WILDLIFE MANAGEMENT IN OLD-GROWTH FORESTS

Richard D. Taber, *Session Leader* and *Session Editor*

SITKA BLACK-TAILED DEER/OLD-GROWTH RELATIONSHIPS IN SOUTHEAST ALASKA: IMPLICATIONS FOR MANAGEMENT

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ABSTRACT

Population levels of Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) are expected to decline as harvest of old-growth forests in southeast Alaska proceeds. The extent of this decline will vary in accordance with the quantity and quality of old-growth harvested. Old growth in southeast Alaska is likened to a fine-grained mosaic of habitat patches that deer utilize selectively—seasonally and annually. Impacts of timber harvesting on long-range carrying capacity for deer and other wildlife in southeast Alaska will be difficult to assess until wildlife old-growth habitat relationships are better understood. This paper reviews the relationship of deer to forest habitat in southeast Alaska and outlines current forest-management practices. Two approaches for allocation of old growth as deer habitat are compared: (1) allocation by stand, and (2) allocation by watershed. We conclude that allocation by watershed is the more appropriate management approach in southeast Alaska.

INTRODUCTION

Abundance and distribution of Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) in southeast Alaska will be strongly influenced by future forest management. Forest lands of commercial quality in the Tongass National Forest dominate the land base of southeast Alaska and still exist predominantly as old growth. Approximately 142,450 ha of old growth have already been harvested; and with passage of the Alaska National Interest Lands Conservation Act in 1980, Congress mandated a future harvest of 2.4 million m^3 (450 million bd ft) per year, or about 7,000 ha each year.

On multiple-use forest lands, certain stands will be allocated to timber production while others will be designated for retention to help meet wildlife habitat needs. We consider this concept an "allocation-by-stand" approach to forest wildlife management. Given our knowledge of the relationship between deer and old-growth, and our lack of knowledge of habitat needs for other species, this approach may not meet the optimal habitat needs of deer and other wildlife on these lands. This paper reviews relationships between deer and the forest, discusses current forest-management practices, and evaluates an alternative approach for allocation of old growth as deer habitat in southeast Alaska.

RELATIONSHIPS BETWEEN DEER AND THE FORESTS

Old-growth forests (*in sensu* Bormann and Likens 1979; Franklin *et al.* 1981; Schoen *et al.* 1981) in southeast Alaska are steady-state forests where mortality generally balances growth, and individual trees range in age from seedlings to a thousand years. Variation in tree diameter and height produces a broken, multilayered canopy. An abundant and variable understory, snags, and woody debris on the forest floor contribute to the structural heterogeneity of the old-growth forest. Variable soil conditions, topography, drainage patterns, understory composition, and frequency and degree of prior disturbance (e.g., wind) can dramatically alter the character of the forest. Size of affected areas is variable, with small patches contributing to the fine-grained

[1]Deceased.

variability of old growth. A forest patch is defined here a a small (0.5 to 5-ha) portion of a stand. A patch has relatively homogeneous understory and overstory characteristics. Numerous patches make up larger (2 to 50-ha) stands identified by a generally homogeneous overstory. The time required for a forest stand to develop old-growth characteristics in the Pacific Northwest and Alaska ranges from 200 to 300 years (Harris and Farr 1974; Alaback 1982; Franklin *et al.* 1981).

In winter, deer in southeast Alaska prefer old growth over earlier stages of forest succession (Wallmo and Schoen 1980; Kirchhoff *et al.* 1983; Rose 1984). This occurs because the old-growth overstory provides both snow interception and understory development. More winter forage is available than in earlier seral stages. Similar findings have been reported for Columbian black-tailed deer (*O.h. columbianus*) on portions of Vancouver Island, British Columbia (Jones 1974; Weger 1977; Harestad 1979; Hebert 1979), and for northwest white-tailed deer (*O. virginianus ochrourus*) in the northern Rockies (Mundinger 1984).

Old growth is variable in structure, and, depending on the season, suitability as deer habitat. Deer prefer specific understory associations, as indicated by distribution of use (Barrett 1979; Schoen *et al*, unpubl. rep., Alaska Dep. Fish and Game Fed. Aid Wildl. Rest. Proj. W-21-1, 1981) and composition of diet (Schoen and Kirchhoff unpubl. rep. Alaska Dep. Fish and Game Fed. Aid Wildl. Rest. Proj. W-22-1, 1983). Availability of understory species is influenced by stand age and structure, (Barrett 1979; Wallmo and Schoen 1980; Alaback 1982), and snow accumulation (Bloom 1978; Schoen and Kirchhoff unpublished data). High-volume, old-growth stands (specifically high-composition hemlock) appear most suitable for deer during winters of heavy snow accumulation (Barrett 1979; Schoen and Kirchhoff unpubl. rep. Alaska Dep. Fish and Game Fed. Aid Wildl. Rest. Proj. W-22-1, 1983).

Survival of deer through winter is dependent principally on their condition entering winter and their energy intake and expenditure during winter. Although deer normally draw on stored energy during winter, a prolonged and excessive reduction in intake results in death or reduced productivity. Winter energy requirements of deer on northern Vancouver Island are best met in old-growth forests (Harestad *et al.* 1982). The same appears to be the case in Alaska. The greater the expanse of suitable old-growth habitat, the greater is the opportunity for wintering deer to obtain sufficient energy.

In summer, Sitka black-tailed deer are dispersed from sea level to the alpine. During this season they maximize their intake of succulent, nutrient- and energy-rich foliage to regain lost weight, resume body growth, nurse fawns, achieve good reproductive health, and store fat for the following winter. Old-growth forest and nonforest lands contribute to this potential, as do recent ($<$20 yrs) clearcuts. In even-age regrowth stands ($>$ 20-30 yrs), however, forage is substantially reduced below old-growth levels (Harris and Farr 1979; Wallmo and Schoen 1980; Alaback 1982). These stands contribute little toward carrying capacity for deer at any time of the year for the remainder of the rotation. On the basis of existing knowledge, there is little reason to expect that silvicultural techniques, such as thinning as currently practiced, will significantly improve this situation (Kessler unpubl. rep., USDA For. Serv., Alaska Reg. Admin. Doc. No. 110, 1982).

FOREST MANAGEMENT

All timber management in southeast Alaska is based on even-aged silviculture with a 90- to 125-year rotation. Of 2.3 million hectares of commercial-quality forest land on the Tongass National Forest in southeast Alaska, only 0.7 million hectares (31%) is scheduled for clearcutting over the next 100 years. It is important, however, to consider the types of forest that those old-growth hectares represent. Commercial forest land ($>$106 m^3/ha) is classified into four volume classes (Fig. 1). The highest class ($>$ 659 m^3/ha) makes up less than 2 percent of the commercial forest land, 1 percent of the total forest area, and 0.6 percent of the total land area of the Tongass National Forest (USDA Forest Service unpubl. rep. Timber Task Force, Alaska Region, 1978). This relatively rare forest class, which is important to wintering deer, has received the greatest harvest pressure. Economic considerations dictate that the higher volume class ($>$ 396 m^3/ha) will continue to receive proportionately greater harvest than the lower volume classes.

Approximately 72,000 ha of forest were clearcut between 1956 and 1972. Average volume cut was approximately 659 m^3 per ha (from Hutchinson and LaBau 1975). Projected harvest will remove 66 percent of today's high-volume stands ($>$ 659 m^3/ha) over the next 100 years. On lands designated for multiple use the loss will be 72 percent. Relative to conditions prior to

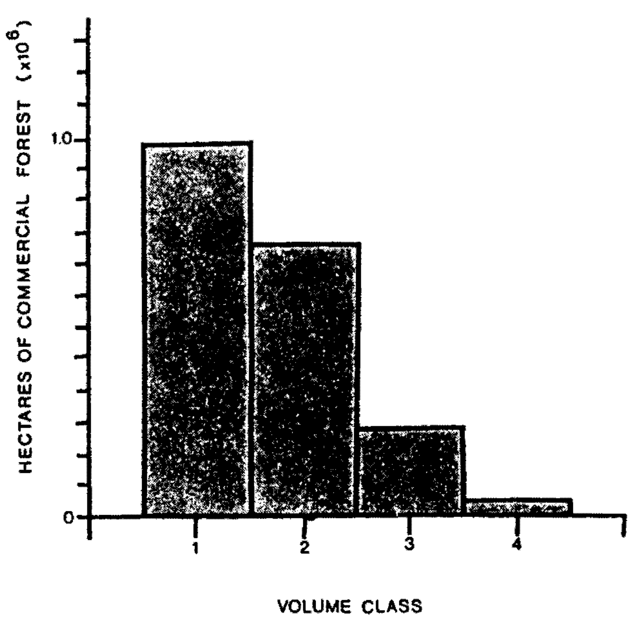

Figure 1. Number of hectares of commercial forest land in each of four volume classes on the Tongass National Forest in southeast Alaska. (Volume class in m^3/ha: 1=106-264, 2=264-396, 3=396-659, 4=659+)

industrial-scale logging (circa 1950), the loss of high-volume stands on the Tongass Forest will approach 80 percent over the next 100 years (USDA Forest Service and Alaska Department of Fish and Game, unpublished data).

This trend will have serious consequences for deer. If, for example, approximately 30 percent of the operable forest is harvested during the first entry into a watershed, and that harvest is concentrated in the higher volume timber stands, up to 90 percent of the most important deer winter range (during heavy snow years) may be lost. The habitat loss will be permanent because old growth is nonrenewable on a 100-year rotation.

Two basic approaches toward resolution of the old-growth allocation issue have been advocated. The Forest Service, through the Tongass Land Management Planning process, has approached the problem by allocating stands within any given watershed or value comparison unit to timber production or old-growth retention (Phillips 1982). In contrast, the Alaska Department of Fish and Game, through its Forest Habitat Integrity Plan, has advocated the allocation of entire watersheds, rather than individual stands, to either timber production or old-growth retention (Matthews and McKnight 1982).

These two forest-management strategies are different, and their advantages and disadvantages need to be compared. Our discussion is restricted to black-tailed deer, but the concepts may apply to other wildlife species. For this discussion, we refer to the Tongass Land Management Planning process as "allocation by stand" and the Forest Habitat Integrity Plan process as "allocation by watershed."

Currently, the forest-wildlife inventory base and habitat-use relationships are not adequate to quantitatively predict the consequences to wildlife of altering the forest landscape. Forest managers require this knowledge in order to plan the spatial and temporal cutting patterns in a way that would have predictable consequences on wildlife populations. "Old-growth forest" is too broad a category to allow effective forest planning for the Sitka black-tailed deer, because old growth is highly variable and deer preferences for specific old-growth associations vary with winter conditions. Preliminary data (Schoen *et al.* unpubl. rep. Alaska Dept. Fish and Game Fed. Aid Wildl. Rest. Proj. W-21-2, 1982) suggest that a variety of forest stands on the winter range is critical to deer carrying capacity.

Managing a landscape to provide variety is the objective of the allocation-by-stand approach for old-growth retention. Unless inventory data are adequate, however, and habitat-use relationships sufficient to manage for habitat variety, such an approach is taken at the relatively high risk of eliminating an adequate habitat mosaic. In this sense, allocation by watershed is more conservative and less dependent on inventory data and knowledge of habitat relationships. The principal assumption is that entire watersheds, left intact, will support current deer populatoins indefinitely.

The propriety of one allocation system over the other is analogous to a marginal yield problem (Fig. 2). The question is: How will the deer carrying capacity of a watershed respond to allocation of increasing proportions of land to timber production? If the response is linear, then the choice between allocation by stand versus allocation by watershed is insignificant. If the relationship is curvilinear, however, the choice is important, and the degree of importance is directly related to the shape of the curve. If medium-to-high levels of deer are the objective, the choice of allocation is more important than if low levels are acceptable. If the relationship is convex (Fig. 2, B), allocation by stand is the most appropriate system because some portion of the watershed can be allocated to timber production with negligible effects on deer. The optimal allocation level is at point "b" of the curve where a small increase in harvest results in a disproportionately larger decrease in deer carrying capacity. If, however, the relationship is concave (Fig. 2, C), the optimal proportion allocated to timber production is either 0 or 100 percent (because even a small harvest would result in a large decline in deer carrying capacity), and allocation by watershed is the most appropriate system.

The interaction of many factors determines the shape of the curve for any given watershed and logging system. Two such factors are the degree of dependence of deer on specific forest stands or communities and the probable cutting sequence in the watershed. For example, if deer are highly dependent on the availability of low-elevation, high-volume (e.g., > 396 m^3/ha) old-growth stands during winters with heavy snow accumulation, and if these

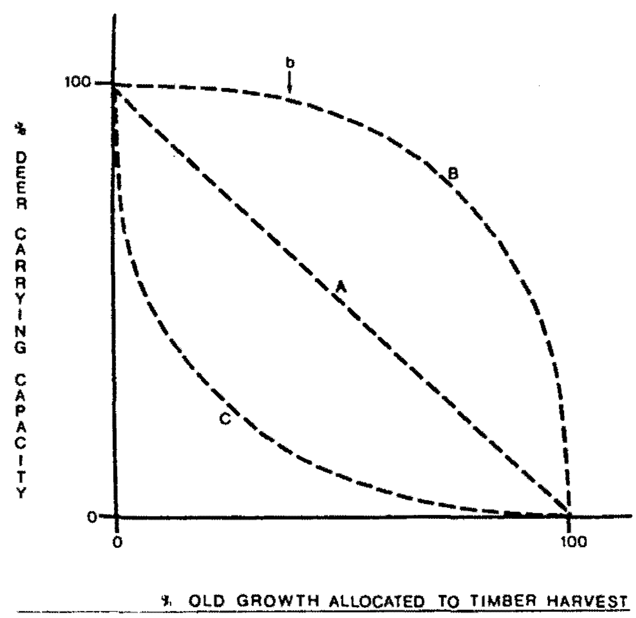

Figure 2. A marginal-yield model displaying possible responses of deer to timber harvesting. If the response is linear (line A), the choice between allocation by stand or allocation by watershed is insignificant. If the relationship is convex (line B), allocation by stand is most appropriate since some harvest can occur (to point b) with minimal effects on deer. If, however, the relationship is concave (line C), the optimal proportion allocated to timber production is either 0 or 100 percent, and allocation by watershed is most appropriate.

stands are the first to be harvested in the watershed, the yield curve will be steeply concave, and allocation by watershed is the most appropriate system. If, however, deer are not dependent on low-elevation, high-volume old growth, or if timber harvest begins with high-elevation and/or low-volume old growth, the yield curve is convex, and allocation by stand is appropriate. As used above, deer "dependence" on particular forest stands is the relative importance of those stands in determining the carrying capacity of a landscape for deer. The relative importance of different stands may vary with changing winter conditions, but the limiting nature of the landscape, in a long-term sense, is determined by the most severe conditions and the rate of population increase during recovery from severe conditions.

Because all forest stands are not of equal value as deer habitat, the characteristics of retained areas are critical when allocated by stand; size and spatial location are very important. If widely scattered, these areas might represent "islands" of optimal habitat in a "sea" of marginal habitat. During a winter of deep snow, for example, a clearcut might be a physical barrier to deer dispersal. Muskegs, non-commercial forest, and low-volume forest stands may pose similar problems. Although second-growth stands do not pose a physical barrier, they are avoided by deer because forage is minimal. Some high-quality "islands" of habitat, if surrounded by unusable habitat, may receive heavy pressure every year, and overuse of these areas might result. Consequently, when deer need them most, their forage resources would already be depleted. An additional factor to consider is the potential for concentrating predation on a few small areas of high-quality habitat. This situation may, in fact, be occurring on Vancouver Island (Hebert, British Columbia Fish and Wildlife Branch, personal communication 12 April 82) and Annette Island (Rose, Annette Natural Resource Center, personal communication 5 April 82), where logging has concentrated deer onto remaining old-growth areas easily accessible by wolves.

Because reserves of optimal habitat surrounded by altered, suboptimal habitat resemble a system of islands, certain principles of island biogeography may apply (MacArthur and Wilson 1967; Diamond 1975; MacClintock *et al.* 1977). Diamond (1975) notes that for the purposes of maintaining the maximum number of species in equilibrium, habitat reserves are better if they are bigger and closer together. Small, disjunct patches of high-quality wildlife habitat surrounded by low-quality habitat may be of relatively little value to wildlife.

Permanency of retention is an important management consideration because old growth in southeast Alaska is non-renewable under current management practices. Permanency is subject to administrative changes in land allocation as well as natural disturbance. Additional old-growth harvest is relatively easy once a watershed has been entered and roads built. As old-growth stands become smaller and more isolated, they also become more susceptible to windthrow that further reduces their size.

In the short term, it would probably be more cost-efficient to allocate old growth by stand, if all multiple-use watersheds were entered and the best timber taken first. Initially under this strategy, fewer acres would be cut because a greater number of high-volume stands would be harvested. Also, the visible impact would be less apparent under allocation by stand, at least for the initial portion of the rotation period.

Under allocation by watershed, entire areas would essentially become unavailable to wildlife dependent on old growth. Also, if those drainages were harvested in a single entry, it might take one or more rotations to reintroduce a stand mosaic of varying ages. Thus, it would be preferred ecologically to harvest those drainages designated for intensive forestry in multiple entries.

RESEARCH AND MANAGEMENT IMPLICATIONS

In southeast Alaska, deer and timber production cannot be maximized simultaneously on the same area. Even moderate timber harvesting can have adverse effects on deer in a greater proportion than the area harvested if particular forest stands are harvested. We are presently unable to prescribe the habitat mix necessary for maintaining an optimal balance between acres of habitat retained for deer and acres of timber harvested within any given watershed.

The allocation of retention by watersheds would provide for deer, on selected watersheds, the natural mix of habitats that contribute to their year-round welfare. This approach can also ensure protection of those watersheds most important to anadromous fish. Allocation by watershed has the additional advantage of protecting natural ecosystems for the potential benefit of species whose habitat requirements are still unknown.

The information necessary to determine whether or not we are approaching our goals of management for deer (or, more generally, wildlife), depends upon realistic inventories of wildlife populations and habitat resources. Such inventory programs should be initiated and expanded. It is hoped that we will some day be better able to relate landscape mosaics to carrying capacity of wildlife, and provide multiple-use land managers with better guidelines. Continuing research will be necessary to accomplish that goal. A rigorous ecological and economic assessment of the feasibility of enhancing second growth for wildlife is also an important research need. If second-growth enhancement proves feasible, watersheds committed to intensive forestry might be manipulated to provide some benefits that are currently unavailable. This possibility, however, must be demonstrated rather than assumed.

Because of the critical nature of this resource-allocation issue, a coordinated management and research effort to monitor the results of alternative old-growth allocation should be considered. Wildlife and other resources within three adjacent, and similar, watersheds could be monitored. The short- and long-term results of allocations by stand within one watershed could then be compared to the net results of allocation by watershed in the other two. Such a program would require a major commitment by numerous agencies and/or universities because final conclusions would require that monitoring be continued throughout an entire rotation (100 yrs). In the interim, harvest of old growth will proceed on multiple-use forest lands.

Whatever approach is taken to maintain habitat for deer and other fish and wildlife on the Tongass National Forest, major trade-offs are inevitable if the proposed level of nonrenewable old-growth habitat is extracted from the forest. The challenge will be in developing an allocation plan that will minimize the long-term trade-offs as well as provide an opportunity to increase our understanding of deer and other wildlife habitat requirements before all multiple-use watersheds have been permanently altered.

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Fish and Wildlife Relationships in Old-Growth Forests

Proceedings of a Symposium Sponsored by
Alaska District, American Institute of Fishery Research Biologists
Northwest Section, The Wildlife Society
Alaska Council on Science and Technology
Held in Juneau, Alaska, 12-15 April 1982

Symposium Editors

William R. Meehan
Theodore R. Merrell, Jr.
Thomas A. Hanley

Published by the American Institute of Fishery Research Biologists
December 1984

Available from John W. Reintjes, Rt. 4, Box 85, Morehead City, NC 28557 Price $20.