. Rather, it is the process of death and decay and the disturbance agents and their interactions that may make trees suitable for use by wildlife. This concept is illustrated in the following examples:

C. Steeger

Wildlife tree

Fire – The effect of wildfires on trees depends on a variety of factors including the species and size of trees, and the intensity and frequency of fires. For example, a mature western larch in an ecosystem with frequent low-intensity ground fires may be scarred by a fire, subsequently attacked by wood-boring beetles, and finally invaded by a heart rot fungus which eventually kills the tree. The fungus softens the tree and facilitates cavity excavation by a woodpecker. The relatively firm root system and slow decay rate of the larch make it a valuable wildlife tree for many years. On the other hand, an intense fire could kill the larch instantaneously and harden it to a degree that renders it unsuitable for use by primary cavity nesters.

Disease – Disease-causing fungi are widespread and responsible for the death and decay of many trees. Heart or stem rot fungi are generally very selective in their choice of tree species and are often restricted to particular parts of trees. In contrast, Armillaria root disease is very common throughout the southern interior of British Columbia, affecting and killing large numbers of trees and sometimes entire stands. Armillaria-weakened trees are often attacked by bark beetles (Tkacz and Schmitz 1986) which are subsequently fed upon by woodpeckers. Phellinus ignarius and Fomes fomentarius are common heart rot fungi infecting aspen and birch, respectively. They soften hardwood stems, permitting nest cavity excavation by woodpeckers.

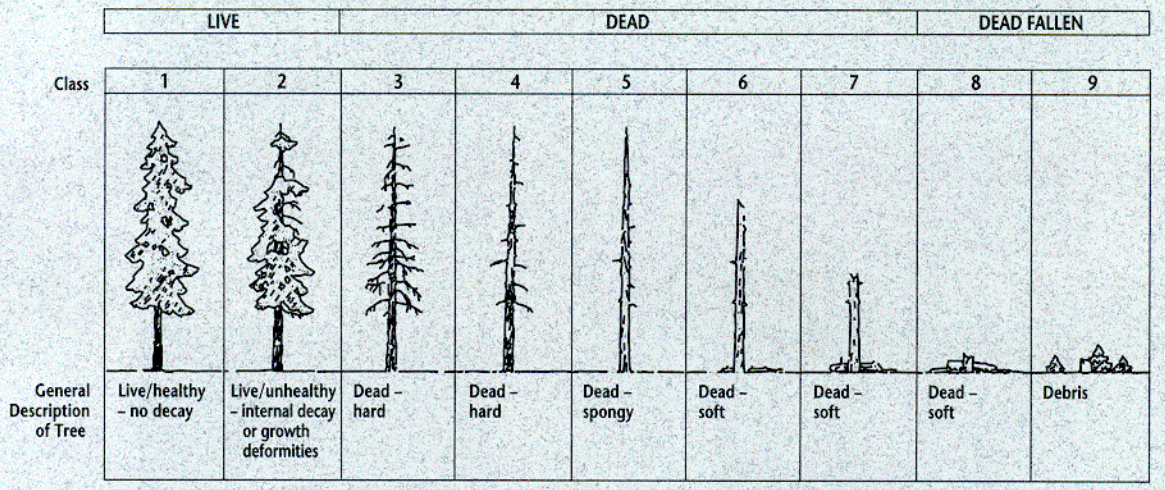
Insects – Of the many parasitic insects that affect the forests of British Columbia, bark beetles are among the most severe, killing millions of trees each year. When bark beetle populations reach very high (epidemic) densities, they often cause rapid and extensive tree mortality. At low (endemic) levels, bark beetles may not kill trees directly, however they may stress trees and make them more susceptible to diseases or other parasites. Again, it is the interaction between several disturbance agents that is often responsible for the trees' demise. Other insect groups that parasitize trees and are widespread throughout British Columbia include secondary beetles (i.e., beetles that attack dead trees such as engraver and ambrosia beetles), defoliators (e.g., moths, loopers), sucking insects (e.g., aphids), and woody tissue feeders (e.g., weevils and ants). Representatives of all these insect types have been reported in the diets of woodpeckers, especially when insects are present at high population levels.

Climatic Factors – Mortality or injury caused by snow, wind, or extreme temperatures can also create wildlife trees. Trees at high elevations are often affected by snow or high winds which can result in broken or deformed tops or trunks. Once a portion of a tree is broken off, it is usually invaded by fungi, thereby becoming more suitable for use by woodpeckers and other wildlife tree users. Trees go through a variety of phases during their life cycles, beginning with germination and growth, and followed by deterioration, death and decay. These phases are influenced by various forest health agents and result in trees with a variety of growth forms and decay conditions. For example, a live healthy tree might suddenly break, fall over and die during a severe storm, while a tree invaded by decay fungi might die gradually in a standing position over a period of several decades. Standing trees in various stages of root, sapwood and heartwood decay occur throughout natural forests. These range from live trees without decay, to hard, spongy, or soft snags, and finally to remnants of debris. Certain tree defects are associated with stages in the process of tree deterioration and decay: dead limbs and spiked tops; loss of needles or leaves, twigs, and branches; sloughing or loss of bark; and broken tops or trunks and other forms of mechanical tree damage. In order to classify the various tree decay conditions, the British Columbia Wildlife Tree Committee developed a Wildlife Tree Classification System (Box 2). This system depicts the general process of deterioration and decay typical of common thick-barked tree species, such as Douglas-fir or ponderosa pine. Physical characteristics and typical wildlife uses for each decay class are also listed. In the absence of detailed knowledge about the habitat requirements of certain wildlife species, this classification system provides a useful guide for identifying potentially valuable wildlife trees.

K. Morgan

Sapsuckers frequently nest in aspens

Box 2. British Columbia Wildlife Tree Classification System



M. Nyhof

Red-breasted Sapsucker

M. Nyhof

Red-naped Sapsucker

M. Nyhof

Yellow-bellied Sapsucker

M. Nyhof

Williamson's Sapsucker

T. Zurowski

Lewis' Woodpecker

M. Nyhof

Downy Woodpecker

M. Nyhof

Hairy Woodpecker

M. Nyhof

Black-backed Woodpecker

M. Nyhof

Three-toed Woodpecker

T. Zurowski

White-headed Woodpecker

M. Nyhof

Pileated Woodpecker

M. Nyhof

Northern Flicker

Woodpecker Field Studies In British Columbia

The biology of woodpeckers and their responses to changes in forested habitats in British Columbia is being investigated by a number of researchers. The following sections provide an overview of three ongoing woodpecker studies in the interior of British Columbia (Fig. 1): (1) the Hat Creek Study (University of Victoria with support from Fraser River Action Plan, Pacific Wildlife Research Centre, B.C. Ministry of Forests, Ministry of Environment, Lands and Parks); (2) the Kamloops Forest Region Study (B.C. Ministry of Forests, Fraser River Action Plan, Pacific Wildlife Research Centre); and (3) the Nelson Forest Region Study (B.C. Ministry of Forests, Ministry of Environment, Lands and Parks).

A summary of characteristics for the three study areas is given in Table 1. The Hat Creek study focuses exclusively on Red-naped Sapsuckers whereas the Kamloops and Nelson studies investigate all locally occurring woodpecker species, as well as other cavity nesters. The primary goal of all three projects is to investigate woodpecker habitat requirements and to develop forest management guidelines for the conservation of critical habitats for these species. Here, we present preliminary

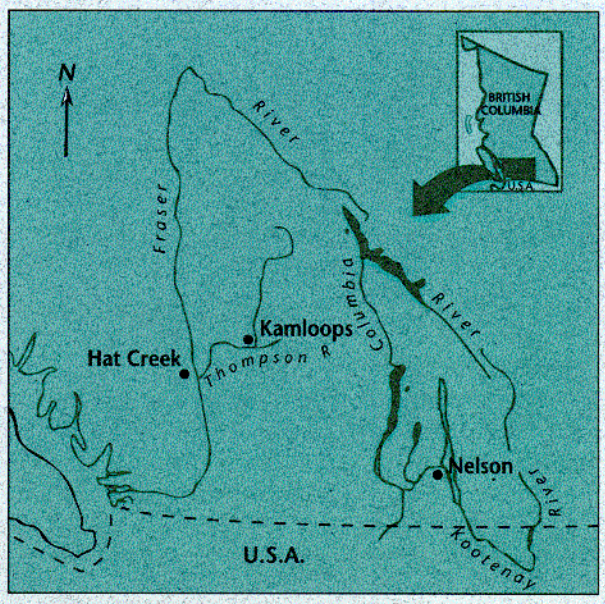


Fig. 1. Woodpecker research sites in British Columbia

results from these projects and, based on this information, we formulate a set of recommendations for the management and conservation of the province's woodpeckers and their habitat.

Table 1. General characteristics of the three study areas.

	Hat Creek	Kamloops Region		Nelson Region	
		Opax	Sicamous	West Arm	Deer Creek
Biogeoclimatic Subzone[1]	IDFxw	IDFxh	ESSFwc	ICHdw	ICHdw
Total area (ha)	450	500	500	60	70
Elevation (m)	1,200	1,100	1,600	1,100	900
Aspect	flat	flat	north	south	south to west
Forest Type	riparian	mature upland	mature upland	mature upland	riparian/ mature upland

[1]IDFxw = very dry, warm Interior Douglas-fir; IDFxh = very dry, hot Interior Douglas-fir; ESSFwc = wet, cold Engelmann Spruce – Subalpine Fir; ICHdw = dry, warm Interior Cedar-Hemlock; *sensu* Meidinger and Pojar 1991.

I. Hat Creek Valley

Principal Investigators: E.L. Walters and E. H. Miller
University of Victoria, Victoria, British Columbia

This long-term population study of the Red-naped Sapsucker, initiated in 1989, is the most comprehensive investigation of the species to date. The study is investigating (i) demographic parameters (e.g., population size, clutch size, fledgling success, and juvenile and adult survivorship), (ii) habitat and spatial use (e.g., territory/home range size and shape), and (iii) feeding use on tree species and associated damage to vegetation by sapsuckers. The methods employed include banding of individuals, radio-telemetry (a technique for determining locations and movements of individuals involving attachment of a radio-transmitter and monitoring of the signals emitted with a receiver), nest searches, and identification and characterization of trees used for nesting, roosting, foraging and drumming.

E. Walters

Red-naped Sapsucker

The study area is located within the Hat Creek valley near the community of Cache Creek in south-central British Columbia. This dry interior ecosystem within the Interior Douglas-fir (IDF) biogeoclimatic zone is biologically rich but heavily impacted by agriculture, cattle ranching, forest management and other human activities. The slopes of the narrow valley are forested with second-growth Douglas-fir, ponderosa pine and lodgepole pine, with a minor component of trembling aspen. The valley bottom contains the same tree species, but includes hybrid white spruce and willow.

II. Kamloops Forest Region

Principal Investigator: W. Klenner, Ministry of Forests, Kamloops, British Columbia

Since 1992, researchers in the Kamloops Forest Region have been investigating nest site selection and foraging habitat of primary cavity nesters in two study areas: a mid-elevation stand in the Interior Douglas-fir zone at Opax Mountain near Kamloops and a high-elevation stand in the Engelmann Spruce – Subalpine Fir (ESSF) zone near Sicamous Creek. Stands at Opax Mountain are comprised mainly of Douglas-fir and trembling aspen interspersed with some paper birch, lodgepole pine and some hybrid white spruce. The Sicamous stands are dominated by subalpine fir with a minor component of Englemann spruce.

The primary goal of this study is to examine the impacts of forest harvesting on woodpecker nesting and foraging behaviour in an experimental context. At Opax Mountain, six harvesting treatments were carried out in winter 1993/94: small patch clearcuts with (i) 20% and (ii) 50% area removal; uniform selection with (iii) 20% and (iv) 50% volume removal; (v) uniform selection with 35% volume removal and unharvested reserves; and (vi) an unharvested control. Four harvesting treatments and an unharvested control were established at Sicamous Creek in 1994/95. All treatments involved 33% area removal with either (i) individual tree selection, (ii) 0.1 ha group selection, (iii) 1.0 ha patch clear cuts, or (iv) 10.0 ha clearcuts. In both study areas, each treatment was replicated twice. The information presented here was collected during pre-harvest surveys. The methods employed include nest searches, foraging observations, characterization of trees used for nesting and foraging relative to trees in the surrounding habitat and in randomly chosen plots. After the experimental cutting, nesting and foraging habitat use by woodpeckers will be followed for two more years.

III. Nelson Forest Region

Principal Investigators: C. Steeger and M. Machmer, Pandion Ecological Research Ltd., Ymir, British Columbia

Since 1992, this study has investigated the use of wildlife trees by cavity nesters at two sites within the Interior Cedar Hemlock (ICH) zone: the West Arm Demonstration Forest at Kootenay Lake, near Nelson, and Deer Creek on the Lower Arrow Lake, near Castlegar. The stands at the West Arm site consist mainly of Douglas-fir, with some veteran ponderosa pine. Dominant conifer species at the Deer Creek site are Douglas-fir, lodgepole pine and western larch, and hardwoods include paper birch and trembling aspen. Both the West Arm and Deer Creek stands contain a high incidence of Armillaria root disease and moderate to high bark beetle populations resulting in an abundance of dead trees.

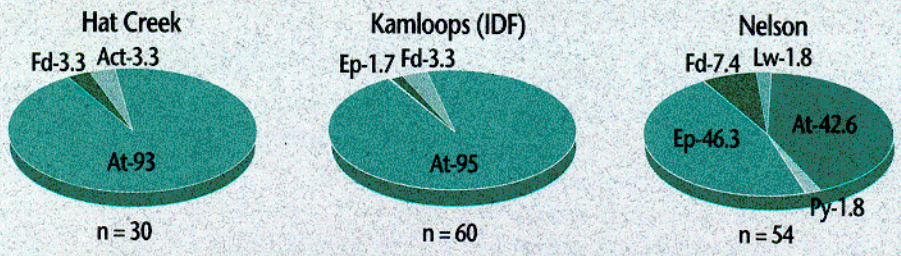
The main objectives of this study are (i) to describe existing wildlife tree habitat use by cavity nesters, (ii) to examine the influence of tree disturbance agents on wildlife tree use, and (iii) to conduct experimental harvesting trials to examine the effects of a "clearcut with wildlife tree patch" silvicultural system on habitat selection by cavity nesters. Methods used include nest searches, observations of foraging woodpeckers, characterization of trees used for nesting and foraging, and assessment of habitat attributes within plots surrounding trees used for nesting and in plots selected at random. Results presented here were collected during three years of pre-harvest data collection. Harvesting trials at Deer Creek occurred during winter 1995/96, to be followed by two years of post-treatment surveys.

Preliminary Results and Discussion

Species Diversity – A total of seven, eight and seven woodpecker species were found within the Hat Creek, Kamloops and Nelson study areas, respectively. Red-naped Sapsuckers, Northern Flickers, and Pileated, Hairy and Downy Woodpeckers were common to all areas. Williamson's Sapsucker, and Three-toed and Black-backed Woodpeckers were present in the Kamloops area, whereas only the latter two species were found in the Nelson area.

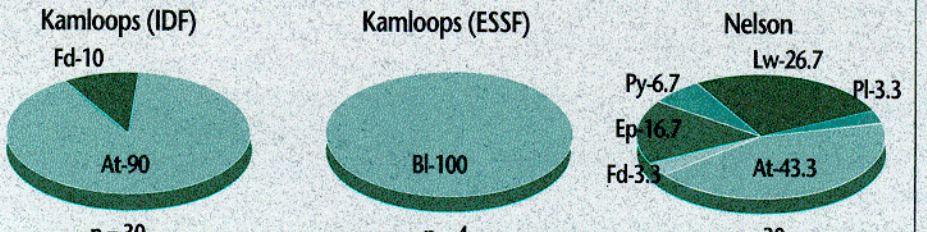
Trees Used for Nesting – Data on nesting (and foraging) habitat use for each study area are summarized by bio-geoclimatic subzone; therefore results for the two Kamloops sites are presented separately and the two Nelson sites are combined. In all three study areas, Red-naped Sapsuckers nested predominantly in deciduous hardwoods; trembling aspen was used almost exclusively at Hat Creek and at the Kamloops IDF site whereas both aspen and paper birch were used in the Nelson area (Fig. 2). This pattern reflects the availability of these two hardwood species in the different areas. The same trend was observed for trees used by the other woodpecker species found within the IDF and ICH sites of the Kamloops and Nelson regions, respectively (Fig. 3). For all woodpecker species combined, a greater diversity of tree species with nests was observed in the Nelson region, possibly reflecting the greater diversity of tree species found in the ICHdw subzone. Four Three-toed Woodpecker nests were found at the Sicamous (ESSF) site, all of which were in subalpine fir.

Fig. 2. Nest Tree Species (%) Used by Red-naped Sapsuckers



At = trembling aspen; Act = black cottonwood; Ep = paper birch; Fd = Douglas-fir; Lw = western larch; Py = ponderosa pine

Fig. 3. Nest Tree Species (%) Used by Other Woodpeckers



At = trembling aspen; Bl = subalpine fir; Ep = paper birch; Fd = Douglas-fir; Lw = western larch; Pl = lodgepole pine; Py = ponderosa pine

The characteristics of trees used for nesting by woodpeckers in the three study areas are summarized in Table 2. In general, trees chosen by most woodpecker species were on average greater than 30 cm d.b.h. and 15 m in height. At the IDF sites, these trees tended to be alive (decay class 1 or 2; see Box 2), whereas the trees used for nesting at the Nelson ICH and Kamloops ESSF sites were either hard snags (decay classes 3 and 4) or live trees.

At Hat Creek and at Deer Creek in the Nelson region, trees used for nesting were assessed with respect to diseases. Ninety-seven percent of the aspen nest trees at Hat Creek were infected with heart rot (determined through core samples) but only 13 percent of those had external conks indicative of aspen trunk rot *Phellinus tremulae*. At Deer Creek, over half of the trees used for nesting by woodpeckers had visible signs of disease (i.e., 21 of 27 paper birch and 3 of 33 trembling aspen had heart rot conks; 3 of 8 western larch had dwarf mistletoe; 4 of 5 Douglas-fir, and 8 of 70 deciduous trees had Armillaria root disease). It is likely that some of the apparently healthy aspen had internal decay that was not detected since they often do not develop visible conks.

Table 2. Characteristics of trees used for nesting by woodpecker species and study site.

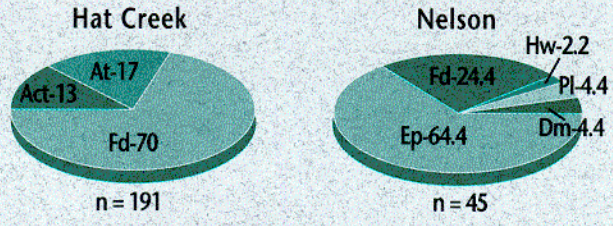
			Tree Characteristics		
Study Site	**Woodpecker Species**	**Trees** (n)	**D.B.H.**[1] (cm)	**Height**[1] (m)	**Decay Class**[2]
Hat Creek (IDF)	Red-naped Sapsucker	30	29.4	16.9	2 (2-3)
Kamloops (IDF)	Red-naped Sapsucker	60	31.4	22.8	2 (1-6)
	Pileated Woodpecker	6	46.3	30.7	1 (1-3)
	Hairy Woodpecker	8	35.2	25.2	1 (1-3)
	Northern Flicker	14	39.1	19.9	2 (1-6)
	Three-toed Woodpecker	1	21.5	23.0	1 (-)
Kamloops (ESSF)	Three-toed Woodpecker	4	38.2	26.1	3 (3-5)
Nelson (ICH)	Red-naped Sapsucker	54	35.5	22.8	2 (1-6)
	Pileated Woodpecker	3	63.0	36.5	2 (1-4)
	Hairy Woodpecker	8	36.6	25.0	2 (1-5)
	Northern Flicker	8	50.9	28.9	1 (1-3)
	Three-toed Woodpecker	9	32.0	14.6	3 (1-4)
	Downy Woodpecker	2	34.7	16.4	4 (-)

[1]D.B.H. and height values are expressed as medians (i.e. the middle value in an array of data ordered from smallest to largest).
[2]Decay class values (see Box 2) are expressed as medians (range).

Trees Used for Foraging – At Hat Creek, about one half of sapsucker feeding was on trees, mostly Douglas-fir (Fig. 4), and the remainder was on willow thickets and some juniper. At Deer Creek in the Nelson area, sapsuckers fed mainly on deciduous trees (Fig. 4) while the other woodpecker species foraged mostly on conifers (Fig. 5). Douglas-fir was the dominant tree used for feeding at the Kamloops IDF site, whereas lodgepole pine, Douglas-fir and western larch were all used for feeding in Nelson. At the Kamloops ESSF site, Three-toed Woodpeckers (the only species observed feeding at this site) foraged mainly on sub-alpine fir and to a lesser extent on Engelmann spruce.

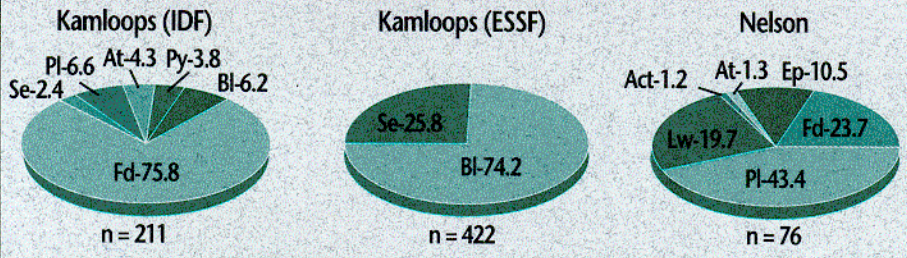
The characteristics of trees used by foraging woodpeckers are summarized in Table 3. At Hat Creek, sapsuckers foraged on trees ranging from 6.8–138.0 cm diameter. They tended to use Douglas-fir and juniper for establishing wells early in the season (April) and then switched to deciduous species such as aspen and willow in early May. The sapsuckers relied on willow for sap throughout the rest of the season (at least until late August). Large trees with furrowed bark (Douglas-fir from 30–50 cm d.b.h. and cottonwood from 40–80 cm d.b.h.) were important for insect foraging when the parents were feeding young. Once fledged, young were observed feeding on the willow sap wells with supplemental insect feedings from their parents.

Fig. 4. Foraging Tree Species (%) Used by Red-naped Sapsuckers



Act = black cottonwood; At = trembling aspen; Dm = Douglas maple; Ep = paper birch; Fd = Douglas-fir; Hw = western hemlock

Fig. 5. Foraging Tree Species (%) Used by Other Woodpeckers



Act = black cottonwood; At = trembling aspen; Bl = subalpine fir; Ep = paper birch; Fd = Douglas-fir; Lw = western larch; Pl = lodgepole pine; Py = ponderosa pine; Se = Englemann spruce

Table 3. Summary of the characteristics of trees used for foraging by woodpecker species and study site.

Study Site	Woodpecker Species	Tree Characteristics: Trees (n)	D.B.H. (cm)[1]	Decay Class[2]
Hat Creek (IDF)	Red-naped Sapsucker	194	33.6	1 (1-3)
Kamloops (IDF)	Hairy Woodpecker	138	20–30	2 (1-6)
	Three-toed Woodpecker	19	20–30	2.5 (1-5)
	Pileated Woodpecker	65	30–50	3 (1-6)
	Black-backed Woodpecker	2	30–50	4 (3-5)
	Downy Woodpecker	3	<10	3 (1-3)
Kamloops (ESSF)	Three-toed Woodpecker	422	30-50	3 (1-6)
Nelson (ICH)	Red-naped Sapsucker	45	<20	1 (1-3)
	Hairy Woodpecker	22	20–30	3 (1-5)
	Three-toed Woodpecker	34	20–30	2.5 (1-6)
	Pileated Woodpecker	8	20–30	4 (1-5)
	Black-backed Woodpecker	3	40–50	3 (3)
	Downy Woodpecker	9	20–30	4 (1-9)

[1]D.B.H. values are expressed as medians.

[2]Decay class values (see Box 2) are expressed as median (range).

At the Kamloops IDF site, woodpeckers foraged on trees ranging from less than 10 cm to 50 cm in diameter. A comparison of trees used for foraging with those available revealed the following: Three-toed Woodpeckers were not selective with respect to tree diameter whereas Hairy Woodpeckers showed some selectivity for larger trees and Pileated Woodpeckers preferred trees greater than 30 cm d.b.h.. Preferences for certain tree decay classes were also observed: hard live and dead standing trees (class 2 and 3) by Three-toed Woodpeckers, hard snags (class 3) by Hairy Woodpeckers and hard to spongy snags (classes 3 and 4–5) by Pileated Woodpeckers. Live healthy trees (class 1) were selected against by all three species. This is presumably because unhealthy or dead trees are more susceptible to insect attack and are therefore preferred for feeding by insectivorous species. Three-toed Woodpeckers foraging at the Sicamous ESSF site clearly preferred trees greater than 30 cm d.b.h. of decay class 3.

At Deer Creek, sapsuckers foraged on generally smaller trees than at Hat Creek, but a tendency to select healthy live trees was evident in both populations. The other woodpecker species at Deer Creek foraged on trees similar in characteristics to those used at the Kamloops IDF site. Individual species appeared to concentrate on particular tree species. At Deer Creek, for example, we observed Three-toed Woodpeckers feeding primarily on mountain pine beetle infested lodgepole pine while Black-backed Woodpeckers foraged on western larch inhabited by wood-boring beetles.

Presence of disturbance agents on foraging trees was only assessed at the Deer Creek study site. Red-naped Sapsuckers foraged primarily (75%) on live healthy trees, a behaviour that is consistent with their feeding mode of extracting sap from vigorously growing trees. Conversely, most trees (86%) used for foraging by the other woodpecker species showed visible signs of disease and/or insect attack. Again, these results are consistent with known diets of these species most of which are insect specialists. About 75% of trees used for foraging by Three-toed Woodpecker were lodgepole pine and all of these were infested with mountain pine beetle. All trees used for foraging by Pileated Woodpeckers showed evidence of Armillaria root disease which likely facilitates colonization by ants, the preferred prey of this species.

M. Nyhof

Hairy Woodpecker

Summary

The three studies summarized here show a relatively high diversity of woodpecker species within the observed Interior Douglas-fir and Interior Cedar-Hemlock stands. Although the Three-toed Woodpecker was the only woodpecker species observed in the Engelmann Spruce-Subalpine Fir zone, Pileated, Black-backed and Hairy Woodpeckers occasionally inhabit these higher elevation forests during spring and summer.

Woodpeckers selected mainly deciduous trees with heartwood decay for nesting (aspen in the Interior Douglas-fir and aspen and birch in the Interior Cedar-Hemlock biogeoclimatic zone). Strong selection for heart rot-infected aspen was also observed by Harestad and Keisker (1989) who investigated use of trees for nesting by primary cavity-nesting birds in the IDF zone near Kamloops. Heart rot-infected aspen and birch are presumably preferred nest trees because of their hard outer shell surrounding soft, decayed inner wood. Also, they are often of large size but may remain alive and firmly rooted for some time if not affected by other diseases. Western larch appears to be an important tree species for woodpecker nesting in ICH stands, as is subalpine fir in the ESSF zone.

Conifers were the preferred trees for foraging by woodpeckers in the three study areas. Except for sapsuckers, woodpeckers feed primarily on insects which they excavate from the bark or wood of coniferous trees. In general, it is the larger, more mature and unhealthy trees that are most often attacked by insects and which are subsequently fed upon by woodpeckers. This food source is especially important during winter when British Columbia's resident woodpeckers rely almost exclusively on insect-infested trees.

Red-naped Sapsuckers as well as the other British Columbia sapsucker species are migratory and generally do not overwinter in the province. Although insects play an important role in their diet, they seem to rely heavily on sap for their nutritional requirements. A variety of trees are used by the sapsuckers depending on the time of year and stage of nesting. Insects were primarily taken from the bark of large trees while sap wells were created in a variety of trees and shrubs.

Patterns of woodpecker nesting and foraging habitat use found in the southern interior do not necessarily reflect those in other parts of the province. In the Nimpkish River Valley on northern Vancouver Island, a study conducted by Canadian Forest Products Ltd. found that 62, 49 and 48 percent of Hairy Woodpecker, Northern Flicker, and Red-breasted Sapsucker nests, respectively, were in western hemlock (Deal 1995). Western white pine comprised 13 and 33 percent of Northern Flicker and Red-breasted Sapsucker nest trees, respectively. In contrast to the interior studies, western hemlock and western white pine appear to be important nest tree species in the Coastal Western Hemlock (CWH) biogeoclimatic zone. Average nest tree diameters in the CWH zone are also much larger (80.4, 63.8 and 79.6 cm d.b.h. for the Hairy Woodpecker, Northern Flicker, and Red-breasted Sapsucker, respectively; compare with Table 2). These differences reinforce the need to obtain site-specific information for effective woodpecker and wildlife tree management.

Management Recommendations

Woodpeckers use a great variety of trees of different species, sizes and characteristics. Individuals of the same species may prefer different tree species or use trees for different purposes depending on elevation and biogeoclimatic zone. In addition to functioning as woodpecker habitat, dead and defective trees may pose extreme hazards during forestry operations and workers need to be protected when such trees are retained (see item 5 below). Management guidelines must ensure both the maintenance of habitat for woodpeckers (and other wildlife populations) and productive, sustainable and safe forestry practices. Integrating wildlife habitat management objectives with those of commercial forestry operations is a challenging task.

C. Steeger

Extensive woodpecker feeding on bark beetles

The following set of recommendations provides some general guidelines regarding the number, characteristics and distribution of wildlife trees that should be retained in commercial forests as well as on private land, in parks, and in urban areas. Background information on the B.C. Workers' Compensation Board (WCB) logging regulations regarding snag removal is provided, as well as some suggestions for wildlife habitat-sensitive firewood cutting. For sound woodpecker habitat management, consider the following:

1. Know Your Local Woodpeckers

- Woodpecker habitat management will be most effective if local species diversity is known. Public and private land and tree managers are encouraged to determine which species reside in an area under development and to focus their management efforts accordingly.

K. Morgan

Where there are no hazards to people or property leave all potential wildlife trees standing

2. Leave Trees Important for Nesting

- Retain all trees with woodpecker nest cavities; nest cavities can be recognized by their well-delineated round or oval shape.
- In mixed deciduous-coniferous stands, retain a mixture of healthy and diseased mature hardwoods and conifers including snags whenever possible;
- In pure coniferous stands, retain veteran trees wherever possible;
- In pure deciduous stands, retain a mixture of healthy, diseased and dead trees in interspersed patches; avoid reducing the stand to less than 20 percent of its original density.

3. Leave Trees Important for Feeding and Communication

- In all stands, retain patches of dead trees in a variety of decay stages, especially insect host trees. Some trees susceptible to future insect attacks should also be left. In stands with severe insect problems or potential for epidemic outbreaks, contact your local forest health officer for advice on how many attacked or susceptible trees are safe to retain.
- For sapsuckers, leave patches of deciduous shrubs (esp. willow) and trees consisting of a variety of sizes, both conifers and deciduous hardwoods.
- Retain some tall hard dead trees or trees with dead spiked tops that can be used for drumming by woodpeckers.

4. Spring and Summer Logging

- If logging during the woodpecker breeding season (April to August) cannot be avoided, thoroughly survey the cutblock to find active nests. If nests are located in dead or hazardous trees, protect them in wildlife tree patches (see item 5 below). Note that it is illegal in British Columbia to fell a tree that contains an active nest of any bird (B.C. Wildlife Act, Section 35).

5. Danger Trees and Wildlife Tree Patches

- The Workers' Compensation Board of B.C. in Section 60 of the Industrial Health and Safety Regulations requires that all snags, and hazardous trees and saplings that are within reach of work areas and roadsides be felled during forestry operations. "Where practicable, snags shall be felled: (a) progressively with the falling of other timber, and (b) before falling adjacent live trees." (60.38). These and other regulations in Section 60 which have implications for wildlife tree management must be complied with at all times. However, snags and hazard trees important for wildlife may be retained if they are contained within appropriate no-work zones. The following regulations apply:

– A dead tree ≥ 3 m in height and not leaning away from the work area requires a no-work zone of radius 1.5 times its height. Conversely, a dead tree leaning away from the work area may be retained without precautions.

– A dead tree ≥ 3 m in height and leaning toward the work area on a slope >30% requires a semicircular no-work zone of radius 1.5 times its height plus a site and slope-specific extension downslope.

– A live tree with a hazardous feature such as a dead top or large dead limb requires a no-work zone of radius 1.5 times the height or length of the hazardous part. Again, adjustments for lean and steep slopes have to be made if applicable.

– No worker shall enter a no-work zone and no trees shall be cut within a marked patch, with one exception: snags or hazard trees within the buffer zone that can reach the work area have to be removed by an experienced snag faller prior to or concurrent with harvesting operations.

- The procedure of delineating no-work zones (which are marked with special tape) results in two types of leave areas: (i) the area in which the wildlife trees are contained and (ii) a surrounding buffer zone which is free of snags or hazard trees that can reach the work area. These two areas together are contained within a no-work zone and are referred to as a wildlife tree patch. Important habitat trees for woodpeckers often occur in a clumped distribution (e.g., within disease centres or areas attacked by beetles). It is therefore desirable to establish wildlife tree patches that contain several valuable habitat trees. In general, a minimum of 10 to 15 percent of each cutblock should be retained as wildlife tree patches; more area (trees) might be required if the abundance of woodpeckers is particularly high or if vulnerable or threatened species are breeding in the stand.

6. Wildlife Trees in Urban Areas and Parks

- Some woodpeckers (e.g., Northern Flickers, Hairy and Downy Woodpeckers) frequently visit or breed in urban areas. Early in the breeding season, they are often conspicuous and noisy, calling from exposed places or drumming on the most resonant surfaces available (e.g., metal roofs or power poles). Private residents are encouraged to endure such "disturbances" as they do not last for more than a few weeks. If woodpecker pairs are detected nesting in a particular tree, such trees should be protected from disturbances and retained for as many years as possible. In parks, where snags may pose concerns for the safety of visitors, park managers or rangers may want to evaluate their options when a tree with an active nest becomes a hazard tree. Careful assessment of the tree (see item 8 below) or temporary closure of a section of a trail, picnic area, or campground may be feasible alternatives.

7. Responsible Firewood Cutting

- Each year, public firewood cutting contributes signif icantly to the removal of valuable woodpecker habitat as dead trees are an excellent source of dry, seasoned fuel wood. Firewood cutters are encouraged to refrain from felling trees larger than 40 cm d.b.h., as well as those in important habitat areas such as along marshes, streams, or lakes. Trees with evidence of recent feeding activity or nest cavities, often recognized by fresh wood chips at the base of the tree, should not be removed.

8. Learning More About Woodpeckers and Wildlife Trees

- The B.C. Forestry Continuing Studies Network (administered through a provincial office at the University of British Columbia and several regional delivery centres) offers three short courses which deal specifically with the integration of cavity nester habitat and forest management. The Wildlife/Danger Tree Assessor's Course trains participants in identifying valuable wildlife trees, in assessing potential hazards and in performing the necessary steps to ensure the safety of workers and the general public as well as habitat protection. Two Stand Level Biodiversity Courses (one for forest managers and one for forest field workers) are offered and also include useful information for the management of cavity nesters.

- More detailed and updated information on research and management of woodpeckers and wildlife trees in British Columbia may be obtained from (i) the B.C. Wildlife Tree Committee in Victoria, (ii) the Pacific Wildlife Research Centre in Delta, and (iii) the Centre for Conservation Biology at the University of B.C. in Vancouver.

- For land managed under the Forest Practices Act of British Columbia, specific requirements can be found in the Operational Planning Regulations under "Content of forest development plans" – Part 3 Section 15(7)(b), "Content of silviculture prescriptions" – Part 5 Section 39(3)(d), and "Content of stand management prescriptions" – Part 5 Section 54(2)(c), and in the Biodiversity Guidebook.

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Appendix 1. List of species and their scientific names mentioned in the text.

Woodpeckers

Red-breasted Sapsucker	*Sphyrapicus ruber*
Red-naped Sapsucker	*Sphyrapicus nuchalis*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Williamson's Sapsucker	*Sphyrapicus thyroideus*
Lewis' Woodpecker	*Melanerpes lewis*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Black-backed Woodpecker	*Picoides arcticus*
Three-toed Woodpecker	*Picoides tridactylus*
White-headed Woodpecker	*Picoides albolarvatus*
Pileated Woodpecker	*Dryocopus pileatus*
Northern Flicker	*Colaptes auratus*

Secondary Cavity Nesters

Northern Saw-whet Owl	*Aegolius acadicus*
Flammulated Owl	*Otus flammeolus*
Vaux's Swift	*Chaetura vauxi*
Mountain Chickadee	*Parus gambeli*
House Wren	*Troglodytes aedon*
Red-breasted Nuthatch	*Sitta canadensis*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
European Starling	*Sturnus vulgaris*
Mountain Bluebird	*Sialia currucoides*
Common Goldeneye	*Bucephala clangula*
Bufflehead	*Bucephala albeola*
Northern Flying Squirrel	*Glaucomys sabrinus*
Red Squirrel	*Tamiasciurus hudsonicus*

Other Vertebrate Species

Ruby-throated Hummingbird	*Archilochus colubris*
Rufous Hummingbird	*Selasphorus rufus*
Brown Creeper	*Certhia americana*
Northern Goshawk	*Accipiter gentilis*
Great Horned Owl	*Bubo virginianus*
Marten	*Martes americana*
Raccoon	*Procyon lotor*

Beetles

Mountain pine beetle	*Dendroctonus ponderosae*
Spruce beetle	*Dendroctonus rufipennis*
Douglas-fir beetle	*Dendroctonus pseudotsugae*

Trees

Tembling aspen	*Populus tremuloides*
Black cottonwood	*Populus trichocarpa*
Paper birch	*Betula papyrifera*
Douglas-fir	*Pseudotsuga menziesii*
Lodgepole pine	*Pinus contorta*
Ponderosa pine	*Pinus ponderosa*
White spruce	*Picea glauca*
Engelmann spruce	*Picea engelmannii*
Hybrid white spruce	*Picea engelmannii x glauca*
Subalpine fir	*Abies lasiocarpa*
Grand fir	*Abies grandis*
Western larch	*Larix occidentalis*
Western hemlock	*Tsuga heterophylla*
Western white pine	*Pinus monticola*