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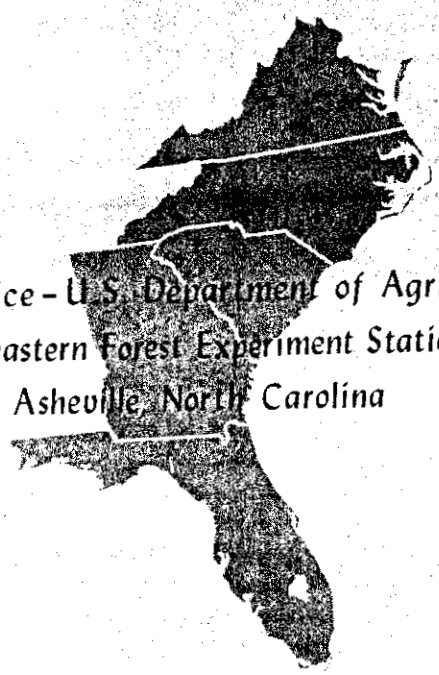

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Sampling and Analytical Techniques for an Interim Survey in the South Carolina Lowcountry

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Abstract.--Remeasurement of 675 permanent sample locations in the South Carolina Lowcountry using modified sampling techniques showed that net growth of pine for the 6 years 1968-1974 was 637.0 million cubic feet while removals were slightly over 390.6 million cubic feet. In 1974, there were 1,533.5 million cubic feet of pine in the area with that portion in sawtimber size amounting to more than 4,987.2 million board feet. Despite a high rate of forest activity in the area over the past 6 years, 56 percent of the stands that remained in forest were in good condition, 14 percent were mature and ready for harvest, and another 14 percent needed some type of intermediate treatment to improve the stand. The remaining 16 percent needed regeneration or stand conversion to make them productive.

Keywords: Forest survey, mensuration.

The Forest Resources Research Work Unit of the Southeastern Forest Experiment Station has been resurveying the forest resources of the five Southeastern States on a cycle of approximately 10 years. Results of past surveys have identified areas where this interval was too long. Extensive land use changes, major increases in resource demand, and widespread natural disturbances have adversely altered both the quantity and condition of forest resources before up-to-date information became available. This paper describes the sampling and analytical techniques used in an interim survey of seven counties in South Carolina referred to as the Lowcountry (fig. 1). These procedures may be applicable in other areas where interim information is needed.

The fourth Forest Survey of South Carolina, completed in 1968, showed that the net annual growth of pine timber exceeded the pine removals by 25 percent in 1967 in the Lowcountry.[1] Furthermore, timber products output studies

[1]Cost, Noel D. 1968. Forest statistics for the Southern Coastal Plain of South Carolina, 1968. U.S.D.A. For. Serv. Resour. Bull. SE-12, 35 p. Southeast. For. Exp. Stn., Asheville, N.C.

[3]Welch, Richard L. 1968. Forest statistics for the Northern Coastal Plain of South Carolina, 1968. U.S. For. Serv. Resour. Bull. SE-10, 35 p. Southeast. For. Exp. Stn., Asheville, N.C.

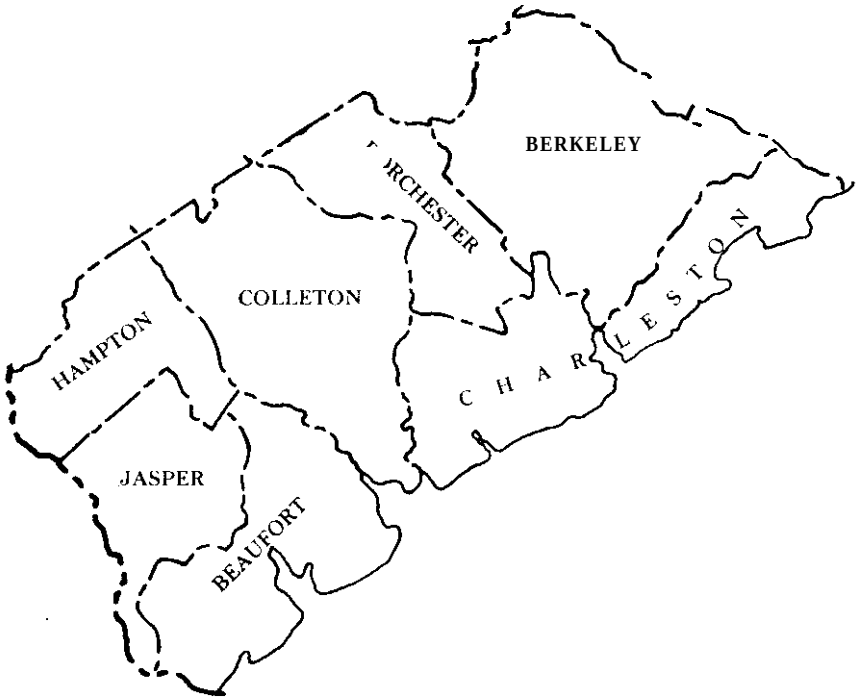

Figure 1.--Lowcountry of South Carolina.

in 1970 and 1972 indicated only a modest increase in pine removals. Nevertheless, there was widespread local concern that Lowcountry pine resources were being depleted, and the next resurvey was not scheduled until 1978. The interim survey evolved out of this concern.

The field survey was conducted by the South Carolina State Commission of Forestry in cooperation with the Lowcountry Resource Conservation and Development Project. The Forest Resources Research Work Unit of the Southeastern Forest Experiment Station provided technical assistance in designing the sample and processing the data.

SAMPLING PROCEDURES

The primary objective of the interim survey was to determine changes in the pine timber volume since 1968. Under standard Forest Survey procedures, these changes would have been determined along with those of all components of the inventory. All 1,306 permanent sample locations in the Lowcountry would have been relocated, and a host of detailed measurements and classifications would have been made. Since much of this information was not needed in the interim survey, the standard procedures were modified.

The number of sample locations to be relocated was reduced to 675 by deleting all locations that were not likely to have pine volume. Locations were deleted if they were not on forest land or if they contained no pines in 1968. Pine

volume ingrowth on these sample locations during the 6-year period would have been minimal and would not have appreciably affected the outcome of the study.

The sample design at the remaining sample locations was a 10-point cluster of plots with a basal area factor of 37.5. The cluster was systematically spaced to cover 1 acre. All trees 5.0 inches d.b.h. or larger were measured on variable plots at all 10 points, and trees 1.0 inch to 4.9 inches d.b.h. were measured on a plot with a fixed radius of 6.8 feet at the first three points. All the measurements were recorded on a sample record so that remeasurement would be possible.

In standard surveys, all surviving trees in the 10-point clusters are remeasured, all ingrowth trees are measured, and all dead or removed trees are accounted for. The growth on the dead and removed trees is computed by using average annual diameter increments for the area and adjusted average bole length equations. In the limited interim survey, the standard procedures were streamlined considerably. All hardwood trees recorded on the sample record were ignored. This step greatly reduced the cost of the study because 301 sample locations were in oak-pine or hardwood forest types. All trees at the first three points that were less than 5.0 inches d.b.h. were ignored unless they grew to be 5.0 inches or larger. To further streamline the fieldwork, surviving trees were not actually remeasured. Growth on surviving trees was computed in the same way that growth is normally computed for dead or removed trees.

The area description was also kept to a minimum. Normally, an array of information would be collected to describe both the area and the forest condition at each location. In the interim survey, only two pertinent questions were answered: (1) What treatment or disturbance, if any, has taken place since the 1968 survey to create the current forest conditions? (2) What management opportunities are there, if any, to improve timber growth?

FIELD PROCEDURES

The field procedures were to find the old sample location, classify the area, record all dead or removed trees, and measure and record the ingrowth trees. New information was written on a remeasurement record form (fig. 2).

County maps and aerial photographs showing the approximate locations of the samples were available from the 1968 survey. An azimuth and distance from a clearly defined starting point to the location center was on the old sample record. Using this information, all of the samples were relocated.

The area information consisted of location identification, several items needed in processing, and the two area classifications. The location identification information was transferred from the old sample'record. The area classifications were the same as those in the 1972 survey of Georgia.[3]

[3]Knight, Herbert A., and Joe P. McClure. 1974. Georgia's timber, 1872. USDA For. Serv Resour. Bull. SE-27, 48 p, Southeast. For. Exp. *Stn.*, Asheville, N.C.

STATE	UNIT	COUNTY	LOCATION	LAND USE	PAST TREAT. OR DIST.	TREAT. OR DIST. PERIOD	TREAT. OPPOR.	REMEAS. PERIOD
XX	X	XX	XXX	X	XX	XX	X	XXX
39								

POINT NO.	TREE NO.	SPECIES	HISTORY	OLD D.B.H.	NEW D.B.H.	CUT-MORT. PERIOD	UTILIZ.
X	XX	XXX	X	XXX	XXX	XX	X

LAND USE

1 Forest
2 Nonforest

SPECIES

110 Shortleaf
111 Slash
115 Spruce
121 Longleaf
128 Pond
131 Loblolly

TREE HISTORY

Remeasurement of sample location

1 Live tree recorded on *previous* survey *or* live tree tallied on the 10-point cluster.

2 Ingrowth 5.0 inch d.b.h. or larger on smallest fixed plot not recorded on previous survey.

6 Dead tree 5.0 inch d.b.h. or larger recorded as a live tree on previous survey.

8 Tree removed from commercial forest recorded as live tree on *previous* survey.

Figure 2.--Remeasurement record form.

The first 3 points of the 10-point cluster were always checked for ingrowth pines (trees growing from below 5.0 inches d.b.h. to 5.0 inches or larger). If an ingrowth pine was found, point number, species, and appropriate tree history were recorded, and the new d.b.h. was measured and recorded. No attempt was made to obtain ingrowth mortality or removal data.

All 10 points were checked for mortality and removed trees. If one was found, point number, tree number, species, and old d.b.h. were recorded, along with the appropriate tree history and the approximate period since death or removal. In addition, a utilization class was given to each removed tree. No tree information was recorded for surviving trees.

DATA PROCESSING

The processing procedures consisted of editing the new data; merging the new data with that of 1968; computing new diameters and bole lengths, where needed; computing volumes; and compiling tables.

After the data on the remeasurement records were punched into data cards, extensive computer editing was done to spot omissions, invalid codes, and errors in logic. When the data were found to be free of such errors, they were merged with the historical data from the 1968 survey, and the new diameters and bole lengths were computed.

During the 1968 survey, 3,060 pines in the vicinity of the Lowcountry were remeasured about 10 years after the preceding survey. Average annual radial increment was determined by species and 2-inch-diameter class. These averages were used to estimate diameter growth for all trees needing new diameters. Bole-length equations generated from length measurements on 11,264 trees in the Southeast were used to estimate bole-length increment. The lengths were measured with sectional aluminum poles, as described by McClure.[4] Because the average bole lengths computed from these equations were regional, they were adjusted to gain local sensitivity. This adjustment was done tree by tree, by determining the ratio of the old bole length to a computed old bole length, and then applying the ratio to the new computed bole length.

Both the old and new cubic volumes were computed with standard equations. The cubic-foot volumes were then converted to board feet by using average board foot-cubic foot ratios for all trees that were 9.0 inches d.b.h. or larger.

RESULTS

In 1974, there were 1,533.5 million cubic feet of pine in the area (table 1). The net growth for the 6-year remeasurement period was 637.0 million cubic feet, and the removals amounted to over 390.6 million cubic feet. Although

Table 1.--Changes in volume of pine in South Carolina Lowcountry, 1968 to 1974

Item	All timber	Sawtimber
	M cubic feet	M board feet
Inventory 1968	1,287,210	4,305,897
Period changes:[1]		
Gross growth	673,444	2,232,198
Mortality	36,490	117,760
Net growth	636,954	2,114,438
Removals	390,629	1,433,120
Net change	246,325	681,318
Inventory 1974	1,533,535	4,987,215

[1] Does not include ingrowth mortality or ingrowth removals.

[4] McClure, Joe P. 1968. Sectional aluminum poles improved length measurements in standing trees. U.S.D.A. For. Serv. Res. Note SE-98, 4 p. Southeast. For. Exp. Stn., Asheville, N.C.

gains were made in all diameter classes, the greatest gain was found in the 8-inch class (fig. 3). Of the six pine species in the area, only spruce pine lost volume (table 2). Loblolly pine made the greatest gain. The board-foot volume of pine increased from 4,305.9 to over 4,987.2 million board feet.

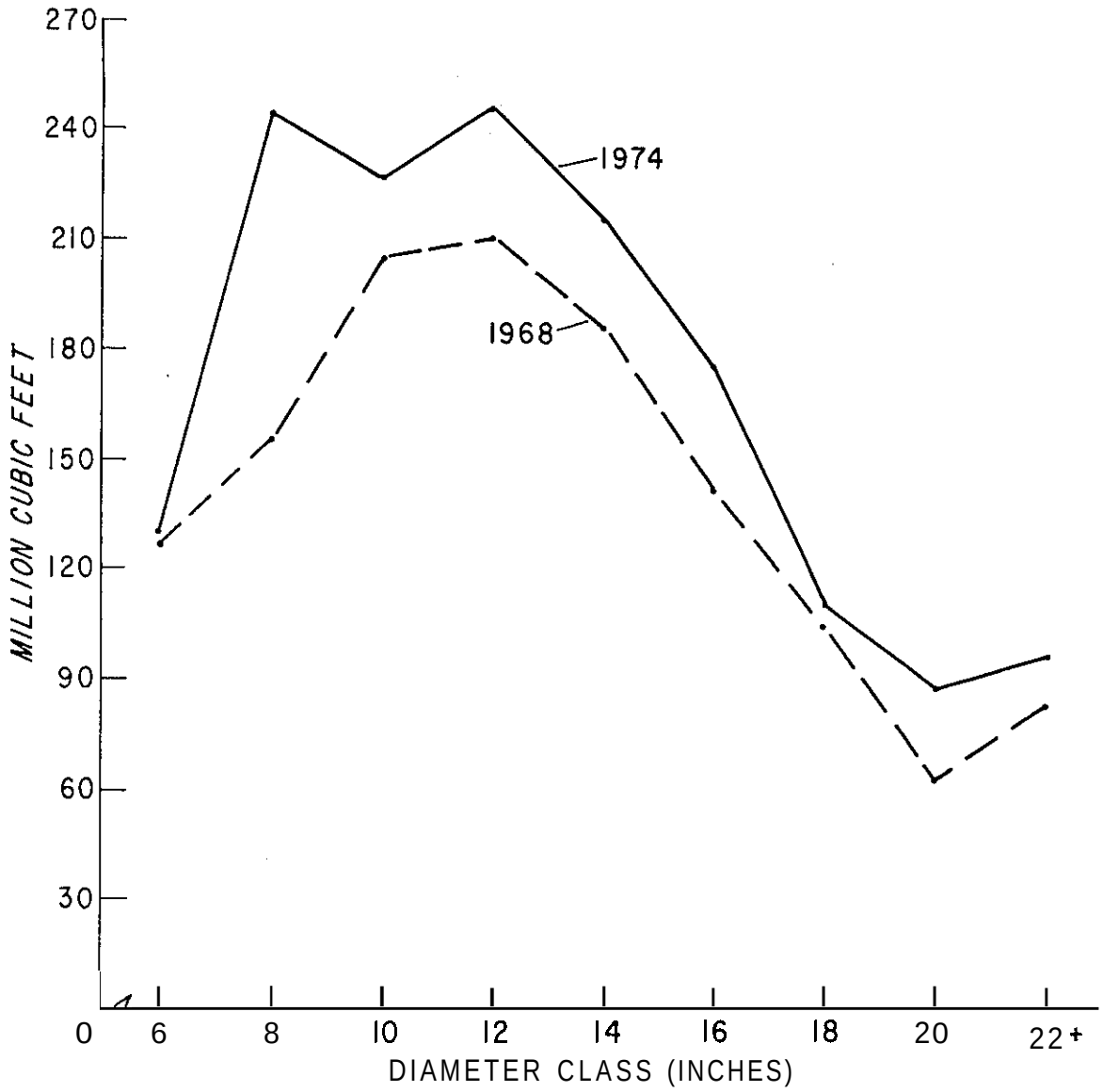

Figure 3. --Changes in volume by diameter class, South Carolina Lowcountry, 1968-1974.

Over 46 percent of the stands revisited had not been treated or disturbed in the 6-year interval (table 3). However, only 33 percent of the stands in pine forest types in 1968 remained undisturbed or untreated. Thus, the expected high rate of activity in the pine types was verified.

Table 2.--Changes in volume of pine timber on commercial forest land, by species, South Carolina Lowcountry, 1968 to 1974

Species	Inventory in 1968	Net change between 1968 and 1974	Inventory in 1974
	Thousand cubic feet		
Loblolly pine	720,462	106,683	827,145
Longleaf pine	205,594	760	206.354
Slash pine	111,503	71,892	183,395
Pond pine	181,734	68,455	250,189
Shortleaf pine	35,744	2,161	37,905
Spruce pine	32,173	-3,626	28,547
All species	1,287,210	246,325	1,533,535

Table 3.--Distribution of remeasured sample locations, by recent stand history, South Carolina Lowcountry, 1974

Recent stand history[1]	Number of locations
No significant treatment or disturbance	313
Harvesting or artificial regeneration	111
Thinning or other stand improvement	58
Other miscellaneous treatments[2]	147
Natural disturbance	21
Diverted to other land use	25
Total number of samples	675

[1]Primary treatment or disturbance since 1968.
[2]Includes prescribed burning, drainage, site preparation. and other man-caused disturbances.

Despite the high rate of activity in the area, 56 percent of the stands that remained in forest were in good condition and required no treatment; another 14 percent were mature and ready for harvest (table 4). Almost 16 percent of the stands needed regeneration or stand conversion to make them productive.

The reliability of the volume estimates in this study depend largely on the sampling error of the 1968 survey. The standard error was computed by

Table 4.--Distribution of remeasured sample locations, by treatment opportunity, South Carolina Lowcountry, 1974

Treatment opportunity	Number of locations
Immature stand in good condition	367
Merchantable stand damaged (salvage needed)	1
Mature stand ready for harvest	90
Commercial thinning	63
Precommercial thinning	1
Cleaning, release, or other stand improvement	25
Stand conversion	17
No manageable stand (regeneration needed)	86
Total number of samples	650

random-sampling formula to be 5 percent for the 1968 inventory. Since the 1968 pine sample and ingrowth were completely accounted for, there is no sampling error associated with the estimate of net change.[5]

DISCUSSION

The Lowcountry interim survey provided a reliable up-to-date look at the pine situation, and the results are being used to guide forest management in the area. The study cost approximately $20,000 and took 3 months to complete. Three two-man crews accomplished the fieldwork. The average cost of remeasuring and processing was $30 per sample location, or one-third the cost of a complete remeasurement. Financing for the entire Lowcountry study was arranged by the South Carolina State Commission of Forestry; the Forest Resources Research Work Unit of the Southeastern Forest Experiment Station provided technical assistance and historical records needed for the study.

In addition to the direct benefits of the Lowcountry survey, it also demonstrated that standard remeasurement procedures could be modified to provide a reliable up-to-date look at a particular timber situation at a relatively low cost. At present, there are approximately 40,000 permanent sample locations distributed across all land uses in the Southeast. Although they were intended for use in statewide surveys, they can be used in smaller areas of 1 million acres or more and still yield reliable results. Should it be necessary to conduct interim surveys in the future, the permanent sample locations, the sampling procedures, and the analytical techniques are available.

[5]Spurr, Stephen H. 1952. Forest inventory. 476 p. The Ronald Press Co., New York.

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