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Spruce Reproduction Dynamics on Alaska's Kenai Peninsula, 1987-2000

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Abstract

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During the past 30 years, spruce forests of Alaska's Kenai Peninsula have undergone dramatic changes resulting from widespread spruce bark beetle (*Dendroctonus rufipennis* (Kirby)) infestation. In 1987 and again in 2000, the Pacific Northwest Research Station's Forest Inventory and Analysis Program conducted initial and remeasurement inventories to assess broad-scale impacts of this infestation.

Changes in regeneration of Sitka spruce (*Picea sitchensis* (Bong.) Carr.) and white spruce (*Picea glauca* (Moench) Voss) are examined by using data collected on 130 plots. Regeneration of Sitka and white spruce in terms of mean number of seedlings per plot is not significantly different from the 1987 findings. The number of plots where seedling stocking remained at previous levels or increased, slightly exceeded the number of locations where seedling stocking declined. Almost half the plots (49 percent) had decreased numbers of seedlings, and almost 72 percent of the plots fell in the less-than-fully-stocked category in both inventories. Also, the distribution of the seedlings over the plot was not uniform. No plots had seedlings on all plot cluster sample points in either inventory.

Keywords: Forest surveys, timber resources, reproduction (spruce), Alaska (Kenai Peninsula).

Summary

Alaska's Kenai Peninsula is ecologically and geographically diverse. Forest cover on the peninsula reflects that diversity. Resulting forest types range from those similar to interior Alaska's (white spruce [*Picea glauca* (Moench) Voss], black spruce [*P. mariana* (Mill.) B.S.P.], and paper birch [*Betula papyrifera* Marsh]) to those common in the mountainous south-coastal regions (Sitka spruce [*Picea sitchensis* (Bong.) Carr.] and mountain hemlock [*Tsuga mertensiana* (Bong.) Carr.]).

During the past three decades, populations of the spruce beetle (*Dendroctonus rufipennis* (Kirby)) reached epidemic proportions; the scale of the infestation has declined dramatically in recent years. Interest has risen on the impacts of the beetle infestation, particularly as regards its effect on future forest composition. This study examined data collected by the Pacific Northwest Research Station, Forest Inventory and Analysis Program in 1987 and again in 2000 to assess impacts of the infestation on spruce reproduction dynamics.

Spruce seedling data were examined to assess seedling stocking in 1987 and 2000 to identify regional patterns of differences. Analysis indicates that seedling stocking conditions in 2000 differ little from those found in 1987. Across all study plots there is no general decline or increase in seedling stocking. The number of plots where seedling stocking remained at previous levels, or increased, slightly exceeded the number of locations where seedling stocking declined. Seedling stocking on almost half the study plots is likely below levels needed to provide relatively rapid, short-term regeneration of fully stocked, mature spruce stands.

Introduction

This study provides a broad view of spruce reproduction dynamics in south-central Alaska's Kenai Peninsula. The region is between 148°30' and 152°00' W. longitude and between 59°05' and 61°05' N. latitude (fig. 1). The area is about 5.2 million acres, and forest land accounts for about 1.9 million acres (van Hees and Larson 1991). For several decades, the forest resource—white spruce (*Picea glauca* (Moench) Voss), Sitka spruce (*P. sitchensis* (Bong.) Carr.), and Lutz spruce (*P. x lutzii* Little), in particular—has been damaged owing to an infestation of the spruce beetle (*Dendroctonus rufipennis* (Kirby)).

The Pacific Northwest Research Station, Forest Inventory and Analysis (FIA) Program conducted an inventory in 1987 to assess impacts of the infestation. The FIA Program remeasured the plots in 2000. Analysis of the 1987 inventory data indicated that the infestation in 1987 was larger than in the recent past and that it would maintain its magnitude and then likely increase in the near future (van Hees 1992.) The infestation did expand to all forests with white and Sitka spruce, but by 2000, when remeasurement began, spruce beetle populations had declined dramatically (fig. 2) Annual aerial surveys indicated populations had fallen to endemic levels in many areas where they recently had been considered epidemic, and by

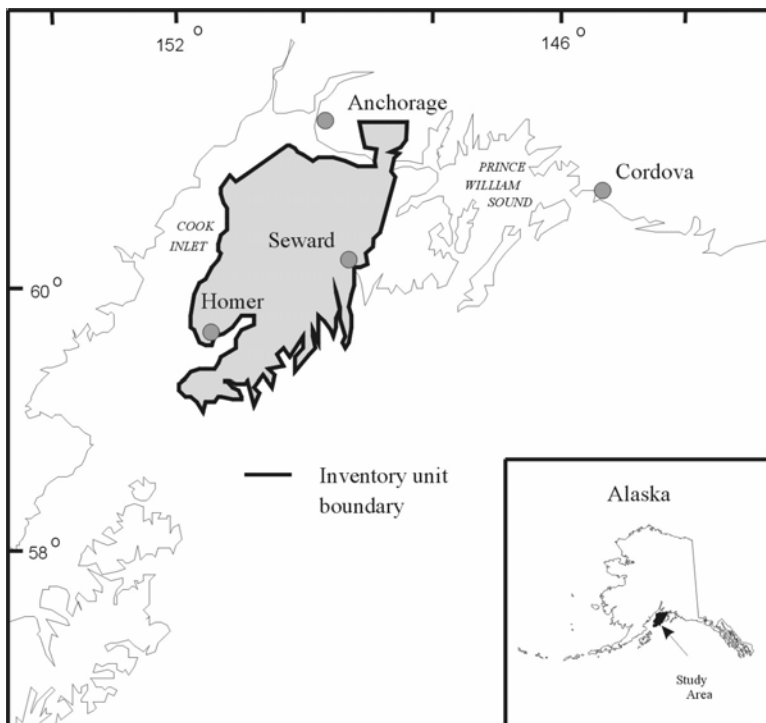


Figure 1—Kenai Peninsula forest inventory unit.

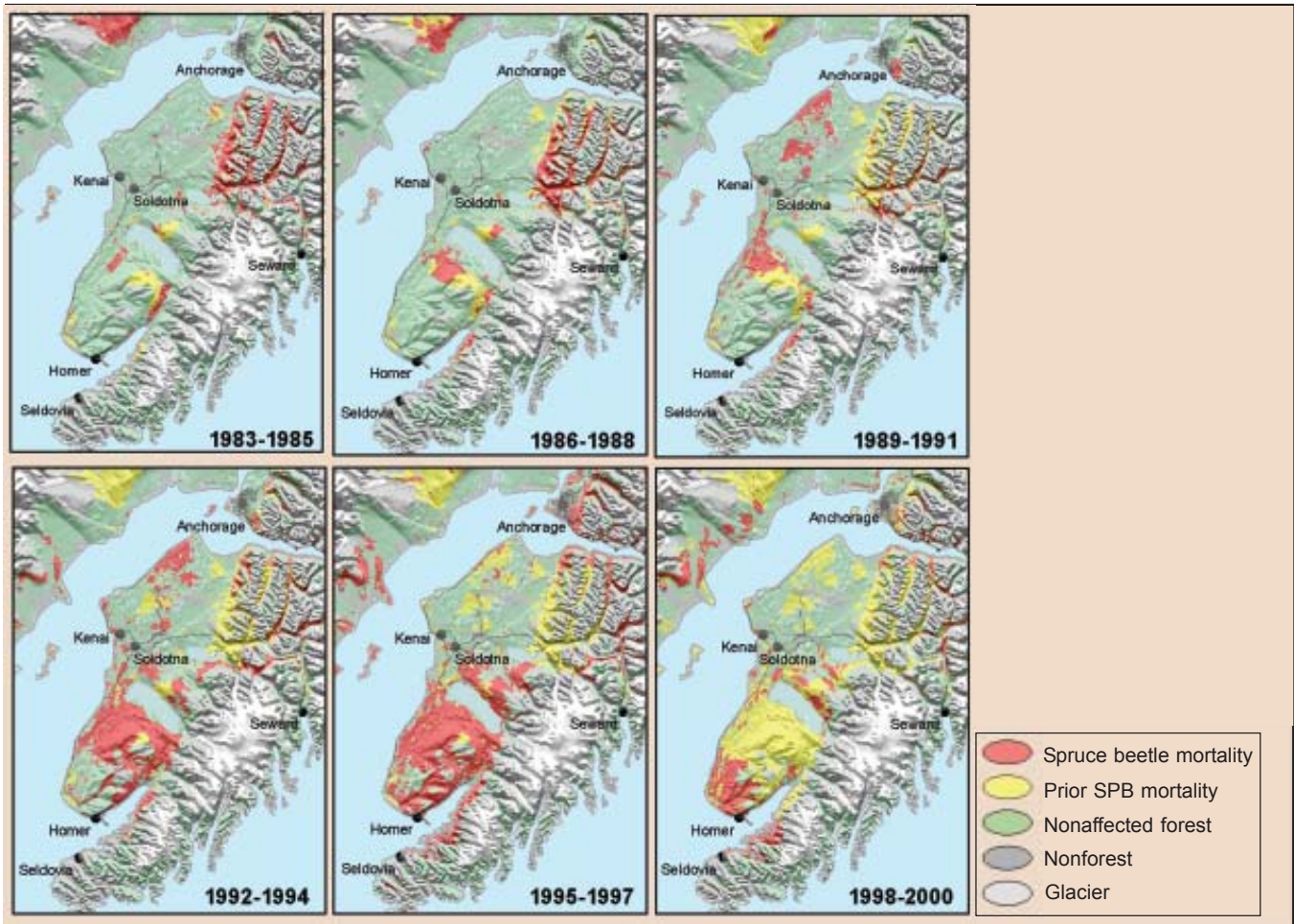


Figure 2—Sequential maps showing spruce beetle (SPB) activity on the Kenai Peninsula, 1983–2000 (Wittwer 2004).

2002 the epidemic was essentially over (Wittwer 2003). This study addresses two questions: How did the 2000 spruce reproduction status differ from that found in 1987, and what regional differences exist?

The Kenai Peninsula is ecologically diverse; three ecoregions are found there (fig. 3) The Cook Inlet Basin is characterized by a mild climate, level to rolling topography, and soil generally free from permafrost. Vegetation includes black spruce (*Picea mariana* (Mill.) B.S.P.) forests, ericaceous shrubs in open bogs, mixed forests of white and Sitka spruce, quaking aspen (*Populus tremuloides* Michx.), and birch (*Betula papyrifera* Marsh.) on better drained sites, and tall-shrub communities of willow (*Salix* spp.) and alder (*Alnus* spp.) on slopes along the periphery of the basin. Conversely, the Chugach–St. Elias Mountains region has steep and rugged topography, a transitional climate, and is largely barren of vegetation other than dwarf and low-scrub communities. Along valley bottoms and lower valley slopes, alder shrublands and mixed forests are present. The Gulf of Alaska



Figure 3—Ecoregions of the Kenai Peninsula, Alaska (Map by Dustin Wittwer).

coast region is characterized by deep narrow bays, steep valley walls, and irregular coastlines with glacial moraine deposits on lower slopes. The climate is maritime, and forests of Sitka spruce and mountain hemlock (*Tsuga mertensiana* (Bong.) Carr.) are found near sea level (Nowacki and others 2001).

Forest-type distribution on the Kenai Peninsula (fig. 4) is closely aligned with ecoregions described above. White and black spruce, paper birch, and quaking aspen are generally found in the Cook Inlet Basin, Sitka spruce in the Gulf- of Alaska Fjordlands, and mountain hemlock in the Chugach–St. Elias Mountains region. A few plots with cottonwood (*P. trichocarpa* Torr. & Gray) are also found in the Chugach–St. Elias Mountains region.

Spruce regeneration dynamics is of particular concern where spruce mortality was highest. Spruce mortality over the last decade follows regional forest-type patterns: generally declining mortality in northwestern regions where spruce was a secondary forest component versus generally increased mortality where spruce stands predominate, particularly western and southwestern regions of the peninsula (fig. 5).

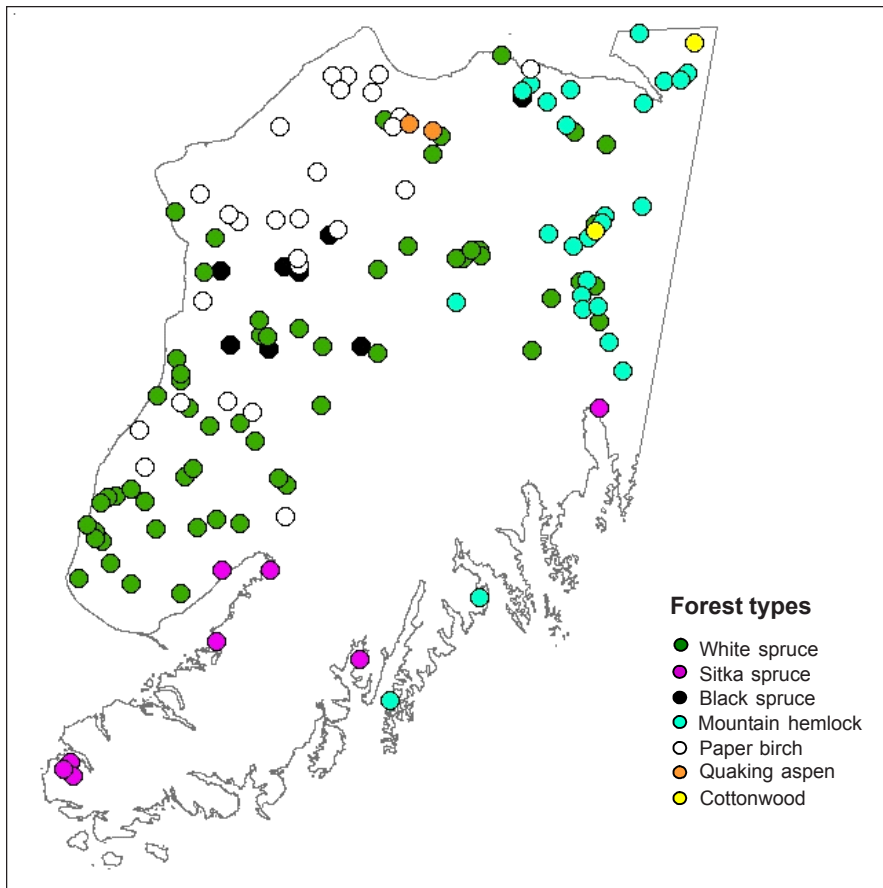


Figure 4—Inventory plots by forest type, Kenai Peninsula, Alaska, 2000.

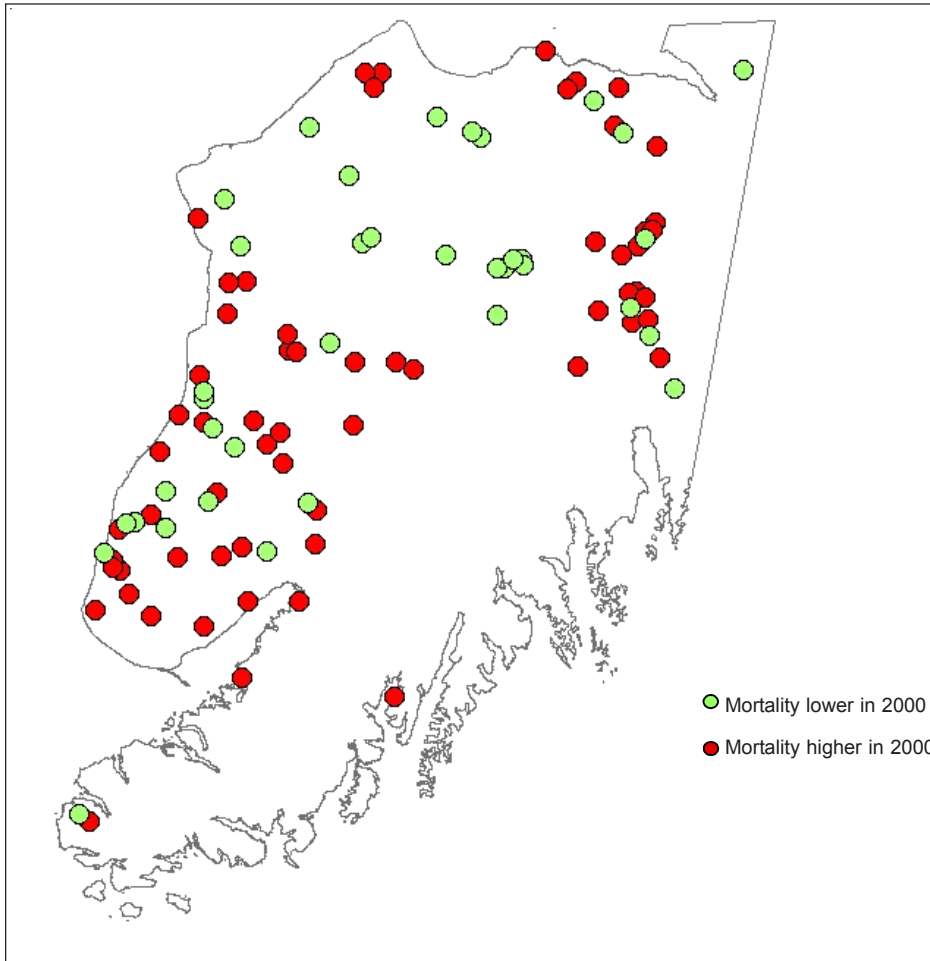


Figure 5—Inventory plots showing increased or decreased spruce mortality from 1987 to 2000, Kenai Peninsula, Alaska.

Methods

The inventory design used a double sample for stratification to improve area estimation (Bickford 1952). In the first sample, 5,597 photopoints were systematically distributed over 1:60,000-scale aerial photographs and then interpreted. Each photopoint was placed in one of four strata: productive forest (forest land capable of producing at least 20 cubic feet of wood per acre per year at culmination of mean annual increment), other forest, nonforest, and water. Forest land is land at least 10-percent stocked by live trees of any size, or land formerly having such tree cover and not currently developed for nonforest use. The minimum area for classification as forest land or subclasses of forest land was 1 acre.

From the 5,597 photopoints, a random sample of 1,216 plots was selected for potential ground visitation. All potentially productive forest-land plots ($n = 130$) were selected for ground measurement. These ground plots were initially measured

in 1987 and were remeasured in 2000. Ground plots were sampled with a five-point cluster (a central point with four additional points located 328.1 feet away in each cardinal direction).

Initial installation of the plot in 1987 required crews to locate the plot with respect to enduring reference points recognizable on aerial photos and the ground to aid future relocation of the plot in the event of fire, timber cutting, or other changes making visual relocation difficult. Some plot or point monumentation could not be recovered in 2000. In such cases, the plot (or part of plot) was reinstalled at the same location. Distance and azimuth data collected in 1987 were used in 2000 to ensure crews installed replacement points or plots in the correct location.

Variable-radius sampling was used to select trees. Measurements taken on these trees were used to estimate plot characteristics such as stand-size class, forest type, and volumes per acre. Total numbers of seedlings by species, on a 4.9-foot-radius microplot centered on each point in the cluster, were recorded. Seedlings were recorded only if they were established seedlings. A tree was considered an established seedling if it was less than 1.0 inch in diameter at breast height, had good coloration, no evidence of disease, and a root system in contact with mineral soil. Data-collection procedures are described in USDA Forest Service documents (1987, 2000.)

Plots that had at least one spruce seedling (either Sitka, white, or Lutz spruce) in either inventory were selected for this analysis. Ninety-six plots met this criterion. Plots without spruce seedlings in either inventory were considered as not contributing to spruce reproduction dynamics. *T*-tests (Snedecor and Cochran 1967) were performed on all 130 plots and on the 96-plot subset to examine overall mean differences in numbers of seedlings per plot between the two inventories.

In south-central Alaska, Sitka and white spruce cross-pollinate to produce the hybrid Lutz spruce. Identification of Lutz spruce from features apparent to the unaided eye is difficult. Field crews were instructed to identify trees as either white spruce or Sitka spruce depending on which species the tree most closely resembled.

Spruce seedling stocking on each plot was calculated as the sum of the numbers of spruce seedlings found on all five microplots within that plot. To assess magnitude of changes in spruce seedling stocking, plots were grouped into four levels of spruce seedling stocking. The minimum stocking levels were (1) no seedlings in one inventory, (2) one or two seedlings in either inventory, (3) three to four seedlings in either inventory, and (4) five or more seedlings in either inventory. All 96 plots were used for each group. Under the sampling scheme used for the initial and remeasurement inventories, each seedling sampled

represents about 100 seedlings per acre. Plots with five or more seedlings are considered fully stocked.

Decades of spruce-beetle-caused mortality brought about changes in stand-size class. Spruce reproduction in areas of high mortality, as reflected in stand-size class decreases, was characterized by examining seedling stocking dynamics in relation to regional changes in plot stand-size class. Plot stand-size class was calculated by using stocking of live, growing-stock trees (USDA Forest Service 2003.) Growing-stock trees include all live trees except for cull trees.

Results

Appendix table 6 lists study plots with stand-size class and number of seedlings at both measurement dates. Not all remeasurement points were in exactly the same locations because monumentation placed in 1987 was not recovered (app. table 6.) Five plots were completely reinstalled, one required reinstallation of four points in the cluster, six needed two points reinstalled, and nine had one point needing reinstallation.

No significant difference is evident in the mean number of seedlings per plot across the inventory unit between 1987 and 2000 (table 1).

Stand-Size Class Dynamics

Plot stand-size classes declined between 1987 and 2000. Forty-two percent (40 plots) of all plots showed stand-size reduction. Sixty plots had sawtimber-sized stands in 1987. Stand-size class declined on 34 (57 percent) of these plots; 45 percent became nonstocked (table 2.) Reduction of stand-size class from sawtimber to nonstocked indicates near to total mortality of all spruce trees on the plot. Generally, in regions of increased spruce mortality (fig. 5), stand-size class declined between 1987 and 2000, whereas in regions of lower mortality, stand-size class was more stable (fig. 6).

Seedling Stocking Dynamics

There is little indication of significant increases or decreases in seedling stocking across all plots (fig. 7). Almost half of the plots (47) had decreased numbers of seedlings, 37 had increases, and on 12 plots, seedling stocking remained level.

Fifty-one percent (49 plots) of all plots were stocked with at least one seedling in both inventories (table 3). Twenty-five plots (26 percent) were not stocked with any seedlings in 1987 but had 1 or more seedlings by 2000. Twenty-two plots were stocked with at least one seedling in 1987 but by 2000 had no seedlings on them. Twenty-eight percent (27 plots) of all plots were at least fully stocked (5 or more

Table 1—Results of *t*-tests comparing 1987 and 2000 mean number of seedlings per plot for all plots (df = 129) and for only those plots with spruce seedlings on either occasion (df = 95)

Survey date	Mean	Degrees of freedom	alpha	<i>t</i> value	Critical value
1987	2.8307	129	0.05	0.5057	1.9797
2000	2.5304				
1987	3.8333	95	.05	.5052	1.9883
2000	3.4375				

Table 2—Number of plots, with at least one spruce seedling at either or both inventories, by stand-size class, Kenai Peninsula, Alaska, 1987 and 2000

Stand-size class, 1987	Stand-size class, 2000				All classes
	Nonstocked	Seedling and sapling	Poletimber	Sawtimber	
	<i>Number of plots</i>				
Nonstocked	2	—	—	—	2
Seedling and sapling	1	2	2	—	5
Poletimber	3	2	17	7	29
Sawtimber	27	2	5	26	60
Total	33	6	24	33	96

— = no data collected.

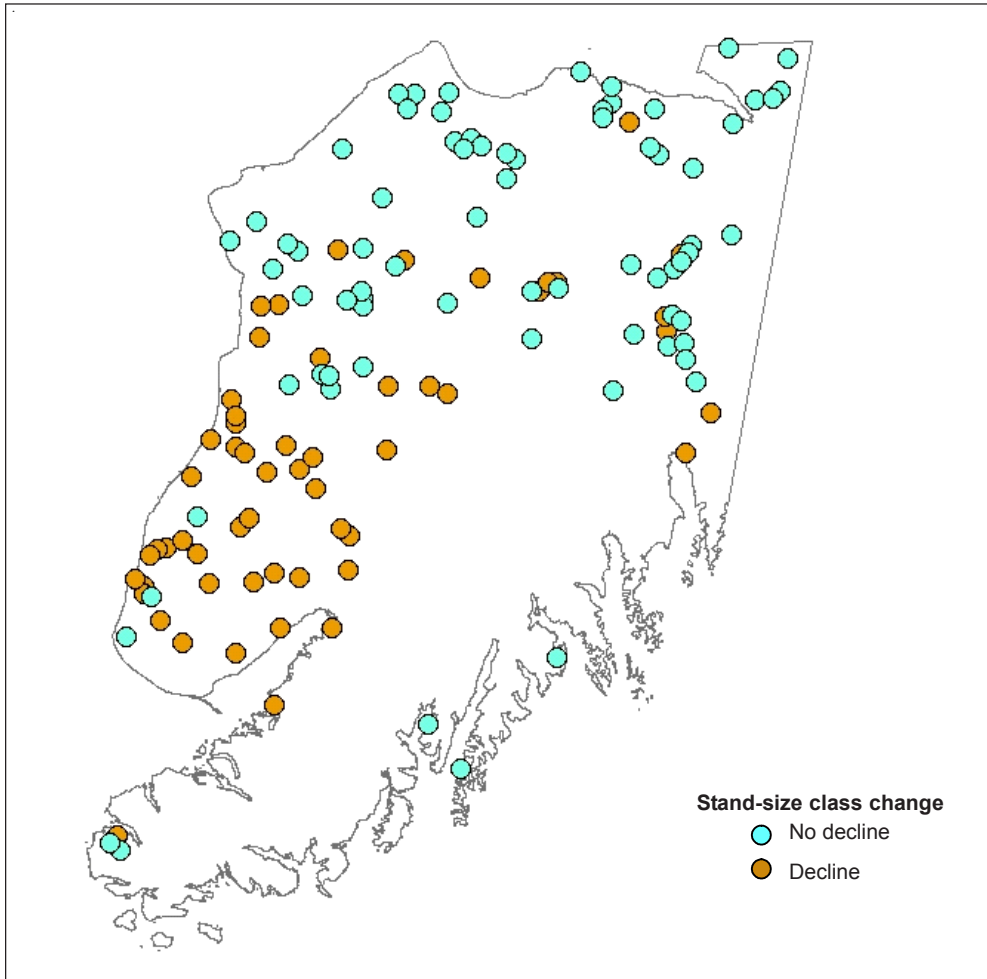


Figure 6—Inventory plots by stand-size class change from 1987 to 2000, Kenai Peninsula, Alaska.

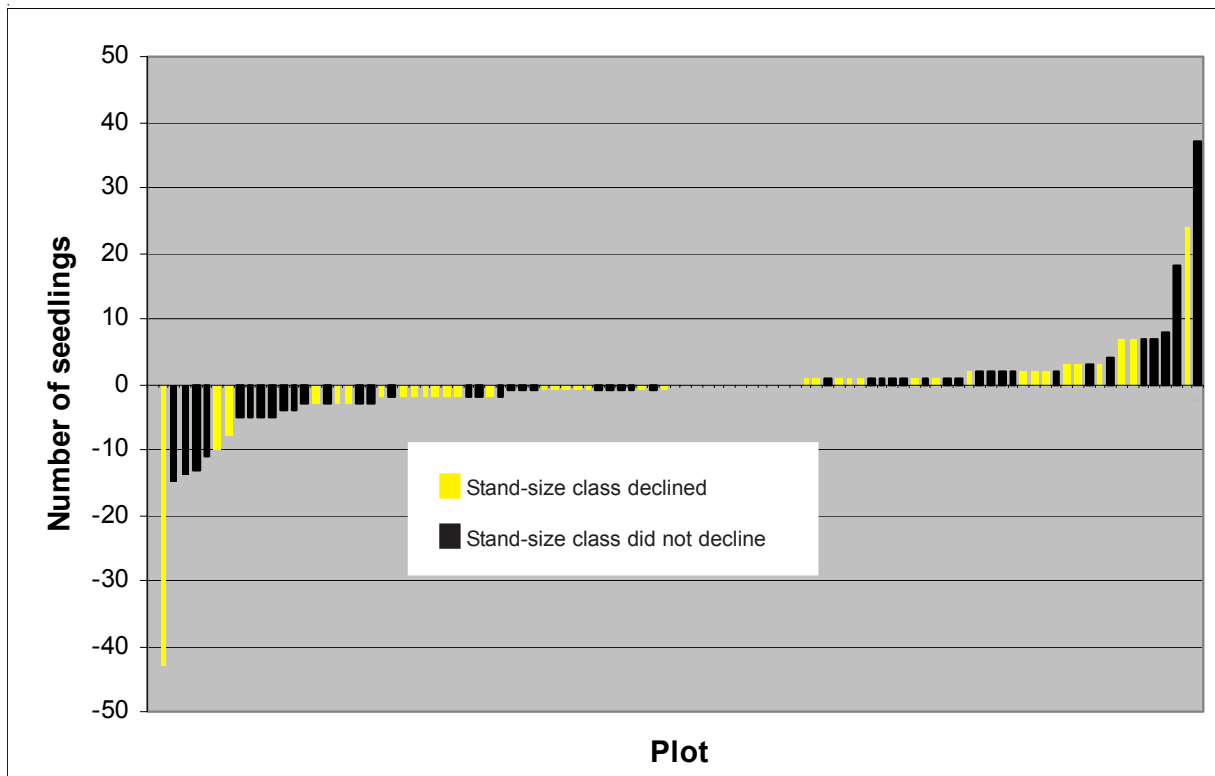


Figure 7—Individual plot changes in number of spruce seedlings and stand-size class, Kenai Peninsula, Alaska, 1987 to 2000.

Table 3—Number of plots by seedling stocking level, Kenai Peninsula, Alaska, 1987 to 2000

Seedling stocking level, 1987	Seedling stocking level, 2000				Total
	0	1–2	3–4	5 +	
	<i>Number of plots</i>				
0		14	3	8	25
1–2	16	11	7	0	34
3–4	3	10	5	1	19
5 +	3	3	2	10	18
Total	22	38	17	19	96

seedlings) in at least one inventory. Ten were fully stocked at both inventories, nine that were not fully stocked in 1987 became so in 2000, and eight that were fully stocked in 1987 were less than fully stocked in 2000.

Among marginally well-stocked plots (at least three seedlings per plot), only slightly more than half (57 percent or 55 plots) of the plots were stocked in at least one inventory (table 3). Eighteen plots were stocked in 1987 and 2000, stocking

rose to three or more seedlings between 1987 and 2000 on 18 plots, and on 19 plots, the 1987 stocking declined to less than three seedlings by 2000.

Few plots were fully stocked (five or more seedlings) in either inventory (app. table 6). Almost 72 percent of plots fall in the less-than-fully-stocked category in both inventories. Although a plot is considered fully stocked by the presence of five or more seedlings, the spatial distribution of the seedlings over the five sample points on the plot is rarely uniform. No plots had seedlings on all five points at either inventory.

Regional differences in spruce reproduction dynamics are evident. In the northwestern areas of the inventory unit where mortality declined, stand-size class did not decline, and paper birch forest types predominate, reproduction dynamics were relatively static (fig. 8). Most locations with one or more seedlings in 1987 remained stocked with at least one seedling (61 percent), 25 percent showed improvement from no seedlings to at least one, and 14 percent declined from one or more seedlings to not stocked (table 4).

Spruce reproduction in the southwestern region was more dynamic (fig. 9). The forests of this region are mainly composed of spruce types and suffered extensive mortality with resultant declines in stand-size class. Forty-two percent of the

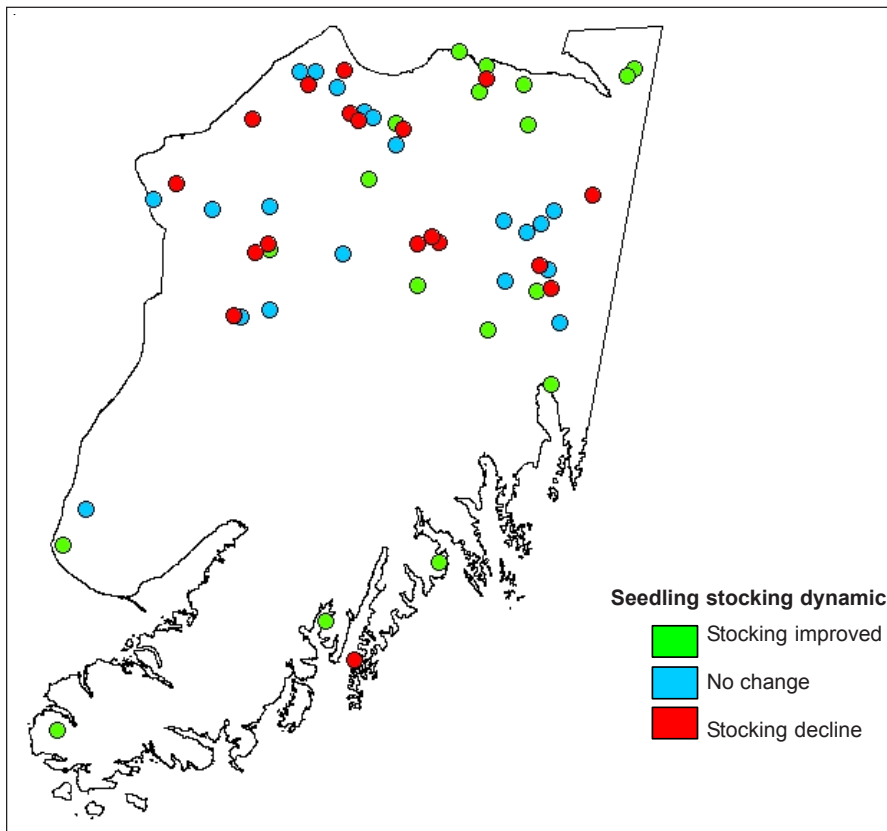


Figure 8—Inventory plots by spruce seedling stocking dynamic where stand-size class did not decline, Kenai Peninsula, Alaska, 1987 to 2000.

Table 4—Number of plots by seedling stocking level for plots where stand-size class did not decline after 1987, Kenai Peninsula, Alaska

Seedling stocking level, 1987	Seedling stocking level, 2000				Total
	0	1–2	3–4	5 +	
	<i>Number of plots</i>				
0		8	1	5	14
1–2	6	8	4	0	18
3–4	2	5	5	0	12
5 +	0	3	2	7	12
Total	8	24	12	12	56

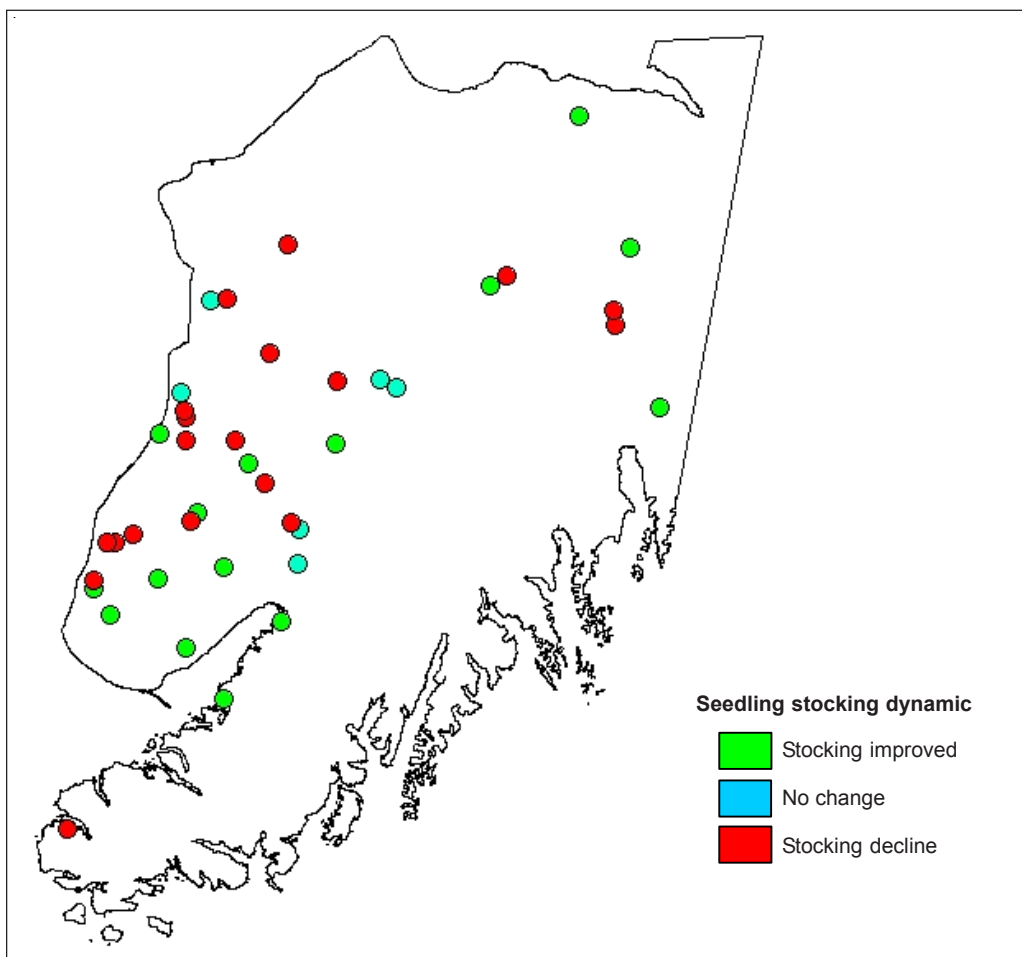


Figure 9—Inventory plots by spruce seedling stocking dynamic where stand-size class declined between 1987 and 2000, Kenai Peninsula, Alaska.

Table 5—Number of plots by seedling stocking level for plots where stand-size class declined between 1987 and 2000, Kenai Peninsula, Alaska

Seedling stocking level, 1987	Seedling stocking level, 2000				Total
	0	1–2	3–4	5 +	
	<i>Number of plots</i>				
0		6	2	3	11
1–2	10	3	3	0	16
3–4	1	5	0	1	7
5 +	3	0	0	3	6
Total	14	14	5	7	40

plots where stand-size class declined maintained spruce seedling stocking levels of at least one seedling; 26 percent showed stocking levels improved from no seedlings in 1987 to at least one seedling, and on 33 percent, stocking declined to zero (table 5).

Discussion

The status of spruce reproduction on productive forest land in 2000 was not dramatically different from that found in 1987. Most plots did not have full stocking at either inventory. In 1987, the spruce forests were mature (63 percent of plots had sawtimber-sized stands); by 2000, many of these locations had become nonstocked, having no trees at least 5 inches in diameter. Similarly, Holsten et al. (1995) in a study conducted near Hope, Alaska, in the Resurrection Creek drainage of the north-central Kenai Peninsula to examine effects of fire and the spruce beetle outbreak noted spruce seedling density was low at both the beginning (1980) and end (1991) of the study. Revisits of these plots in 1996 (Schulz 2000) found more of the unburned plots had spruce seedlings than did the burned plots.

The survey protocol used to count seedlings for this study likely underestimates number of seedlings. The requirement that a seedling be established with roots in mineral soil can cause undercounts. White spruce can reproduce under the closed canopy of mature stands, and seed germination occurs on a variety of seedbeds—commonly on rotted logs. On the southern peninsula, where stands have usually not burned for hundreds of years according to radiocarbon-dated soil charcoal, most tree recruitment is on nurse logs and nurse stumps (Berg 2004.)

Between 1987 and 2000, logging activity affected about 29 percent of the plots. Nine plots were clearcut either entirely or partially: two were entirely cut, one was

80 percent cut, three were 40 percent cut, and three were 20 percent cut. Additionally, 19 other plots had some harvest effect (≥ 25 percent of trees cut or damaged in association with tree removals.) Reproduction after stand removal (either through natural agents or by mechanical means) can occur on remaining organic material and exposed mineral soil, but seedling-to-seed ratios drop as subsequent growth of nontree vegetation increases with successive years (Burns and Honkala 1990: 211-212).

Stocking of five seedlings per plot is considered a fully stocked location; this translates to about 550 seedlings per acre. Stocking by one seedling per plot cannot be considered good stocking. Twenty-three plots were stocked with one seedling in 1987, and 11 more had two seedlings. In 2000, the numbers of plots with one and two seedlings were 22 and 16, respectively. In 1987 there were 18 plots that had five or more seedlings, and in 2000 the number was 19 (app. table 6.) In general, although there were changes on individual plots, seedling stocking status did not change dramatically between 1987 and 2000.

Regional differences coincident with ecoregion and forest type distributions exist. There are few pure spruce stands in the northwest or east; spruce mortality was highest in southwest along with stand-size declines where most of the spruce mortality occurred. However, regeneration is taking place—sometimes at relatively high levels, such as along the southern edge of the lowlands region.

Metric Equivalents

1 inch = 2.54 centimeters

1 foot = 0.3048 meter

1 mile = 1.609 kilometers

1 acre = 0.4047 hectare

1 cubic foot = 0.0283 cubic meter

1 cubic foot per acre = 0.07 cubic meter per hectare

Degrees Fahrenheit = $(1.8 \text{ }^\circ\text{Celsius}) + 32$

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Appendix

Table 6—Study plots by number of new points installed, stand-size class, and number of spruce seedlings, 1987 and 2000, Kenai Peninsula, Alaska

Plot number	Number of new points installed	Stand-size class		Number of spruce seedlings (No. of points/plot)	
		1987	2000	1987	2000
1	0	Sawtimber	Sawtimber	4(2)	1(1)
2	0	Sawtimber	Nonstocked	8(1)	0
3	1	Sawtimber	Sawtimber	0	8(2)
20	0	Sawtimber	Nonstocked	0	1(1)
22	0	Poletimber	Nonstocked	2(2)	0
23	2	Nonstocked	Nonstocked	0	18(1)
24	0	Sawtimber	Nonstocked	2(2)	2(1)
26	0	Poletimber	Poletimber	4(2)	0
28	0	Poletimber	Poletimber	2(2)	1(1)
29	0	Poletimber	Sawtimber	9(2)	9(3)
30	0	Poletimber	Seedling/sapling	9(2)	8(2)
31	2	Sawtimber	Nonstocked	0	1(1)
32	0	Poletimber	Poletimber	1(1)	1(1)
33	1	Sawtimber	Nonstocked	0	2(1)
35	0	Seedling/sapling	Seedling/sapling	24(4)	19(3)
37	2	Poletimber	Poletimber	0	1(1)
39	0	Poletimber	Poletimber	8(4)	4(3)
40	2	Seedling/sapling	Seedling/sapling	2(1)	0
42	0	Poletimber	Seedling/sapling	4(2)	1(1)
43	0	Sawtimber	Poletimber	7(3)	5(3)
44	0	Sawtimber	Sawtimber	3(1)	2(1)
47	0	Sawtimber	Sawtimber	0	2(2)
48	0	Poletimber	Poletimber	7(4)	2(1)
49	0	Sawtimber	Sawtimber	1(1)	1(1)
50	0	Poletimber	Poletimber	3(2)	3(2)
51	0	Sawtimber	Sawtimber	4(1)	3(1)
52	0	Poletimber	Sawtimber	3(1)	0
53	1	Sawtimber	Sawtimber	1(1)	0
56	0	Poletimber	Poletimber	7(1)	2(2)
57	0	Poletimber	Sawtimber	1(1)	1(1)
58	0	Poletimber	Poletimber	4(1)	4(1)
59	1	Sawtimber	Sawtimber	1(1)	0
60	0	Poletimber	Poletimber	0	2(2)
62	0	Sawtimber	Sawtimber	1(1)	0
64	0	Poletimber	Sawtimber	0	1(1)
66	0	Poletimber	Poletimber	29(3)	15(3)
67	0	Poletimber	Nonstocked	2(2)	0
68	0	Sawtimber	Sawtimber	1(1)	1(1)

Table 6—Study plots by number of new points installed, stand-size class, and number of spruce seedlings, 1987 and 2000, Kenai Peninsula, Alaska (continued)

Plot number	Number of new points installed	Stand-size class		Number of spruce seedlings (No. of points/plot)	
		1987	2000	1987	2000
70	0	Sawtimber	Sawtimber	2(1)	2(1)
71	0	Poletimber	Sawtimber	1(1)	3(1)
72	0	Sawtimber	Sawtimber	4(2)	2(2)
73	1	Sawtimber	Nonstocked	10(2)	0
74	5	Sawtimber	Nonstocked	2(1)	0
75	1	Sawtimber	Sawtimber	1(1)	4(2)
76	0	Sawtimber	Sawtimber	7(1)	4(1)
77	0	Sawtimber	Sawtimber	8(1)	6(3)
78	5	Sawtimber	Nonstocked	0	1(1)
79	5	Poletimber	Nonstocked	0	7(4)
80	0	Sawtimber	Nonstocked	2(1)	0
81	0	Sawtimber	Poletimber	1(1)	0
82	0	Sawtimber	Nonstocked	2(2)	0
83	0	Sawtimber	Nonstocked	1(1)	0
84	0	Sawtimber	Seedling/sapling	0	3(1)
85	0	Sawtimber	Nonstocked	3(1)	1(1)
86	4	Sawtimber	Nonstocked	1(1)	0
88	1	Sawtimber	Nonstocked	1(1)	0
89	1	Sawtimber	Nonstocked	1(1)	0
90	0	Sawtimber	Nonstocked	1(1)	3(2)
91	0	Sawtimber	Nonstocked	1(1)	2(1)
92	0	Sawtimber	Nonstocked	3(1)	1(1)
93	2	Sawtimber	Nonstocked	0	7(1)
95	0	Sawtimber	Poletimber	0	37(1)
96	0	Sawtimber	Sawtimber	3(1)	4(1)
97	0	Sawtimber	Nonstocked	3(2)	2(1)
98	1	Sawtimber	Nonstocked	0	3(1)
101	0	Sawtimber	Nonstocked	1(1)	3(1)
104	0	Sawtimber	Nonstocked	1(1)	3(1)
106	0	Sawtimber	Seedling/sapling	11(1)	11(3)
107	0	Sawtimber	Sawtimber	1(1)	3(2)
108	0	Sawtimber	Nonstocked	4(1)	7(1)
110	0	Sawtimber	Nonstocked	0	1(1)
111	0	Sawtimber	Sawtimber	0	24(2)
113	0	Sawtimber	Sawtimber	0	4(3)
114	0	Sawtimber	Sawtimber	3(2)	1(1)
115	0	Poletimber	Poletimber	15(4)	2(1)
116	0	Sawtimber	Sawtimber	1(1)	2(1)
118	0	Sawtimber	Sawtimber	0	1(1)

Table 6—Study plots by number of new points installed, stand-size class, and number of spruce seedlings, 1987 and 2000, Kenai Peninsula, Alaska (continued)

Plot number	Number of new points installed	Stand-size class		Number of spruce seedlings (No. of points/plot)	
		1987	2000	1987	2000
119	0	Poletimber	Poletimber	1(1)	0
120	0	Seedling/sapling	Poletimber	10(3)	5(2)
121	0	Poletimber	Poletimber	4(2)	4(2)
123	0	Poletimber	Sawtimber	17(2)	6(2)
125	0	Sawtimber	Sawtimber	0	7(1)
126	0	Sawtimber	Nonstocked	3(2)	0
127	0	Sawtimber	Poletimber	1(1)	2(2)
128	0	Sawtimber	Sawtimber	2(2)	2(2)
129	0	Poletimber	Poletimber	27(4)	12(1)
130	0	Poletimber	Sawtimber	0	1(1)
134	0	Sawtimber	Nonstocked	4(2)	1(1)
136	0	Sawtimber	Sawtimber	0	7(2)
137	5	Seedling/sapling	Nonstocked	43(4)	0
138	0	Poletimber	Poletimber	4(2)	1(1)
139	2	Nonstocked	Nonstocked	1(1)	0
140	0	Sawtimber	Poletimber	0	2(1)
142	0	Seedling/sapling	Poletimber	2(1)	3(2)
143	0	Poletimber	Poletimber	0	1(1)
144	0	Sawtimber	Sawtimber	0	1(1)

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