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Robert D. Baker
Stephen F. Austin State University

David V. Smith
Stephen F. Austin State University

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Recommended Citation

Baker, Robert D. and Smith, David V., "Texas Forestry Paper No. 26" (1974). *Texas Forestry Papers, No. 1-29, 1970-1976*. Book 15.
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TEXAS FORESTRY PAPER

No. 26

APRIL 1974

SCHOOL OF FORESTRY

STEPHEN F. AUSTIN STATE UNIVERSITY

Nacogdoches, Texas

Aerial Photograph Use In Industrial Forest Management In the South, 1970 and 1974¹

by
Robert D. Baker
and
David V. Smith²

Aerial photographs have been around for a long time in the South. The Forest Service used them in the thirties in its land acquisition work. The forests of the Tennessee Valley were mapped from aerial photographs in the late thirties. After World War II a specific group of forestry specialists began to emerge; mostly men trained in military use of aerial photographs, ready to apply their skills in forestry. Recognizing the potential of aerial photography, the forestry schools developed courses in its use. Some organizations were oversold on its capabilities; not finding photographs an efficient alternative to field work, they relegated aerial photographs to occasional use. In the seventies, with rising values and timber management costs, the aerial photograph is being re-evaluated and other space age remote sensing is being investigated.

In 1969-1970 over 150 major forest industry companies and divisions of companies in the South were asked for specific information concerning aerial photograph use in their forest management and related programs. Seventy-five respondents used aerial photographs in forest management programs on nearly 33 million acres of timberland, about 82 percent of the industrial holdings in the South.³

We again questioned southern forest industry companies in order to compare photo use four years later. The 1974 sample is 27 million acres, represented by 61 companies or major divisions, of which 58 reported some use of photographs.

¹ Paper presented at a meeting of the Remote Sensing and Photogrammetry Working Group, at the 2nd Regional Technical Conference, Houston, Texas, March 12, 1974.

² Baker and Smith are Professors, School of Forestry, Stephen F. Austin State University.

³ Baker, Robert D. Aerial Photography Use and Timber Management Programs in the South. Technical papers from the 36th annual meeting of the American Society of Photogrammetry, Washington, D.C. March 1-6, 1970. Pp. 512-520.

AERIAL PHOTOGRAPH USE IN TIMBER MANAGEMENT ACTIVITIES

The recent data show a trend toward more sophisticated use of aerial photographs in timber volume determination. The proportion using photographs to locate ground samples or for photo sampling increased from 21 to 34 percent, while the proportion using photos only to record sample locations declined from 51 to 35 percent (Table 1). A surprisingly large percent of respondents, 26 percent in 1970 and 32 percent in 1974, were not using aerial photographs in timber volume work. As a minimum, aerial photos should be used to help allocate expensive field samples for timber volume estimation in the most efficient manner.

Table 1. Use of aerial photographs in timber volume determination.

| Photo/Ground Measurement | By Number | | By Acreage | |
|--|---------------------|------|------------|------|
| | 1970 | 1974 | 1970 | 1974 |
| | ----- Percent ----- | | | |
| Photos not used | 26 | 32 | 11 | 26 |
| Ground sampling only, with sample locations placed on photos | 51 | 35 | 53 | 35 |
| Photos used to locate ground sample | 21* | 29 | 36* | 28 |
| Photo sampling corrected by some ground samples | * | 5 | * | 11 |
| Photo sampling only | 2 | 0 | negl. | 0 |

* The 1970 survey category was "Ground-Photo Sampling," which was divided into categories in 1974.

There has been a substantial increase during the four-year period in the proportion of respondents using aerial photographs in harvesting, managerial and inventory tasks (Table 2). Respondents in 1970, representing 53 percent of the sample area had plans for obtaining regular photography. In 1974, 64 percent of the reported area was covered by such plans.

Table 2. Uses of aerial photographs in harvesting, managerial, and inventory tasks.

| Activity Involving Photo Use | By Number | | By Acreage | |
|-----------------------------------|---------------------|------|------------|------|
| | 1970 | 1974 | 1970 | 1974 |
| | ----- percent ----- | | | |
| Timber procurement | 72 | 93 | 93 | 97 |
| Planning cutting operations | 74 | 95 | 90 | 95 |
| Formulating logging plans | 74 | 91 | 85 | 90 |
| Timber stand mapping | 62 | 86 | 99 | 92 |
| Road location | 83 | 95 | 91 | 94 |
| Land acquisition | 84 | 95 | 92 | 99 |
| Property lines located on photos | 85 | 95 | 93 | 95 |
| Planning reforestation activities | 80 | 86 | 91 | 94 |

| | | | | |
|---|----|----|----|----|
| Fire, insect and disease control | 59 | 79 | 77 | 83 |
| CFI or growth study plots located on photos | 38 | 46 | 69 | 58 |
| Timber sales work | -- | 88 | -- | 92 |
| Photos used in property tax work | -- | 50 | -- | 54 |
| Photos used in planimetric mapping | -- | 57 | -- | 63 |

Companies in the South today are also using aerial photographs for a number of special purposes. Some of these include layout of fields in agricultural operations, determination of flooded areas, determination of acreages on areas to receive timber stand improvement and tree planting, forest fertilization needs studies, monitoring mineral operations on company lands, recreation development, drainage layout or delineation, wood pile inventories, lawsuits, evaluating fire losses, and to confirm estimates in bidding on tracts of timber.

SOURCES, SCALES AND TYPES OF AERIAL PHOTOGRAPHS USED

A few forest industry companies have aerial photographs on file dating from the thirties, but only one company in 1970 and four in 1974 reported that their latest coverage was more than ten years old. Fifty percent of the respondents in 1970 had coverage taken during the two years prior to the survey and 65 percent in 1974 had coverage not over four years old.

There is a slight trend toward greater use of aerial photographs obtained under contract (47 percent in 1974 vs. 40 percent in 1970) and less dependence on aerial photographs obtained from sources where the primary purpose was non-timber (86 percent in 1970, down to 77 percent in 1974) or where the coverage was flown for another forest ownership (26 percent of area in 1970, down to 13 percent in 1974), (Table 3).

Table 3. Sources of aerial photographs used by firms in the southern forest industry.

| Photograph Source | By Number* | | By Acreage* | |
|--|---------------------|------|-------------|------|
| | 1970 | 1974 | 1970 | 1974 |
| | ----- percent ----- | | | |
| Department of Agriculture or other government source | 84 | 86 | 86 | 77 |
| Purchased from another company, but flown for another purpose or another client. | 12 | 12 | 26 | 13 |
| Contracted for by the company | 40 | 47 | 75 | 75 |
| Company photography | 4 | 9 | 7 | 14 |

*Companies may have several coverages. Column total may exceed 100 percent.

Most companies which contract for photography prefer a scale of 1/15,840 (4 inches per mile). This is the most common scale for forest ownership and timber stand maps and contract flying costs for obtaining it are within the company budgets. Some companies contract for photography at 1/12,000 scale and a small amount of contract photography is at a larger scale. Some trend toward smaller scale photos is evident, such as 1/39,600 and 1/60,000.⁴

Color photography is not widely used by the forest industry in the South. Panchromatic photography is still the standby, used by 91 percent of respondents. About one fourth of respondents had used some black and white infrared photography, but use did not increase between surveys (Table 4).

Table 4. Types of photographs used by firms in the southern forest industry.

| Type of photography | By Number* | | By Acreage* | |
|-----------------------------|---------------------|------|-------------|------|
| | 1970 | 1974 | 1970 | 1974 |
| | ----- percent ----- | | | |
| Black & white, panchromatic | 91 | 91 | 93 | 91 |
| Black & white, infrared | 27 | 24 | 33 | 42 |
| Color, conventional | 5 | 17 | 6 | 39 |
| Color, infrared | 3 | 9 | 12 | 21 |

* Column totals exceed 100 because some companies use more than one type of photography.

PHOTOGRAPH QUALITY

Respondents in both surveys reported that the quality of government photographs varied from poor to excellent. The most consistent criticism was that these coverages are often taken when hardwood foliage is present, making them of limited use for timber management. When panchromatic photographs are obtained during the growing season, pine-hardwood contrast is only fair, rendering stand mapping a difficult task. Late winter panchromatic photography in the South shows very good pine-hardwood contrast and good ground detail. A Louisiana company, taking its own photographs, uses black and white infrared film during the April-June period, when the pine-hardwood contrast is maximum.

One Tennessee company reports coverage in its files for approximately 3.5 million acres of land. For companies such as this, with intensive timber management programs, purchasing photographs already available supplements contract photography and allows some coverage of scattered tracts. Of course, photos at county ASCS offices are available for consultation. We recommend that southern timber and forest products companies obtain and file index sheets of all government or other suitable coverage of their lands to reduce delay when contact prints are needed.

EQUIPMENT USED

The surveys revealed a surprisingly small number of companies using anything more than stereoscopes when they work with aerial photographs. In both surveys less than a third of the companies used radial-line plotters, reflecting pro-

⁴ At least three companies in Texas have either obtained or have contracts for photography at a scale of 1/39,600, which results in a saving in contract flying costs but still provides high resolution contact prints and enlargements at a scale of 1/15,840. One company has used 1/60,000 scale contract-flown photos for control mapping by a photogrammetric mapping firm.

jectors, sketchmasters, pantographs or light tables for transferring delineated timber stands or planimetric detail to maps. Very few, apparently, use any of the instruments or overlays for determining stand height from aerial photographs. Acreage determination instruments or overlays were mentioned by less than a fourth of the respondents in 1970 and less than a third of them in 1974. The companies taking their own photographs, however, are well equipped for printing, for precise measurement and interpretation of the photographs.

The minimum equipment kit for extensive work with aerial photographs of forested areas should include a mirror or pocket stereoscope, a magnifying lens, a set of scales and overlays, including dot grids, parallax wedges, crown density guides, photo-scale protractors and micrometer wedges. These should be available in every district office of the organization.

For intensive aerial photograph work, forestry organizations should have all the equipment mentioned above, plus a scanning or zoom stereoscope, a light table, sketchmaster or reflecting projector, a height-finder or parallax bar, and a planimeter or simple electric area-calculator. These more specialized instruments should be available at every regional forester's office, or chief forester's office for small companies.

EXPANDING APPLICATIONS OF AERIAL PHOTOGRAPHS IN TIMBER MANAGEMENT PROGRAMS

Professional foresters and technicians alike can employ aerial photographs in timber management to good advantage. In response to questions concerning levels of timber management personnel using aerial photographs, most companies in both surveys indicated that all levels use them, from technician to chief forester.

Companies responding to both surveys were asked to report any plans for greater aerial photo use in their timber management programs. Most had no definite plans. Plans which were cited can be summarized as follows:

The 1970 survey. Plans mentioned included using ortho-photographs and mosaics, planning reinventories and stand mapping projects, and photo use in determining plantation acreage. Anticipated use of color-infrared and regular color was mentioned by four companies. Several respondents in the 1970 survey reported being ready to take advantage of new developments in photographic methods and uses.

1974 survey. The 1974 survey did not reveal as many expanded plans for investigating color photography, orthophotography or mosaics as in 1970, but did indicate increased interest in photos for inventory and photo-mensurational procedures. These plans included future flights tied into inventory cycles, stand mapping, stand description and photo-mensurational possibilities. Regeneration surveys, especially the area determination aspects, and plantation examinations for survival/stocking studies were being considered.

AERIAL PHOTOGRAPHS AND REMOTE SENSING IN FUTURE TIMBER MANAGEMENT PROGRAMS

There has been a slow transition from complete dependence on field measurements to a combination of field and photo measurements. The search continues for optimum combinations of data from photographs and other remotely-sensed imagery and from field measurements. The future should lead to an even greater use of information gathered by remote sensors.

Developing trends in technology have placed us on the threshold of: (1) automating timber stand stratification, where different timber species are indicated by their unique tone signatures, either from photographs or from photo-mechanical scanners, (2) determining stand height from the laser-profiler, correlating this with stand density to determine total wood volume and growth rates, (3) digitizing data for instant analysis, (4) data banks for storing information for use when needed in different combinations and permutations, and (5) printing computer-maps for field personnel to use.

Before this future day of automatic data acquisition and analysis comes, however, organizations managing forest land in the South need to more fully utilize photography at its present stage of development. Some organizations are efficiently employing photos today; others are planning for more efficient methods tomorrow; still others have a long way to go. Some have plunged into the use of color photography; others use their black and white prints only occasionally. Some encourage field men to take photos with them whenever they go into the forest; others do not want the photos removed from the office. Forestry organizations in the South can perform many management tasks more efficiently by employing aerial photographs more completely. The incentive is maximum efficiency, maximum cost-effectiveness, and maximum speed. Many firms have recently decided to employ aerial photographs and remotely-sensed images more fully; others will follow their example.