WILDLIFE CONSIDERATIONS FOR SMALL DIAMETER TIMBER HARVESTING

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ABSTRACT

Harvesting small-diameter forests in the interior Northwest has the potential to accelerate the development of old forest characteristics, such as large diameter trees and patchy understory development, increase habitat diversity in landscapes changed by large wildfires, and contribute economic value to local communities. To evaluate the effects of small-diameter harvest on wildlife, managers need to consider three linked wildlife issues: (1) habitat quantity, quality, and distribution; (2) species population structures; and (3) species life histories. Apparent good habitat might not be occupied if landscape connectivity does not allow animals to reach it, or if the animals are incapable of reaching it because they cannot move fast or far. Thinning that results in high diversity and biomass of understory vegetation benefits some species of wildlife, but might not benefit species associated with closed canopies. Variable-density thinning might provide habitat for both closed-canopy and open-canopy species. Retention or creation of snags and large woody debris that provide important habitats is critical, as is maintaining for the long-term the ecological processes that create them (e.g., insects and disease). Collaboration with adjacent landowners to manage for wide-ranging species is important. Participation in adaptive management projects will enhance our ability to manage small diameter forest for both wildlife and human values.

Keywords: small diameter harvest, thinning, wildlife

INTRODUCTION

Active management of small diameter timber can be a viable wildlife management strategy. One of the primary issues for wildlife management and conservation has been habitat fragmentation and its effects on species extirpations, or viability, in managed and unmanaged landscapes (Lehmkuhl and Ruggiero 1991; Creighton et al. 2001). One much-offered solution to minimize fragmentation focuses on creating reserve networks in which large areas have little or no human intervention, while the intervening matrix has some human use (Noss and Cooperrider 1994). Habitat fragmentation and reserves are important issues, but equally important for wildlife conservation is the active management of wildlife habitats to maintain or restore wildlife species and biodiversity in managed landscapes or those otherwise heavily influenced by man's activities, such as fire suppression. Both reserves and active management are viable strategies for wildlife management, each with its own strengths and weaknesses (Everett and Lehmkuhl 1999). In fact, the two strategies are not mutually exclusive, and ecosystem management will require the judicious mixing of both (Everett and Lehmkuhl 1997).

Moreover, active management of small diameter stands directly addresses both habitat fragmentation and maintenance/restoration issues. Extensive landscape analysis for the Interior Columbia Basin Ecosystem Management Project showed that forested landscapes in the interior Pacific Northwest are dominated by small diameter forests as a result of previous management and wildfire in the early 20th century (Fig. 1) (USDA Forest Service 1996). At the same time old forest habitats have declined and become fragmented, and wildlife associated with them has become imperiled (Marcot et al. 1997; Lehmkuhl et al. 1997). In general, fewer wildlife species use middle-age, pole-sapling, or young forests, whose dense canopy structure results in relatively poor understory vegetation diversity, than older forests (Thomas et al. 1979b). These middle-aged small diameter stands might be actively managed to diversify vegetation (hence, habitat) in the short-term, accelerate development of characteristics of older forest in the long-term (decrease old forest fragmentation), and extract forest products for human use. Forests consisting of small diameter trees provide the greatest opportunity for management—both for socioeconomic values and for wildlife management (USDA Forest Service 1996).

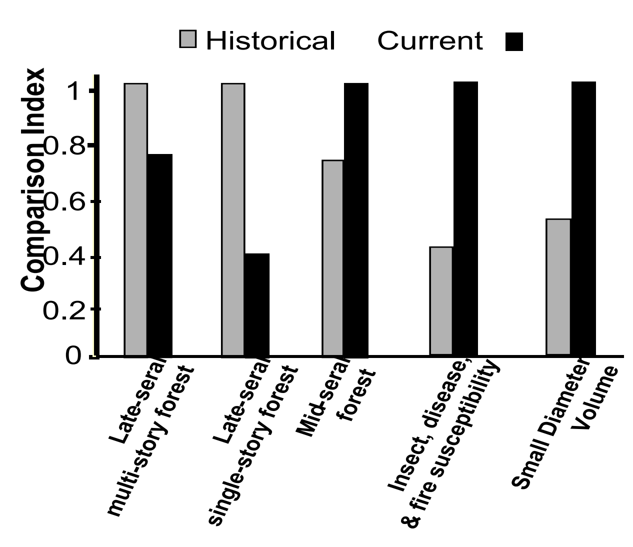

Figure 1.—Some ecosystem changes in the interior Columbia River basin from the mid-1800s to current times that illustrate active wildlife habitat management opportunities. Comparison index shows relative changes from the historical or current period, whichever was greater. (*Source: USDA Forest Service, 1996.*)

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In this paper, we discuss some wildlife management principles that public and private land managers can apply in small diameter forests to benefit wildlife, briefly review what is known about the impacts of thinning on wildlife, and suggest wildlife guidelines for small diameter timber management.

GENERAL CONSIDERATIONS

First, managers need to define their wildlife objectives, which most often boil down to "ecological viability" or "economic viability." The bottom-line for most land managers interested in healthy populations of wildlife is ecological population viability, or the likelihood that a population of a particular species will be able to maintain itself (remain viable) over a long period of time, usually 100+ years. Land managers might have economic viability as an objective for species of economic importance, such as deer and grouse. Economically viable (e.g., huntable) populations, however, usually need to be maintained at much higher levels than ecologically viable populations to provide adequate returns on human effort.

Wildlife managers traditionally focus on managing habitat—cover, food, and water—as the key to wildlife. Though it is true that "habitat is the key to wildlife," as some bumper stickers proclaim, managers need to consider two other keys to successful wildlife management. Three keys for managing healthy wildlife populations under the population viability framework are: habitat, populations, and animal life histories (Gilpin and Soulé 1986). The term "habitat" is often used very generically in a way that is hard to define, except as meaning all natural vegetation conditions, which is not really useful for management. In fact, just about everything is habitat for some species of plant or animal. Habitat, more precisely, should be thought of as the physical and biological environment in which a particular species can exist. We often lump together species that seem to require similar habitat, such as "old-growth-dependent" species, but in reality each species has a particular combination of the physical and biological characteristics of a site that best suits it. When talking about habitat, it is best to specify the species of interest.

Two facets of habitat are quantity and quality. We are familiar with the terms "good habitat" and "bad habitat," but just what do they mean? We define good habitat in terms of population viability: good habitat describes conditions in which the population of a species can reproduce and maintain its population over time. Habitat that meets those conditions is called "source" habitat. It often yields a surplus of animals that move to other areas, thus is an emigrant source of dispersing young that can augment existing populations elsewhere, colonize new habitat patches, or recolonize patches where animals no longer exist (Fig. 2) (Pulliam 1988). Ideally, for those species we desire to have, all habitat would be source habitat.

In terms of population viability, "bad habitat" means vegetation composition and structure that might support some individuals, but does not provide conditions (food, cover, water) that allow a species to survive or successfully reproduce over a long term. An important concept to keep in mind is that bad habitat also might be otherwise good habitat that has been degraded by influences that do not affect the composition and structure of plant communities, for example feral cats eliminating ground-nesting birds near a town, or human disturbance along roads and highways. The formal term for bad habitat is "sink" habitat; that is, apparently good habitat in which populations cannot successfully reproduce and eventually die out.

Sink habitat can be created in several ways (Fig. 2). A patch of habitat might be too small to maintain a viable breeding population, i.e., the rate of death from predation, starvation, or other sources of mortality is higher than the rate of births. A patch of habitat might be affected by human disturbance, e.g., road traffic might lead to poor reproductive performance or elevated mortality (Wisdom et al. 2000). A small patch might have too much "edge," relative to interior area, where habitat is altered by more wind, light, or altered understory, and where higher predation might limit successful reproduction in some species (Janzen 1986). A patch of habitat might be too isolated from similar patches of habitat to allow for immigration, so a population in trouble because of poor weather and food production could not be rescued by immigration of animals from patches of source habitat.

Population characteristics and the life history of the species interact with habitat to determine how well a population persists. For many species, the size and quality of a new habitat patch and the connections among patches determine whether or not a species will occupy a particular patch of habitat. Species that are relatively abundant, can live in a variety of habitats, and have the ability to move about and find, colonize, and reproduce in new habitat patches created by management (e.g., deer, most rodents, and many migratory birds) usually have few problems. Species that are rare, that do not or cannot move much (e.g., reptiles and amphibians), or that have very narrow habitat requirements require more consideration during planning for small diameter harvest. A relatively abundant animal that has a large range of movement has a good chance of finding and colonizing new habitat.

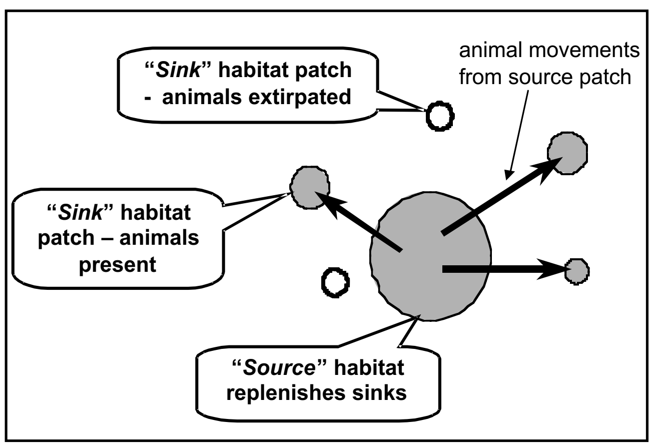

Figure 2.—The relationship between source and sink habitat patches. Source patches have high-quality habitat with self-sustaining wildlife populations that provide immigrants to sink patches. Sink patches have low-quality habitat that cannot sustain populations without immigration from source patches. A species may be absent in sink patches with apparently good habitat because they are too small to sustain a population or too distant from a source of immigrants.

Once there, species that have high reproduction rates, such as hares and rodents, can rapidly build a stable population if there is enough habitat. The question of "enough habitat" depends on the size of the animal relative to how much habitat is there to support a population. For example, a relatively small patch of habitat can support many small animals, such as mice or hares, that reproduce fairly quickly and can form a viable population. That same patch, or stand, might not support a viable population of larger species, such as bobcat (*Lynx rufus*) or lynx (*Lynx canadensis*). In that case, we need to start thinking about larger areas or connecting small habitat patches to support a viable population. One way to increase connectivity is to provide dispersal habitat or habitat corridors to facilitate movements and connectivity between habitat patches (Simberloff et al. 1992).

RESPONSES TO THINNING

Small diameter management could include clear-cut harvesting or thinning, depending on the management objectives. We will focus this review on the effects of thinning because that is the practice most often applied to small diameter stands. Much of the literature on thinning effects on wildlife in Western coniferous forests has focused on coastal Douglas-fir, and interior ponderosa pine and lodgepole pine forests. A brief overview of effects in these forest types should present a good picture of wildlife impacts in most forest types in the interior Northwest.

As might be predicted by the previous discussion of general principles, past research has shown that some species gain and some lose when young forested stands are thinned (Lehmkuhl et al. 1999). That is, the effects of thinning depend on the specific habitat requirements, population structure, and life history (behavior) of individual species. Thinning typically results in greater understory vegetation diversity and biomass, and consequent greater diversity and abundance in forest floor small mammals dependent on shrubs and herbaceous vegetation (Carey and Wilson 2001; Sullivan et al. 2001). Arboreal rodents vary in response to thinning depending on how closely tied they are to understory vegetation development (Carey 2001). Strictly arboreal tree squirrels, such as the Douglas' squirrel (*Tamiasciurus douglasi*) or red squirrel (*T. hudsonicus*), that rely primarily on conifer seeds and bark benefit less by understory development and typically are less affected by moderate thinning vs. severe thinning (Sullivan and Moses 1986; Sullivan et al. 1996; Carey 2001; Carey and Wilson 2001). In the case of red squirrels, accelerated growth of lodgepole pine trees remaining after thinning increases the quality of bark foraging, or damage (Sullivan et al. 1996), depending on your point of view.

Flying squirrels (*Glacomys sabrinus*) are expected to decline with severe reduction of tree canopy with uniform thinning (Lehmkuhl et al. 1999; Carey and Wilson 2001), but increase under patchy variable retention thinning that retains patches of intact canopy while fostering understory development and consequent increases in truffle (underground mushrooms), seed, and fruit foods (Carey and Wilson 2001). Semi-arboreal chipmunks (*Tamias s*p.) generally respond favorably to the higher diversity and abundance of understory vegetation in thinned vs. unthinned stands (Carey and Wilson 2001; Sullivan et al. 2001). Retention of large woody debris, either scattered or piled, also provides important small mammal hiding cover and invertebrate and truffle foraging habitat (Butts and McComb 2000; Carey 2001).

Ungulates generally respond favorably to thinning that increases the diversity and biomass of understory forage plants (Thomas et al. 1979a; Hurst et al. 1982; Bender et al. 1997; Kimball et al. 1998; Peitz et al. 2001). In the past, it was felt that increasing forage production had to be balanced by the provision of adequate thermal and hiding cover within some optimum range (Thomas et al. 1979b; Wisdom et al. 1986). However, recent research has shown that ungulates provided with high quality forage habitat in secure areas can do well without thermal cover throughout the year (Cook et al. 1998). Thus, land managers may not have to be too concerned with reducing forest canopy cover and what was once considered thermal cover, if they are providing high-quality foraging habitat. Security cover to hide ungulates from human disturbance (hunting, traffic, etc.) along roads and trails, however, remains an important element of good ungulate habitat management (Hillis et al. 1991).

Bird diversity and abundance generally respond favorably to increasing diversity and biomass of understory vegetation in thinned vs. unthinned forests (Hansen et al. 1995; Hagar et al. 1996; Chambers et al. 1999b; Haveri and Carey 2000). As predicted by general principles, however, individual species responded differently depending on the species life history, the intensity of harvest, and the spatial pattern created by harvesting (Fig. 3) (Hansen et al. 1995; Chambers et al. 1999a). Species that nest and forage in tree canopies generally decline in abundance with thinning that reduces the canopy volume, while species associated with open canopies increase (Chambers et al. 1999b; Haveri and Carey 2000; Schieck and Hobson 2000). Forest canopy structure may be the single most important habitat variable influencing bird communities in harvested areas (R. Sallabanks, Idaho Fish and Game, Boise, Idaho, pers. commun.). Patchy retention of closed canopy forest, or variable-density thinning, might both retain closed canopy species and foster open-canopy species. The extent of a canopy-species' decline, or an open-species' increase, will depend on the particular thresholds of change in canopy

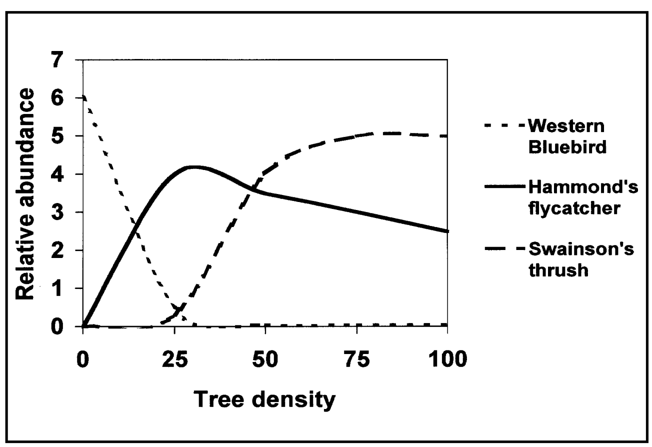

Figure 3.—Generalized bird species responses to tree density in thinned areas. (Adapted from Hansen et al. 1995)

reduction for each species (Hansen et al. 1995). Thus, planning for small diameter thinning should consider what bird species might benefit or not from the harvest, and how the volume and spatial pattern of trees removed might best provide for the most species, or species of special interest.

The landscape context of small diameter thinning projects also needs to be considered. If we consider species that might lose from thinning, then the impact on the population depends on the magnitude of habitat lost to thinning and the loss of connectivity (isolation) with habitat that remains elsewhere on the landscape. Is there enough well-connected habitat left for a viable population? For species that might gain from thinning, the value of the newly created habitat will depend on how well the managed stands match the habitat requirements of the species (i.e., is it "source" habitat?), and whether the animals can get to the new patch of habitat. Both cases come back to issues of habitat quantity, quality, and connectivity and how they interact with species life history and population structure. Connectivity becomes established as target habitats begin to dominate a landscape, usually exceeding about 50% of the landscape (With and Crist 1995; Franklin and Forman 1987; Lavorel et al. 1993; Andren 1994). Strategies for developing connectivity in landscapes where habitat is more sparse (<50%) rely on maintaining or developing dispersal habitat, corridors, or reducing potential barriers to movements (e.g., highways, roads, non-habitat areas). A strategy for maintaining or restoring connectivity, then, must be dual: identify critical sites for habitat maintenance or restoration, and identify their relationship with potential habitat corridors, dispersal habitat, and movement barriers (e.g., highways).

GUIDELINES FOR LANDOWNERS

Nonindustrial private forest (NIPF) landowners are important wildlife habitat managers in terms of the area managed—72% of U.S. timberlands are privately owned and managed (Sallabanks et al. 2000). In Washington alone, they hold approximately 3.1 million acres of timberland, of which over one-third occurs in eastern Washington where small diameter harvest is an important issue. Wildlife and wildlife habitat are important reasons why many landowners own forestland in Washington State (Creighton et al. 2002; Blatner et al. 1999). Most landowners realize the potential role their forests play in the conservation of wildlife populations—not just single species (Creighton et al. 2002), and hold strong views on how their habitats should be managed. Other concerns include the threat of fire, disease and insect outbreaks, and the long-term sustainability of raw materials (Findley et al. 2000). While most NIPF landowners are aware of the importance of a landscape-level perspective in forest management, many are cautious about working across ownerships in order to achieve more regional objectives (Brunson et al. 1996). Effective management of their wildlife habitats requires careful definition of objectives, site and landscape evaluations to assess timber and wildlife potential and tradeoffs, managing for stand structure and the ecological processes that create and maintain structure and function, and collaboration with adjacent landowners (Table 1) (Creighton et al. 2001).

Table 1. Wildlife guidelines for landowners planning small diameter thinning projects.

1) <u>Define objectives.</u>
   a) Human: harvest value, stand improvement, visual, fire prevention.
   b) Wildlife: diversity, game species
   c) Wildlife outcome depends on habitat patch size, productivity, context, and the species life history and population structure.
   d) Human and wildlife values can be compatible!

2) <u>Site evaluations.</u>
   a) Stands.
      i) Vegetation and wildlife inventory.
      ii) Site productivity, or potential for expected change after treatment.
      iii) Species' habitat elements present or possible - food, cover, water.
      iv) Potential to create habitat for the target species.
   b) Landscapes —put stands into landscape context.
      i) Target wildlife will be able to find, use, and persist at site.
      ii) Work with adjacent landowners to meet needs of wide-ranging wildlife.

3) <u>Manage for structure.</u>
   a) Variable-retention thinning maximizes stand diversity.
   b) Snag & defective tree retention or creation is critical for many species.
   c) Nest boxes are a good short-term option for some cavity-dwelling species in the absence of snags.
   d) Leave large woody debris, or scattered slash piles, for cover and foraging sites.
   e) Under-plant vegetation for forage, fruit & seed.

4) <u>Manage for processes.</u>
   a) Manage for processes that create and maintain habitat structure over the long term.
   b) Insects create cover (snags and woody debris) and food.
   c) Disease creates cover (hollow trees & logs, snags, mistletoe) & food (mistletoe) for many species.

5) <u>Collaborate for added value.</u>
   a) Collaboration necessary to realize landscape-scale objectives for wide-ranging species like deer, elk, bear, grouse.
   b) Participate in adaptive management to learn more about effects on forest & wildlife diversity, productivity, & economics.

Defining Management Objectives

It is important that landowners have well-defined objectives regarding wildlife species and populations prior to implementing any management practice. As discussed earlier, thinning young forests impacts different wildlife in different ways: some species gain while others lose. Landowners should consider what wildlife they want to foster, in addition to any aesthetic and economic objectives. On a stand level, timber harvest and wildlife habitat development are not mutually exclusive objectives. Thinning can be an effective habitat enhancement tool for some species in some places, especially in stagnated small diameter stands. However, if the target habitat is fragmented across the local landscape or suitable habitat patches are too small or isolated, animals may not be plentiful enough or able to disperse into project areas, and the usefulness of an area for habitat declines. Therefore, viewing one's forest property in a landscape context is a crucial part of the planning process. The challenge becomes finding common ground between the forest management objectives of the small forest landowner and the larger landscape objectives of its neighbors, then using the best available wildlife and forest management science.

The Stand Perspective

Many landowners make an inventory of their forest property and identify tree species, densities, size and age classes, etc., to help them determine the management options that would improve the value of their forest. This effort also could be used to make an informal assessment of wildlife populations and habitats on the stand-level, then define some wildlife objectives. Landowners with an intimate knowledge of local conditions often are the best people to do that initial wildlife assessment. Because a landowner rarely sees all of the wildlife species inhabiting a forest, measuring some basic habitat components is a good way to assess habitat condition, and thus predict what species might be present. Information such as canopy coverage, shrub layer, plant species, snags, defective trees, logs, and the presence of water should be noted. Then, the wildlife that might use those habitat features can be determined from some general references, such as Thomas (1979) or Johnson and O'Neal (2001).

Landowners need to be specific in their wildlife objectives. If a single species is desired, such as deer or turkey, an assessment of current and potential habitat for the animal should be done in collaboration with agency, consulting, or extension wildlife biologists. Determine the limiting factors such as food, water, cover, or space, specific to the species in question during a general stand inventory, then identify management practices that influence those limiting factors. Landowners interested in providing for a particular community of wildlife (e.g., wetland or old-forest species) can use that same process, plus a serious effort at identifying what species are already present. Moreover, it is essential to compare management objectives against the sites' potential to produce the desired future conditions, either for timber production or wildlife habitat. Comparing site potential and management objectives will produce at least 3 options: (1) do nothing and area will develop in a way that meets your objectives; (2) regeneration harvest; or (3) thin. Each option will have different effects on wildlife, which can be assessed using the principles previously discussed. Once a stand inventory is made and management objectives are well defined, the landowner can compare these stand-level objectives with the landscape management objectives.

The Landscape Perspective

Active management of dense stands may affect wildlife populations by creating certain habitats at a managed site, but also by changing the arrangement of habitats across the larger landscape. Adjacent landowners must work together to meet landscape level objectives for managing rare, uncommon, or wide-ranging wildlife species. Hesitation by private landowners to manage across ownerships may be the biggest challenge for resource management agencies, and the most important issue for small diameter stand management across the landscape. For example, if several landowners with adjacent 40-acre holdings decide to do a regeneration harvest at the same time, then the chances of maintaining forest-dependent species, such as forest songbirds or even wild turkey, in the area will be small.

A 1996 study suggests that many NIPF landowners hesitate to participate in cross-boundary management for fear that they will be subjected to increased regulations (Brunson et al. 1996). There may also be a general distrust of regulatory agencies by landowners, as well as concerns regarding equal access to market shares, and the loss of private property rights (Robinson 1996). These are challenges that agencies need to be aware of when approaching private landowners with proposals for landscape level partnerships.

Combining Objectives

Once stand- and landscape-level inventories are completed and objectives for both are well defined, an examination of management objectives should provide some opportunities for collaboration with others. Identifying similar goals is a first step. For example, if a landowner plans to thin a densely stocked stand, this may provide the resource agency with a habitat component desired in their landscape scheme. Likewise, a variable-density thinning or a partial cut on adjacent public lands may increase the use by elk on the neighboring private land, thus meeting a wildlife objective of the landowner.

There are definite advantages in combining objectives of private and public landowners for landscape management. Many have wildlife objectives that cannot be achieved over small acreages (e.g., elk, deer, or turkey). However, they may be able to provide one or two critical habitat features (Leak et al. 1997) that the public resource manager can incorporate and feature in the larger landscape picture. Examples of this are Habitat Conservation Plans for endangered species developed in conjunction with the U.S. Fish and Wildlife Service, or ecosystem management planning in collaboration with National Forests.

Working closely with landowners and the surrounding communities, providing educational opportunities, and encouraging management across ownerships will be important components in addressing issues of stagnating stands of small diameter trees and wildlife. A recent study of NIPF landowners in Washington state suggests that well-educated and informed landowners are interested in learning more about cross-boundary forest management

(Creighton et al. 2002). Education and cooperation among stakeholders may be the solution to implementing a landscape-level approach to small diameter timber and wildlife issues.

CONCLUSIONS

1. Small diameter harvesting can be good, bad, or neutral for wildlife. Impacts, or wildlife values, depend on the specific species and situation. Some species might gain and some might lose habitat, with potential corresponding short- and long-term effects on population size and persistence. Short-term effects might occur during the first 5-10 years after harvest, but subsequent stand overstory and understory development might provide benefits in the longer term. Objectives should be clearly outlined: what are the desired future conditions and objectives of the landowner? Can modifications be made for wildlife without significantly altering the economic value.
2. Landowners and managers need to consider habitat quantity and quality in conjunction with the population structure and life history of the target species. Landscape level issues of habitat distribution and connectivity across ownerships need to be addressed by collaboration with other private and government land managers.
3. Diversifying stand conditions to increase understory development, large trees, overstory diversity, and dead wood structure (snags, large logs) will generally benefit wildlife diversity. Variable-density harvesting or group selection techniques might maintain closed-canopy species while fostering open-canopy species.
4. The value of harvesting small diameter stands for wildlife will depend on the suitability of resulting stand composition and structure as source or dispersal habitats for individual species, and those species' abilities to find the stand and then persist on site.
5. Some species may lose habitat from thinning, but impacts may be few if habitat conditions similar to those before harvest are abundant and well-connected across the larger landscape.
6. Landowners need to look at the landscape and regional context to fully appreciate the impacts, especially for wide-ranging wildlife like elk and deer. Collaboration with adjacent land managers, both private and public, is important to assess watershed-scale habitat patterns.
7. Participation in adaptive management projects, in which we apply scientific principles to continually learn while managing, is critical to better manage small diameter forests for both wildlife and human values (Marzluff et al. 2000).

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