Timber Management and Deer in Southeast Alaska: Current Problems and Research Direction

by

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Introduction

The geographic distribution of *Odocoileus hemionus* roughly covers the western third of North America. The 3 largest races, the Rocky Mountain mule deer, Columbian black-tailed deer, and desert mule deer, have large geographic ranges which include great habitat diversity (fig. 1). The remaining 6 races have relatively small geographic ranges, especially at the extreme southwest and northwest limits of their distribution.

The Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) occupies a very narrow range, between the ice-capped Coast Range and the sea, at the northwest extent of the species' natural distribution. Its habitat is dominated by 2 major vegetation types--temperate rain forest and alpine tundra. Heavy snow accumulation during winter is characteristic of this region. The alpine zone is highly productive of deer forage but is snow free for only 3 to 5 months of the year. For 7 to 9 months, deer are confined to the lower forest zone. In most winters, deep snow extends well down into the forest zone, often to sea level. Least snow depths occur in old, high-canopied forests, while in openings snow accumulation is much greater [Jones, 1975; Merriam, 1968, 1971; Weger, 1977]. Of the forest habitat that is usable in winter, uneven-aged old-growth stands provide the most available forage for deer (discussed later).

The Alaska Department of Fish and Game and the U.S. Forest Service have mandates to maintain and enhance the populations and habitats of deer in southeast Alaska. Timber harvesting is the man-related factor influencing the largest amount of deer habitat in this region. The Forest Service has estimated that the volume of wood fiber produced per acre from second-growth forest stands will increase approximately 70 percent over the volume produced from old-growth stands [USDA Forest Service, 1977]. Thus, harvesting of old-growth stands will provide more land for regeneration and will increase long-term yields. The planned rotational cycle for timber harvest in southeast Alaska is approximately 100 years [USDA Forest Service, 1969]. Clear-cutting appears to be the most economical method of harvesting this resource.

In 1977, the Alaska Department of Fish and Game and the Forestry Sciences Laboratory of the Pacific Northwest Forest and Range Experiment Station initiated a cooperative research program with the general objective of obtaining information on deer management-timber management relationships. This paper reviews some of our preliminary findings and their implications.

Research Direction

The research program we have formulated begins with studies of use of natural habitat by deer uninfluenced by other land use activities, and builds from there to studies of specific land-use practices to determine their potential for improving or impairing deer habitat. These proposed studies include:

1. Seasonal and daily use of natural habitats.

    a. Distribution patterns.
    b. Movements and activity patterns.
    c. Elevations, slopes, aspects, vegetation types, plant species and snow conditions associated with distribution.

2. Food habits and annual nutritional regimes.

    a. Forage species used.
    b. Nutritional quality of forage species.
    c. Nutritional status of deer.

3. Forage production in old-growth forests and even-aged regrowth during the post-logging sere.

    a. Changes in understory composition and biomass during the post-logging sere (Forest Service contract with Oregon State University).
    b. Composition and density of understory vegetation as related to density of even-aged regrowth forest (conducted under a silviculture research program directed by W. Farr).

4. Relative use by deer of old growth and even-aged regrowth of various ages.

5. Relative snow depths in, and winter deer use of, old growth and even-aged regrowth of various ages and stand densities.

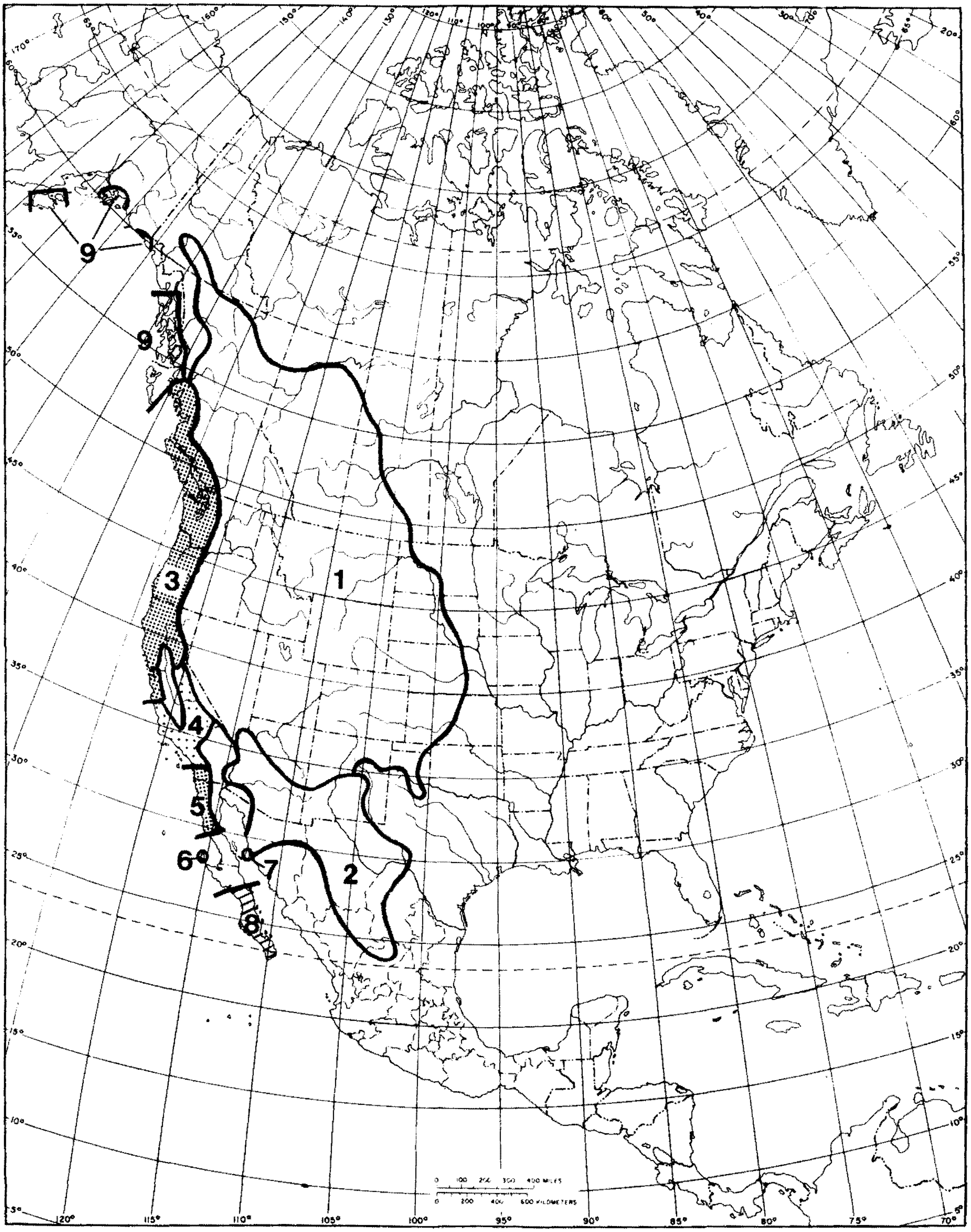

Figure 1. Geographic distribution of the races of Odocoileus hemionus. Races are 1-hemionus, 2 crooki, 3 columbionus, 4 californicus, 5 fuliginatus, 6 sheldoni, 7 cerrosensis, 8 peninsulae, and 9 sitkensis.

Because present forest use and management practices indicated an urgent need for an understanding of logging-related and silviculture-related influences on deer, we have placed initial emphasis on items 3 and 4.

Preliminary Results

Relative use by deer of old-growth and regrowth forests--It may be assumed that, where the choice is available, the amount of use deer make of one habitat relative to another will suggest the relative quality or value to deer of the two habitats. This study was conducted to determine if differential use occurs; later studies will be concerned with identifying and quantifying the causes.

We selected study areas on Admiralty and Chichagof Islands (fig. 2) which had sufficiently high deer densities to provide adequate measurements of relative use and which offered a range of stand ages. At each area, a stand of even-aged regrowth forest, or recent clearcut, was compared with an adjacent or nearby uneven-aged over-mature, or old-growth, forest on a similar site. Relative pellet-group densities were used as the indicator of relative deer use. Our study plan called for sampling in fall and spring for estimates of summer and winter use, respectively. [See Fisch, 1978 and Bunnell, 1978 in these proceedings.] This paper reports on results of the first fall sample, September-October 1977.

The sample in each stand consisted of parallel lines of contiguous 1- x 10-meter plots with the lines arbitrarily spaced to cover the stand. In the fall operation, sample size varied from 113 to 310 plots per stand because of inexperience with logistical problems. (Future samples will consist of 300 plots in each stand.)

Abbreviated results of the fall 1977 sampling are presented in table 1 and fig. 3. They indicate that the regrowth stands as a whole received an average of 1/5 as much use as did the old growth as a whole.

On the basis of this first sample, we can construct a tentative model of summer use of regrowth stands during the post-logging sere (fig. 4). Note than an increase in use over that of the old-growth forest was not measured in our youngest stands (4, 6-10, and 7-11 years). Instead, use was about 1/3, 1/2, and 1/7 that of the nearby old growth. Our observations suggest that within about 15 years, shrubs and trees, plus residual slash, generally become too dense for normal use by deer. It is not until 30 or 40 years that these stands begin to open up and allow unobstructed movement through them.

If there is an increase in deer use in the early years after clearcutting, we have not yet measured it. In Colorado, Wallmo and others [1972] reported a decrease in deer use for 2 years after logging, but an increase 10 years later. Here, in southeast Alaska, we measured a significant decrease in deer use as early as 4 years after logging and continuing to 147 years. Thus, the assumed early seral benefits to deer, if they exist, need to be identified, bracketed in time, and quantified. On southern Vancouver Island, Weger [1977] measured deer use in mature (250+ years) and immature (13-75 years) stands. He found that the mature stands received significantly higher use than the immature stands. On northern Vancouver Island, Jones [1974] observed that deer use of mature timber habitats was generally higher than use of logged habitats.

Forage production in old-growth and regrowth forest stands--Vegetation measurements, a secondary aspect of our fall field work, were discontinued because they were too costly of time and would have prohibited completion of our pellet-group sampling

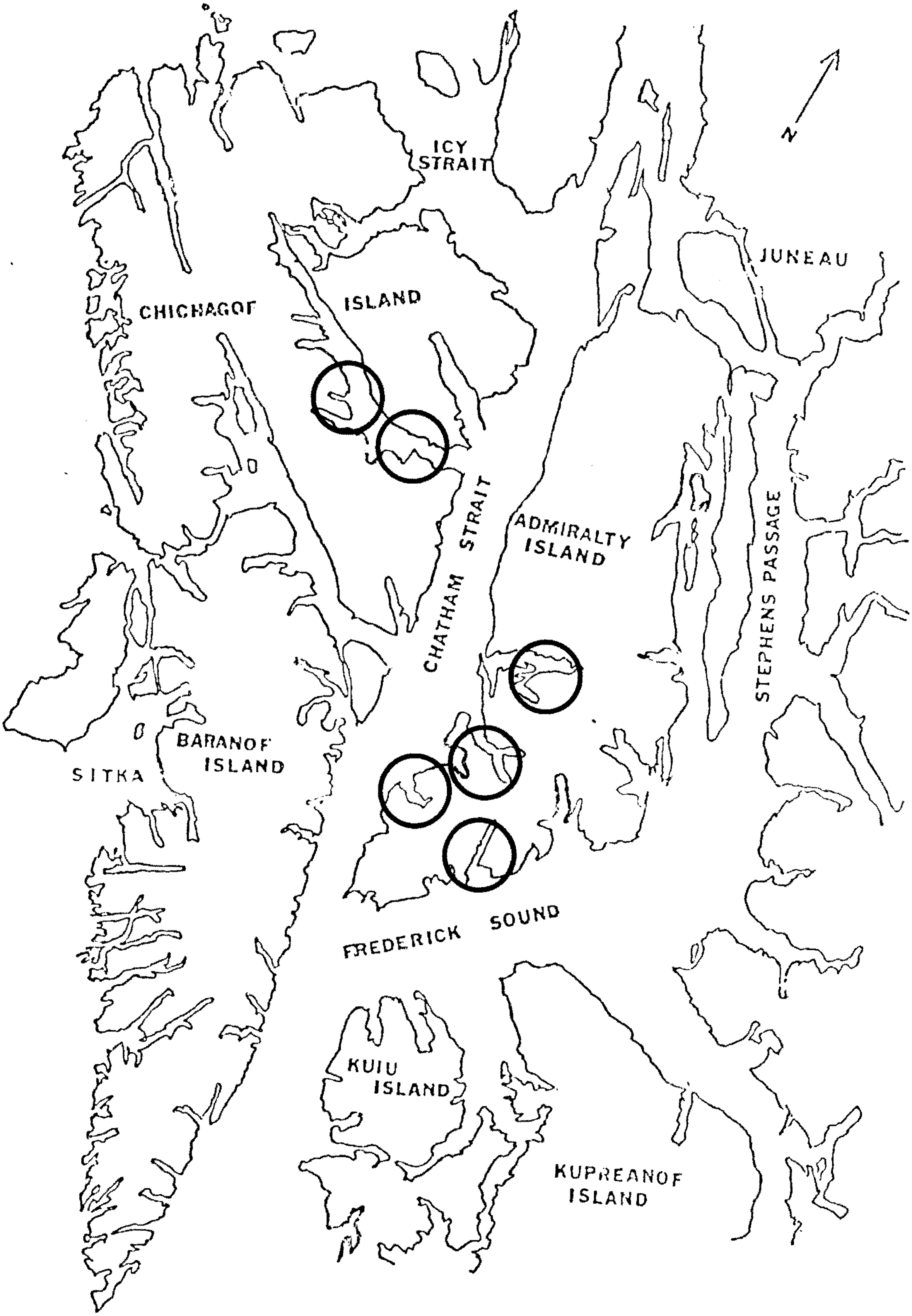

Figure 2. Location of deer use study sites, Fall 1977.

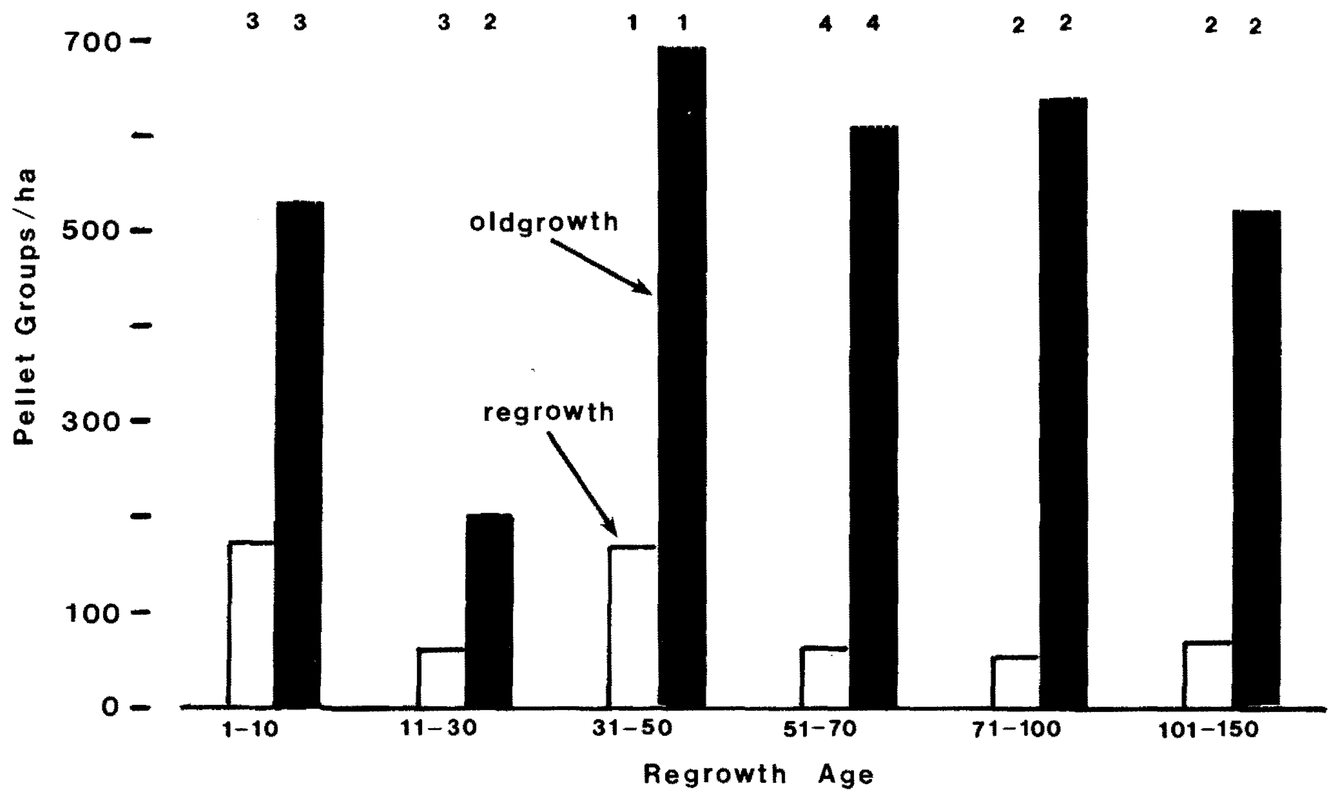

Figure 3. Comparative deer use of old-growth and regrowth stands on Admiralty and east Chichagof Islands, Fall 1977. Number of sample areas in each age category indicated at top.

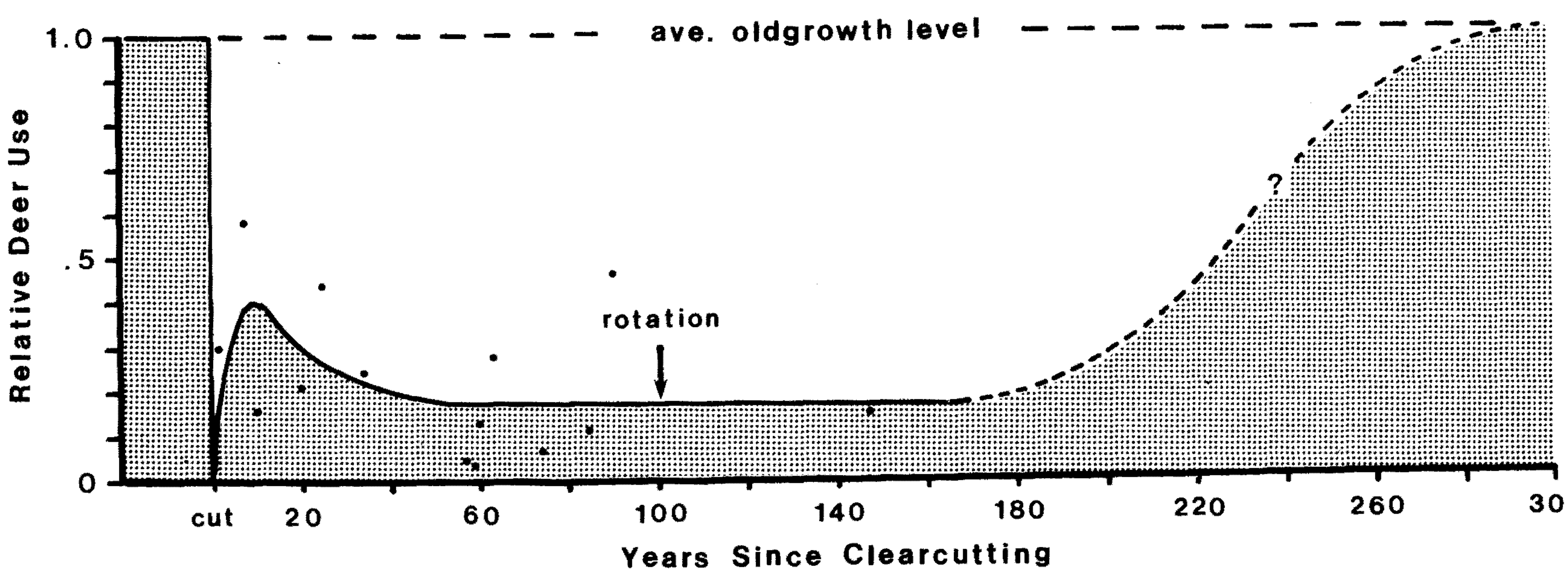

Figure 4. Relative effect of forest succession on summer deer use levels following clearcutting; points represent actual measurements of deer use relative to average use of old growth.

Table 1. Relative pellet-group density in old-growth and regrowth stands on Admiralty and Chicagof Islands, Fall 1977

Age of regrowth (years)	Number of plots[1/] Regrowth	Old growth	Ratio Old growth:Regrowth	Significance[2/]
4	309	310	3:1	**
6-10	240	245[3/]	2:1	N.S.
7-11	275	290	7:1	**
20	200	163	5:1	**
25	233	113	2:1	**
30-34	238	240	4:1	**
57	265	269	22:1	**
59	300	300	29:1	**
60	240	245[3/]	8:1	**
63	238	300	4:1	**
72	300	304	16:1	**
85	195	194	9:1	**
112	200	200	2:1	*
147	200	200	7:1	**
	Σ 3433	$\bar{x}$ 3128	5:1	**

1/ Plot size = 1 x 10 meters
2/ ** = P<.01, * = P<.05, N.S. = P>.05
3/ Same old growth comparison

(our first priority). The data collected (table 2) indicate that even-aged regrowth stands from 30 to 63 years old have less understory vegetation, consisting mainly of herbaceous species that die back in the fall and, when present, small *Vaccinium* plants. Uneven-aged old-growth forests have a substantially greater understory, larger and more robust *Vaccinium*, and abundant evergreen herbaceous species (for example, *Cornus*, *Tiarella*, *Coptis*, and *Rubus pedatus*).

Oregon State University, under contract with the Pacific Northwest Forest and Range Experiment Station, is currently investigating the productivity of the understory community in old-growth and regrowth forest stands throughout the Tongass National Forest. Preliminary data indicate an early increase in the biomass of herbaceous vegetation and shrubs after logging following by a rapid decrease to levels below those in the old-growth forest. Since these data are still being collected and analyzed, we are unable to report further at this time.

Harris [1974] reported the impoverished nature of the understory under even-aged regrowth stands throughout southeast Alaska. Robuck [1975] has estimated that once the understory is shaded out, the forest floor remains relatively free of shrubs, herbs, and ferns until about stand age 200 years. This is about twice as long as the current rotation cycle for this region.

Table 2. Summary of vegetation sampling in old-growth and regrowth forest stands on Admiralty Island, Fall 1977

Stand age (years)	Number of Plots1/	Plants/plot	Plots with vegetation %	Mean plants/plot		
				Shrubs	Forbs	Ferns
30-34	238	7.67	71	0.87	3.51	2.63
Old growth	238	26.16	96	1.13	12.00	11.84
57	267	1.48	25	0.29	0.52	0.60
Old growth	140	38.14	86	3.13	32.34	1.65
59	300	1.46	19	0.33	0.34	0.79
Old growth	97	22.37	93	2.53	17.87	1.84
63	238	4.53	61	2.15	0.97	0.81
Old growth	300	12.58	74	3.54	6.66	1.67
Regrowth	1043	3.58	42	0.86	1.25	1.17
Old growth	775	22.59	84	2.60	4.78	4.78

1/ Plots = 0.5 square meters

Snow depth and winter deer use in old-growth and regrowth forests--In December 1977, snow measurements were made in a highgraded (selectively cut) uneven-aged forest and in an adjacent 8-year-old clearcut near Juneau. Both sites had southwesterly aspects and 10-20-percent slopes. One hundred snow measurement points in each site yielded a range of 48-110 centimeters (mean = 63 centimeters) depth in the clearcut with all points snow covered and a range of 0-58 centimeters (mean = 14 centimeters) in the forest with 29 percent of the points having no snow or only a trace of snow. Numerous deer tracks were observed in the forest and none in the clearcut.

On February 2, 1978, this same clearcut had a mean snow depth of 26 centimeters with 17 percent of the points (number = 100) bare. The forest had a mean snow depth of 0.9 centimeters with 82 percent of the sample points bare. Eighty-four percent of the forest plots (number = 25) had understory plants with green leaves; 72 percent had *Vaccinium* plants. Current deer sign was encountered in the forest but not in the clearcut. The continuation of this study in the same area and 2 other areas was aborted because of an extensive rainy period.

Jones [1975], Merriam [1971], and Weger [1977] reported that from 2 to 3 times more snow accumulates in openings than under old-growth forests. On south-central Vancouver Island, Weger [1977] measured average snow depths of 33 and 54 centimeters (at 640- and 740-meter elevation) in 23-year-old regrowth compared with 12 and 34 centimeters in adjacent mature (250-year) timber. Moreover, depths were much more variable in the timber than in the clearcuts.

We have inadequate knowledge of the effect of age, canopy height, and density of regrowth stands on snow accumulations. The information available, however, suggests that to better reflect deer winter use of the post-logging sere, the model of summer use (fig. 4) can be modified to something of the approximate nature of fig. 5. Thus the usefulness to deer of productive early successional clearcuts appears to be nil, or of limited value, during the critical winter periods of high snow accumulation.

Food habits and nutrition--We have made little progress on the food habits study. An evaluation of microscopic fecal analysis by Katherine Hazard, Forestry Sciences Laboratory, suggests that it is not a highly reliable technique. This is supported by results of a concurrent evaluation by the Colorado Division of Wildlife. Whatever methods are used, adequate food habits research will require a major investment of time and funds; so it must be deferred for now.

From Hazard's work, earlier Alaska Department of Fish and Game studies, and other sources, however, we have some knowledge of winter forage species used by deer. Samples of 11 species were collected in January 1978 and analyzed for several nutritional parameters by the University of Alaska Agricultural Experiment Station (table 3).

Crude protein content of three deciduous shrubs, *Menziesia ferruginea*, *Vaccinium* spp., and *Rubus spectabilis*, was 8.7, 9.1, and 11.2 percent, respectively. They all had well-developed leaf buds and, no doubt, higher protein levels than could be expected in early winter.

Crude protein content of the green-leaved forbs and subshrubs ranged from 10.1 to 19.6 percent, in the order *Coptis*, *Cornus*, *Rubus pedatus*, *Tiarella*, *Pyrola*, from lowest to highest.

Cell-wall content (inversely, an indicator of digestibility) of the three deciduous shrubs was *Rubus spectabilis* 64.0 percent, *Vaccinium* 62.1 percent, and *Menziesia* 61.5 percent. Cell-wall content of the green-leaved forbs and subshrubs ranged from

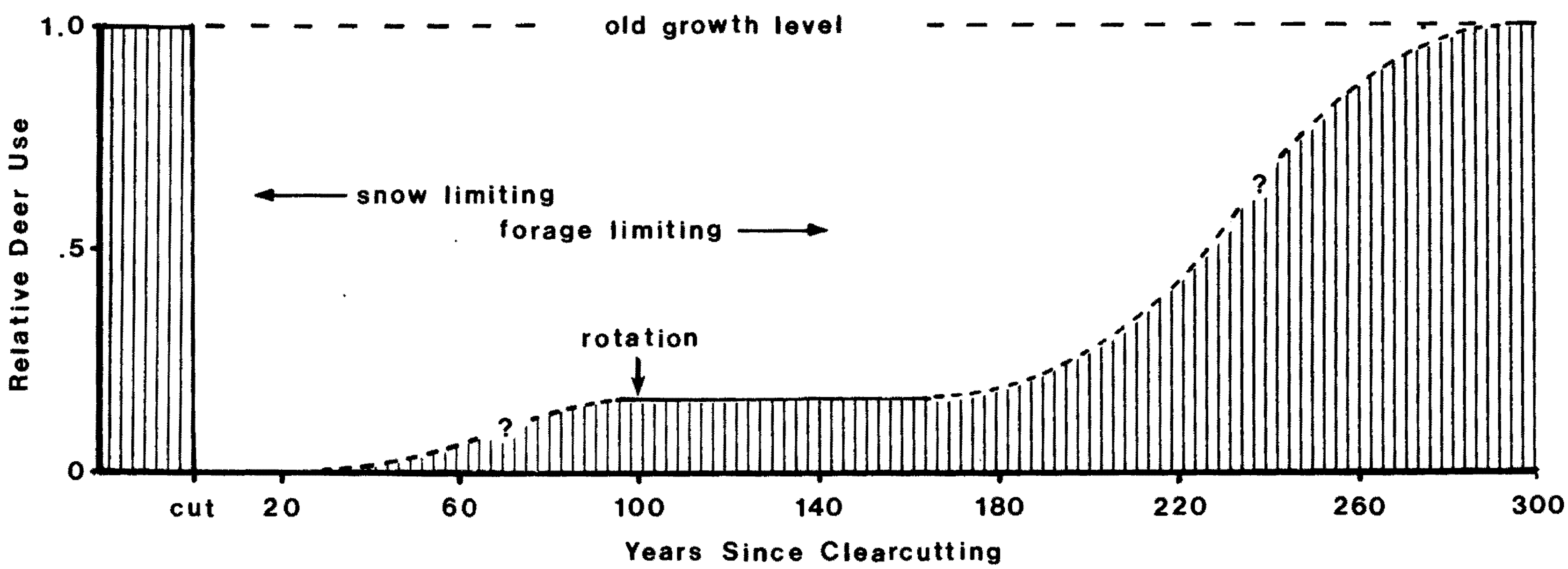

Figure 5. Hypthetical effect of forest succession on winter deer use levels following clearcutting.

Table 3. Composition of 11 winter forage species in terms of certain nutrition-related parameters

	Crude Protein	Cell-wall (NDF)	Acid-detergent fiber (ADF)	Lignin (ADL)	Residual ash
	-----	-----	percent	-----	-----
Pyrola secunda	19.6	21.7	18.7	16.0	2.8
Tiarella trifoliata	12.5	23.7	21.3	12.2	1.5
Rubus pedatus	12.1	32.7	21.7	17.5	1.8
Cornus canadensis	10.4	33.2	26.4	29.5	1.6
Coptis asplenifolia	10.1	38.9	30.7	15.3	1.6
Rubus spectabilis	11.2	64.0	47.2	39.6	1.6
Tsuga heterophylla	9.4	45.2	39.7	37.3	1.3
Vaccinium spp.	9.1	62.1	49.0	35.5	2.9
Menziesia ferruginea	8.7	61.5	46.1	41.2	2.6
Usnea sp.	3.5	16.0	4.2	31.0	1.0
Liverwort	11.8	50.8	27.4	10.9	7.5

21.7 to 38.9 percent, in the order *Pyrola*, *Tiarella*, *Rubus*, *Cornus*, *Coptis*, exactly inverse to protein content. That is, plants with the largest amount of highly digestible cell content have the lowest amount of poorly digestible fiber, or cell-wall material.

Furthermore, lignin, the most indigestible fraction of fiber, was highest in the deciduous shrubs (*Menziesia* 19.0, *Rubus spectabilis* 18.6, and *Vaccinium* 17.4 percent), and relatively low in the green-leaved plants (*Cornus* 7.8, *Coptis* 4.7, *Rubus* 3.8, *Pyrola* 3.0, and *Tiarella* 2.6 percent). Of all plants sampled, the arboreal lichen, *Usnea*, had the lowest lignin content (1.3 percent).

We were unable to obtain estimates of digestibility in time for this report, but a rough estimate can be obtained from the relationship of lignin content to fiber content as obtained by the acid-detergent method. A general predictive equation was calculated from the relationship of the average digestibility of general classes of forage to the product ADF x ADL for these classes (fig. 6).

This procedure suggests that the digestibility of the deciduous shrubs is low, of hemlock somewhat higher, and of the green-leaved plants very high. *Usnea* has the highest hypothesized digestibility but extremely low protein content. [See Bunnell in this volume for further information on this subject.]

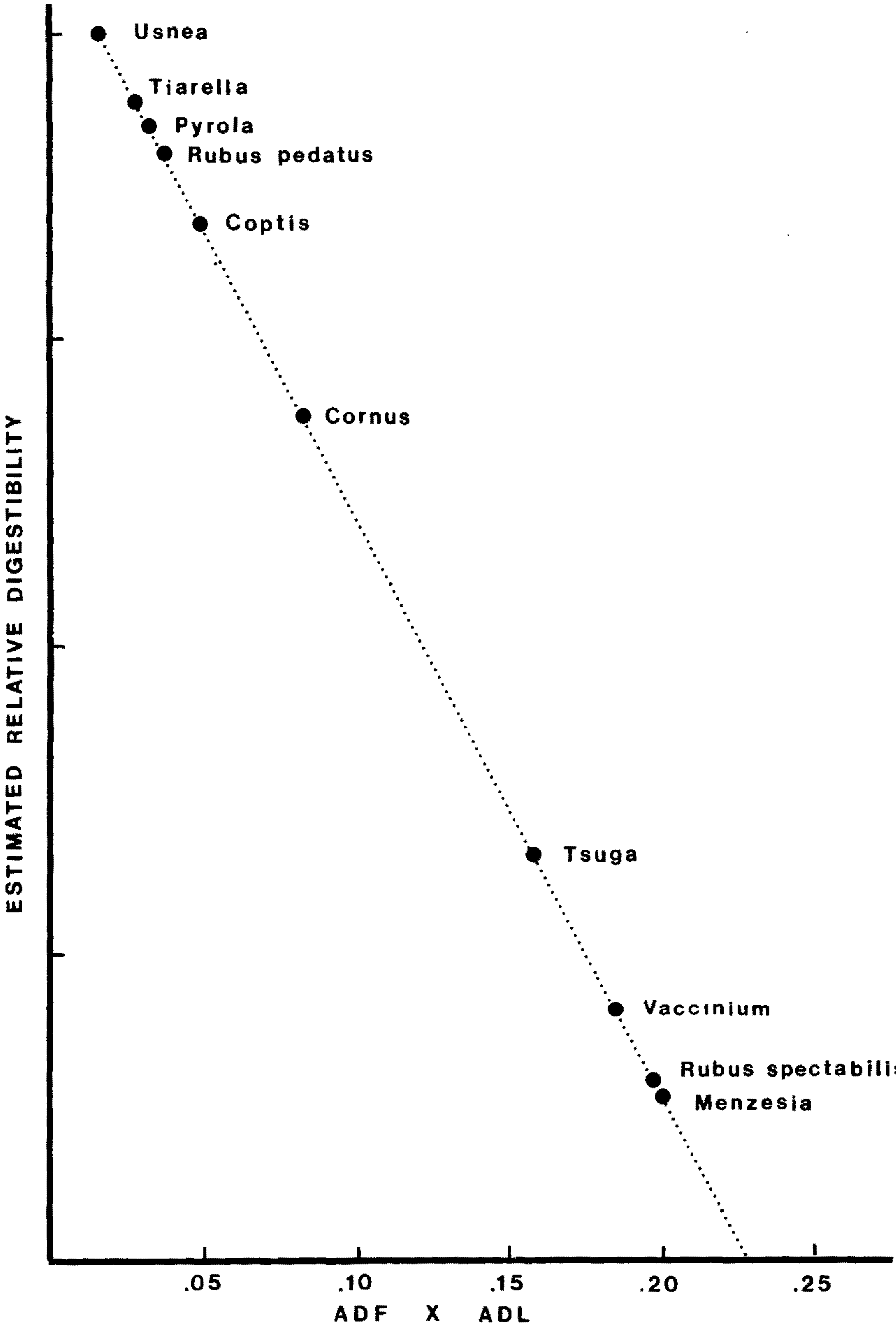

Figure 6. Hypothesized digestibility of several winter forage species based on cell-wall contents. ADF=acid detergent fiber. ADL=acid detergent lignin.

These results indicate the importance of green forage to wintering deer. Our sampling of understory vegetation indicates that such forage is most abundant in the old-growth forest. Our snow measurements indicate that it is also most available during winter in old growth. Even in winters where snow depths become excessive for deer everywhere, it takes longer to reach such depths in old growth and, therefore, the period of starvation conditions is less prolonged.

Seasonal and daily use of natural habitats--We propose to approach this phase of the investigation through radio-telemetry. By monitoring individual animals through daily and seasonal periods, we will be able to elucidate their home range characteristics and activity patterns as well as determine seasonal preferences for specific landscape attributed (for example, elevations, slopes, aspects and vegetation types).

Implications of Preliminary Results

Preliminary data collected thus far indicate the following:

1. For the areas we have measured, deer use of regrowth stands (ranging from 4 to 147 years) averaged about 1/6 that of the nearby or adjacent old-growth forest.

2. We have yet to observe an area or age class (including early successional clearcuts) where deer use actually increased following logging.

3. Regrowth stands from 30 to 63 years old produce substantially less understory vegetation (deer forage) than does the adjacent old-growth forest.

4. The only snow depth comparisons we have made revealed that, even during a moderate winter, a recent clearcut was relatively unusable for deer, while the adjacent uneven-aged, highgraded forest was usable.

5. Green-leaved forbs and subshrubs are more nutritious than deciduous browse during winter. In study areas near Juneau, green-leaved forbs and subshrubs were more generally abundant and avilable during winter in uneven-aged old growth than in an 8-year-old clearcut.

We reemphasize that these are preliminary and partial results of incomplete studies. We cannot ancitipate whether or how much they will be qualified by future data--nor can the forest manager. So today we find ourselves unable to accept the contention that logging is generally beneficial to deer or to reject the possibility that it is generally harmful in southeast Alaska.

While we are pursuing the research as rapidly as time, staffing, funding, and other obligations permit, we feel obliged to expose interim data to the scrutiny and criticism of those responsible for resource management. Existing policy of the Tongass National Forest states [USDA Forest Service, 1977, page 90] that timber harvesting will be planned to protect or enhance wildlife habitat. If the hypotheses presented here prove true, what adjustments would be necessary to protect or enhance existing deer habitat?

There are reported to be about 11.2 million acres (4.5 million hectares) of forested area in southeast Alaska and about 4.9 million acres (2 million hectares) of commercial forest land [Hutchison and LaBau, 1975]. Approximately 87 percent of this commercial forest land is estimated to be in old-growth forest [USDA Forest Service, 1977].

The first Alaskan sawmill was built in the early 1830s; and in the 1850s, Russian mills near Sitka were producing 3,000 board feet of lumber daily. Between 1910 and 1920, 420 million board feet of sawtimber and pilings were sold; in 1920, 100 million board feet from Admiralty Island were consigned to Alaska Pulp and Paper Company; in 1923, six mills were cutting lumber in large quantities. In World War II, about 85 million board feet were cut; since 1953, over 250,000 acres have been clearcut and about 18,000 acres are being harvested annually on the Tongass [Harris and Farr, 1975].

As yet we do not have a complete record of the total amount of land that has been logged--or how, when, or where. Nor do we know where the classified commercial acreage occurs with relation to seasonal habitat utilization by deer. Assuming that the commercial forest land occurs largely at lower elevations and on gentle to moderate slopes (about 50 percent occurs on slopes of less than 35 percent [Hutchison and LaBau, 1975]), we might expect a large amount of the most readily harvestable timber to substantially overlap deer winter range.

Clearcutting and even-aged regeneration appear to be the most efficient method of harvesting and producing timber in southeast Alaska, and the current program of sustained yield management calls for a rotation period based on a 100-year cycle. Our observations indicate that this management policy would impair deer habitat on "managed" sites forever.

Assume that over 1/2 million acres (.2 million hectares) or 13 percent of the commercial forest land in the Tongass are already under even-aged management, that 18 thousand acres (7.3 thousand hectares) are put under management annually, and that second-growth stands will be reharvested at about age 100 years. Further assume that windthrow, slides, and other natural processes increase this conversion of old growth to second growth to 20 thousand acres (8.1 thousand hectares) annually. A hypothetical model of this situation (fig. 7) traces the decline of optimum winter deer habitat from over 4 million acres (1.6 million hectares) today to almost none in 200 years.

Too many variables are involved to use the above example as a prediction of the future. Nevertheless, it is presented to convey the urgency of the need for timber managers to clarify for deer managers the projected rate of liquidation of old-growth forest in southeastern Alaska. Conversion of the uneven-aged climax forest naturally occurring throughout southeastern Alaska to even-aged regrowth ("managed") stands will substantially alter deer habitat from that naturally occurring within the Tongass Forest. Whether or not this change is in the direction indicated by our studies, those responsible for managing deer habitat for the maintenance of reasonable population levels must be in a position to anticipate the potential and long-term effects timber management may have on this resource.

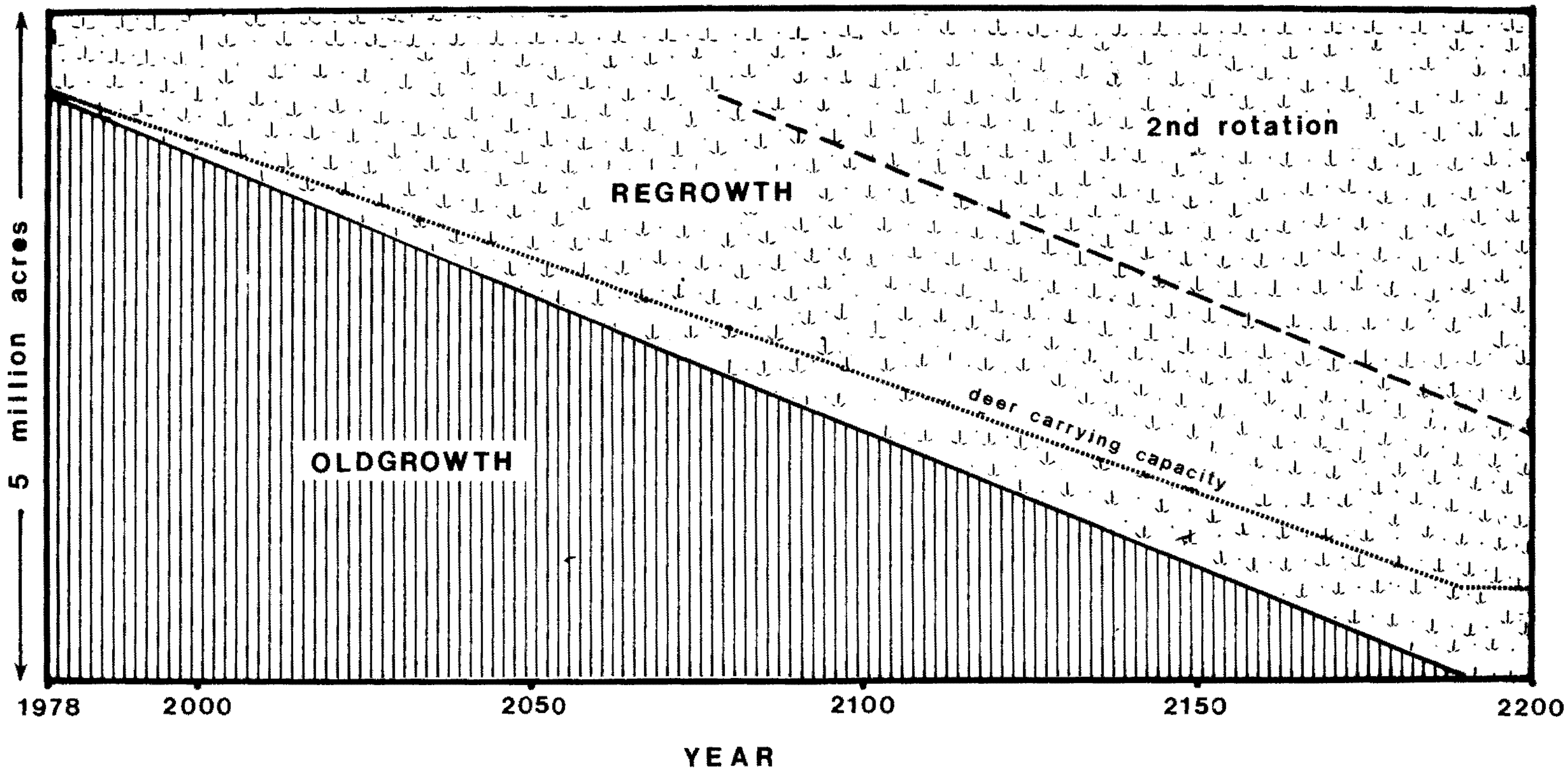

Figure 7. Hypothetical model demonstrating the reduction of the climax forest over time and its impact on optimum winter deer habitat.

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SITKA BLACK-TAILED DEER:

Proceedings of a Conference in Juneau, Alaska

U.S. Department of Agriculture, Forest Service, Alaska Region, in cooperation with the State of Alaska, Department of Fish and Game