FALCON

A Research and Development Program for Advanced Logging Systems



U.S. DEPARTMENT OF AGRICULTURE . FOREST SERVICE

FOREWORD

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To provide more wood products for a growing population and, at the same time, accommodate an increasing concern over the natural environment are the major challenges facing forest land managers. Indeed, it may well be the challenge of the "Seventies."

A portion of this national concern is rooted in timber harvesting methods and associated roadbuilding activities. The concern is genuine and heartfelt. And it is not going to go away. Since roadbuilding, tree cutting, and the tending of forests for intensive production clearly have a place in future forestry, new or improved harvesting systems are needed where significant environmental impacts would otherwise result from conventional logging techniques.

In response to this challenge, the Forest Service has developed a plan for a nationwide Research and Development program using balloons, helicopters, cable systems, and other log transport systems. This program is called FALCON. It was developed in consultation with environmental groups, logging and forest products industries, universities, and other private and public agencies. FALCON activities already have a small start from funds and manpower redirected by the Forest Service and its cooperators. FALCON will reach its planned level of operation as funds become available from Congress.

We are pleased to present for your information the Forest Service's FALCON program. Later, to keep you informed of significant developments and accomplishments occurring under FALCON, the program headquarters office in Portland, Oregon (P.O. Box 3141, zip 97208) will issue a newsletter called FALCON FACTS.

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ABOUT THE COVER—Chosen as the FALCON symbol is this artist's rendition depicting aerial logging.

THE FALCON PROGRAM

The biggest single problem in American forestry today is how to supply expanding demands for timber products and, at the same time, maintain a high-quality forest environment. Mounting concern for environmental quality, the rising timber cut, and an increasing dependency upon difficultto-manage areas for timber production all underlie the sense of urgency behind FALCON.

FALCON's major purpose will be to improve the ability of resource managers to predict the economic and environmental consequences associated with the use of conventional and new logging methods such as balloons, helicopters, and cable systems, singly or in combination, with the aim of providing less damaging timber harvesting methods for environmentally sensitive areas.

FALCON is expected to cost about \$10 million a year for 5 years. About one-third of this budget will be for research and development concerned with environmental questions; two-thirds will be for research and development of aerial logging equipment and methods. Approximately half of the budget will be used by the administrative and research groups of the Forest Service; the other half will support contracts and grants to universities, non-profit organizations, and industry.

FALCON will represent a mobilization and acceleration of the relatively small but growing research and development effort now under way in the Forest Service, industry, and universities. A number of aerial methods that substantially reduce environmental impacts of logging are already being tested. Considerable progress will come through integration of ideas from the aerospace industry, from manufacturers and users of logging equipment, from forest-land managers, and from educators and researchers in the environmental sciences.

FALCON will be a nation-wide effort. It will begin in the Pacific Coast states. From there the effort will extend to the interior-West, the South, and the East. Some regional differences are mainly matters of magnitude and detail; others are due to vastly differing ecosystems. The steep slopes of the Appalachians, the wetlands of the South. and the fragile soils of the interior-West-each calls for an array of harvesting alternatives having the same capability for meeting environmental needs as those to be developed for the Pacific Coast states. In addition, the results of FALCON might prove useful for those parts of the world where surface land transportation systems are presently nonexistent or limited. Much of Africa, Asia, and Latin America presently contains a large proportion of the world's untapped hardwood resource.

FALCON promises better methods to salvage windthrown and fire-killed timber. Such losses often occur in patches and pockets that are impossible to harvest with traditional methods. FAL-CON methods, especially helicopters, also may prove invaluable to prevent insect and disease outbreaks by removing infested and diseased trees at the endemic rather than epidemic stages. The restrictions being imposed upon the use of pesticides make this alternative attractive.

There are currently an estimated 50 million acres of commercial forest land in the United States requiring special logging methods. One of FAL-CON's jobs will be to improve this estimate. Not counted in these 50 million acres are lands in wilderness or other special areas whose reservation, jurisdiction, and use are separate and apart from the FALCON program.

¹ Forestry, Advanced Logging, and CONservation.

ENVIRONMENTAL RESEARCH

Seven subject-matter areas have been recognized for research on the environmental impacts of logging. The first of these is development of procedures for conducting resource inventories and characterizing forest ecosystems with respect to the other six subject-matter areas. FALCON will exploit a large reservoir of information that is already available through past research; it will also be involved with the creation of new information from designed experiments and samplings.

Survey Techniques

FALCON needs, first of all, a survey of forest lands to locate the problem and to establish their nature and extent. Before this survey can be started, some difficult questions must be answered through research. What are the attributes of a particular forest area that require special logging methods? What are the attributes of an area that would identify it as noncommercial forest land in the sense that logging would inflict unacceptable damage to the site? What methods of survey and inventory are available or needed to determine the acreage and volumes of timber that require attention by FALCON?

Logging Residue

Residues are a boon as well as a bane. They contribute to the forest's nutrient reservoir, offer shade for delicate seedlings, furnish cover for wildlife, and reduce erosion. However, in excessive quantities they inhibit both natural and artificial regeneration, cause a tremendous economic loss through nonutilization of usable wood fiber, constitute a fire hazard, and are often unsightly. Some research in this area is already in progress but it needs expansion for the special problems associated with aerial logging.

Answers are needed to such questions as: How best can residues be measured to inventory wood fiber and assess fire hazard? At what level do residues cease to be beneficial? Is there an economic alternative to controlled slash burning? Because they may accommodate partial harvests, advanced logging methods reduce concentrations and amounts of logging slash. This can change both the effects of residues and the means by which they should be treated. In some situations aerial logging may enable full-tree logging, which can further reduce amounts of residues.

Regeneration

The new logging methods, while reducing some environmental impacts, could result in difficult regeneration problems. Avoidance of soil disturbances may affect adversely the regeneration of less shade tolerant species such as Douglas-fir and, hence, may require modified regeneration or planting practices. Where partial cutting is practiced, there are regeneration problems which need research. The economic consequences of a change in species composition must be examined. Knowledge of survival and growth of key species under varying conditions of moisture and light will have to be supplemented.

Soils

Soil studies will be directed at predicting and controlling soil nutrient changes and soil movement associated with logging. The effects of various harvesting methods on soil stability must be better understood. Likewise, nutrient balance and cycling relationships must be investigated. These studies may result in a better classification of operable and inoperable forest lands. The net effect of these possible reclassifications on total timber supply will be of utmost importance.

Water

The effects of logging on the flow of streams and on the temperature, chemical content, mineral content, and micro-organisms in water are already being explored. Under FALCON this research will be accelerated, expanded, and associated more directly with new logging systems. Studies have shown that stream turbidity during storm periods has been greater in logged areas than in comparable undisturbed areas. Logging road construction often contributes more to turbidity and sedimentation than the logging itself. Aerial logging systems minimize disturbance of soils and natural water courses. They also substantially reduce road requirements, particularly the temporary roads required by conventional logging methods, because of longer yarding distances.

Fish and Wildlife

A base of information on fish and wildlife habitats must be developed. The effects of shape, size, and dispersal of cutting units on wildlife population will be studied. The effects of logging on forage and browse production and animal migration patterns will also be studied. The effects of changes in such stream characteristics as organic content, temperature, and sediment concentration on fish habitat must be better understood, especially for anadromous species.

Aesthetics

Many people object to large clearcut logging areas. This is evident from recent Forest Service studies on the Bitterroot, Monongahela, and Wyoming National Forests. Although clearcutting is the only satisfactory silvicultural method in many situations, and thus cannot be discontinued, partial cuts are an acceptable alternative in many others. Aerial logging systems have a potential to make partial cutting or smaller clearcuts practical. Many people also find a dense road network aesthetically objectionable. Advance logging systems can substantially reduce road mileages and increase flexibility in road location.

ENGINEERING RESEARCH

This phase of FALCON'S effort will be concerned with research on machines, mechanical operations, and the total logistics of logging. Special emphasis will be given to helicopters, balloons, and aerial cable systems.

Helicopter Logging

The first year's work will be directed toward studies on the use of various sizes and kinds of helicopters doing both partial-cut and clearcut logging. Optimum yarding distances will be determined for various size machines using uphill, downhill, and cross-slope log removals. Methods must be improved for estimating weights of logs before trees are bucked and logs yarded. Research on automatic hookup mechanisms, landing size and spacing, weight-sensing devices, on-site servicing innovations, visibility improvements, night operations, and homing devices will be directed toward reducing costs and improving safety. Studies will be conducted to determine the effect on helicopter operating costs of many variables including crew size, log weight, log length, elevation above sea level, and yarding distances.

Balloon Logging

Field experiments on balloon logging operations, wind-tunnel tests, and computer simulation studies will be part of a search for a more efficient balloon system for use in both clearcutting and partial cutting. Among other things, this search is expected to result in improved balloon shapes, stronger fabrics, increased protection for personnel and equipment, and better operating procedures. A quick method for estimating log weights will be as important for balloon logging as for helicopter logging.

Skyline Logging

Research now underway on skyline logging will be expanded and directed toward two systems: one for the large timber characteristic of the far West and the other for thinnings and for smaller timber found in the inland-West, Appalachians, and wetlands of the South. There will be cost studies to establish optimum combinations of systems.

Also needed in skyline logging is an improved interlock mechanism on yarders (a device to maintain equal tension on both the payout and haulback lines). Better methods to prevent lateral movement of cable systems in partial harvesting must be developed to avoid damage to residual stands. Longer wearing surfaces on blocks to lengthen cable life and improved methods for determining holding capacity of tail block anchors in a variety of logging situations are also needed.

Other Systems

Studies will be conducted on conventional logging systems, on systems which are entirely new, and on combinations of systems. A hybrid running skyline-balloon system, for example, offers some intriguing possibilities for lifting logs out of swamps in the South. Feasibility studies are also planned for air cushion (or surface effect) vehicles. Such vehicles have low ground pressure characteristics and may have application in wetlands and swamps where conventional equipment is inoperable or environmentally unacceptable.

APPLICATION

One of the aims of FALCON is to apply the technology being developed. Almost from its inception, there will be pilot-scale operations to test, evaluate, and demonstrate advanced and conventional harvesting systems, in terms of both environmental impacts and engineering feasibility. The application aspects of FALCON will have the following components:

Survey of Sensitive Areas

Once survey methodology is worked out (see "Survey Techniques"), improved estimates can be made of the number of acres and volume of timber that require improved harvesting methods. These better estimates are essential to improve allowable cut determination and to guide manufacturers and users of logging equipment in capital investments. Surveys will be started and tested in the Pacific Northwest and then be modified and revised to fit conditions of sensitive areas elsewhere in the United States.

Demonstration and Monitoring

Under FALCON, one or more critical areas in the Pacific Northwest and in other regions will be selected in which helicopters, balloons, skylines, and other systems will undergo comparisons and evaluations. Preliminary to such tests will be baseline measurements of environmental parameters, including soil and water characteristics and plant and animal communities. These environmental factors will be monitored and described for each logging system and companion road system. These areas will serve as a focal point for a synthesis of the component parts of FALCON. In addition, they will serve an important role in training operators of new equipment and facilitating export of technology to other parts of the country.

Alternative Sales and Contractural Arrangements

Changes in present sales and contracting methods may be necessary in order to use fully the advanced logging systems under different situations and to alleviate economic and environmental conflicts. New methods will be developed and tested as part of FALCON.

Safety

Aerial logging, especially with helicopters, raises new problems of safety for men and machines. None of these problems seems insurmountable, but safeguards must be developed to protect men and property as timber is picked up, transported, and set down. The equipment and the procedures must be compatible with requirements of FAA and various other Federal and State groups concerned with safety. The acceptance of aerial logging methods is absolutely dependent on development of adequate safety procedures.

Analysis and Evaluation

A strong analysis and evaluation effort, in cooperation with transportation planning work done elsewhere in the Forest Service, is essential to FALCON. This effort will provide answers to such difficult questions as: How will aerial logging methods tie into existing and planned road networks? What types of roads may be required to accommodate proven logging systems? What kind of continuing road network will be required to service and protect forest land for multiple use management in the long run—after initial timber harvesting is complete?

New techniques of systems analysis, computer simulation, and economic studies will be required to match equipment and transport capabilities with the environmental requirements of particular tracts. Such analyses must provide guidance to optimize combinations of methods, including those traditional ones with acceptable impacts, to achieve both environmental protection and economic efficiency. The evaluation activities must consider the impact of aerial logging methods on revenues from public lands available to State and local governments. These analyses must consider such difficult alternatives as reduced timber harvesting on environmentally sensitive areas with conventional methods versus harvesting with new, more costly methods. Also to be considered are economic trade offs, such as higher logging costs versus reduced road costs.

Extension and Training

FALCON will require costly and complex equipment. A training and educational program must be developed, in cooperation with educational and industrial groups, to assure that well-trained people are available for land-use planning and administration as well as for work on yarders and other machines required in the various harvesting methods. Even today, lack of trained managers and operators is one of the more formidable obstacles to widespread use of balloons, cable systems, and helicopters.

PUBLIC INVOLVEMENT

FALCON is of concern to all users of public forest lands. The proposed FALCON program has been discussed with the Advisory Committees of both the Pacific Northwest Forest and Range Experiment Station and the Pacific Northwest Region. Moreover, the respective bills introduced in the House and Senate provide for an Advisory Council. There has been and will continue to be involvement from the forest industries, public land managers, educators, and the general public.