USING THE WOOD

Utilization issues in the forest have changed dramatically from the early days of looking at large trees with ample wood but also lots of defect, and figuring out what to do with the waste, to looking at lower quality lumber, smaller sizes, and changed species mixes. Along the way, Station research on utilization potential has helped some species, such as alder, tanoak, and white oak, move beyond their designation as "weeds," and take their rightful place in the resource lexicon. Station work on wood recovery from dead, dying, and other salvageable trees had made a major contribution in early years and presaged the challenge of working with smaller trees in later decades.

Today's mills and harvesting techniques are far more efficient, with research input from the Station and many other engineering units. As plantation-grown wood has begun to dominate the supply, the Station has scurried to produce information about quality, products, and markets for wood from pruning, thinning, and managed stands. This has required rapid adjustment, both in the industry, and in the research community, for as little as 20 years ago, most wood was still coming from legacy stands that produced lumber of much greater dimensions. As an example, the remainders (cores) from peeling veneer used to be larger than some of the logs processed for lumber today.

"The average American uses the equivalent of a 100-foot high tree, 16 inches in diameter, each year for wood and paper needs. About 45 percent of the paper consumed in the United States is recovered for recycling."

—American Forest and Paper Association, 1995

Logging technology improvements

Station scientists have contributed to developing logging technology since the mid-1950s, when cable and crane systems were evaluated as ways to protect soils and watersheds, and cut road-building costs, the latter particularly in Alaska. Engineering developments have been made most often in collaboration with private industry, although universities and the National Forest System have regularly been partners in this arena.

Efforts to modernize harvesting systems, such as using long-reach, lightweight cable systems, reflected growing controversy about the environmental aspects of forestry. In the 1960s, increasing demands for logging on steep slopes brought balloon logging into consideration, together with improved skyline systems. The Station's charge was to discover how to harvest steep slopes with the least damage. Helicopter logging also was tested, along with the associated development of power-operated log grapples to facilitate log pickup and release. The PeeWee Yarder was a relatively inexpensive and highly mobile technology developed in the late 1970s to handle smaller logs and partial cutting with a single cable.

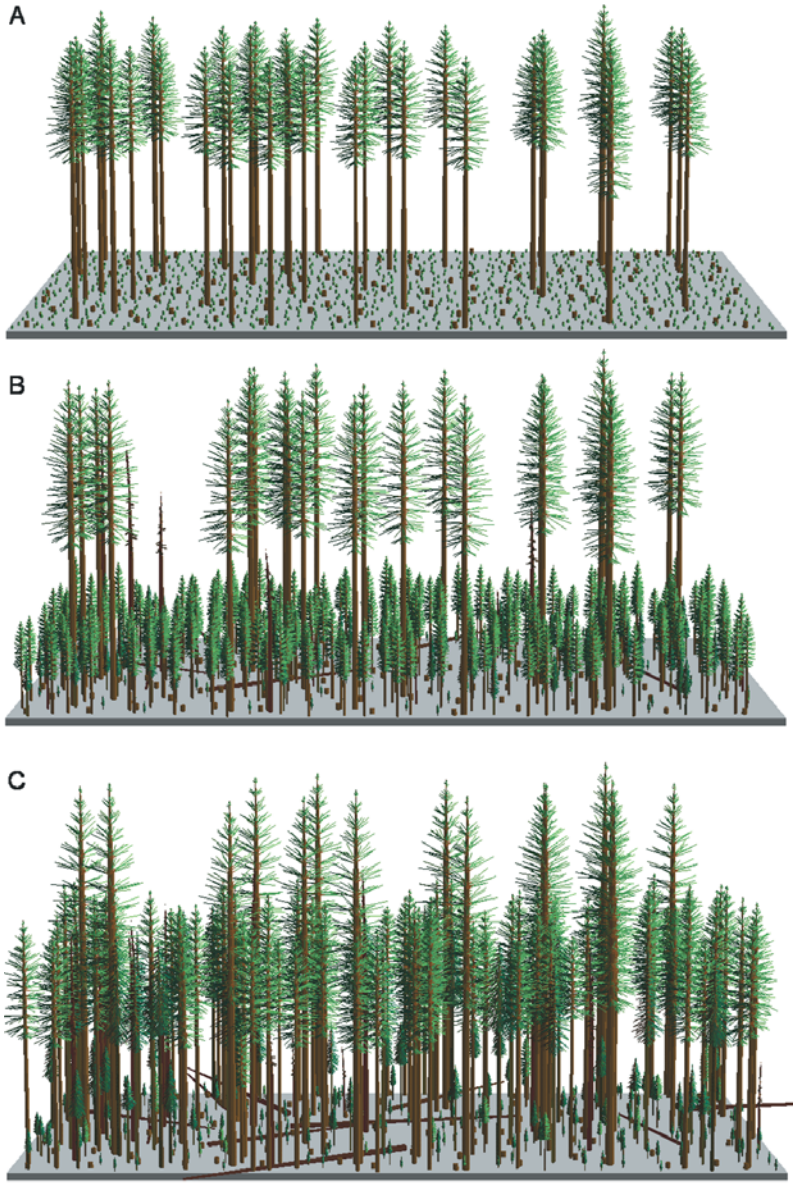
Lumber grading has come a long way from visual estimates of what a tree or stand contains. Mechanical stress testing based on collaborative work between the Station and the Forest Products Laboratory (FPL) in Madison, Wisconsin, now allows stiffness and strength measures of standing trees by sonar technologies. The adoption of these technologies has greatly increased the efficiency of stand evaluation and harvest estimation for forest planners and timber companies of all sizes.

The early 1980s finally saw the completion of practical work, to which Station scientists contributed, on changing the basic wood measurement systems, from the cumbersome board-foot to cubic measure. Cubic measure provides a more consistent measure and a higher level of accuracy, although the board-foot measure continues to be used, with today's far better understanding of its limitations.

Planning for harvest

But perhaps the greater contribution to harvesting methods was in the planning software. In the late 1960s, harvest planning systems were designed to better match logging systems to the terrain and timber type. Improved computing power brought stand visualization systems (SVS) into play, which enabled managers to plan logging across whole watersheds, graphically taking growth and yield into account. These systems have become the "gold standard" of stand visualization worldwide. Updated versions of these software packages continue to be used by the National Forest System, in New Zealand, by the Washington Department of Natural Resources, and by a wide range of private timber companies and consultants.

Other harvest planning systems of world renown developed with Station cooperation include the landscape management system (LMS) and the National Forest vegetation simulator (FVS), which is the national model for tracking vegetation growth.



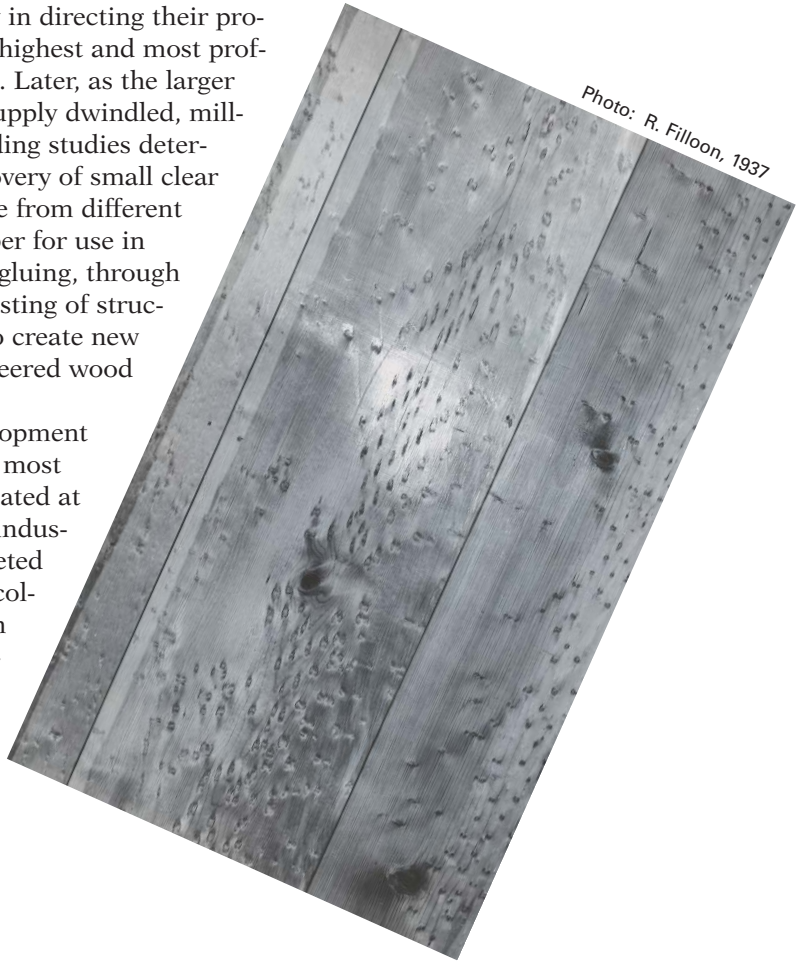
The stand visual system or SVS is used to plan harvests, considering aesthetics and growth of forests across watersheds. Projected appearance of two-aged regime after initial harvest (A) 1 year, (B) 30 years, and (C) 75 years.

Timber to product

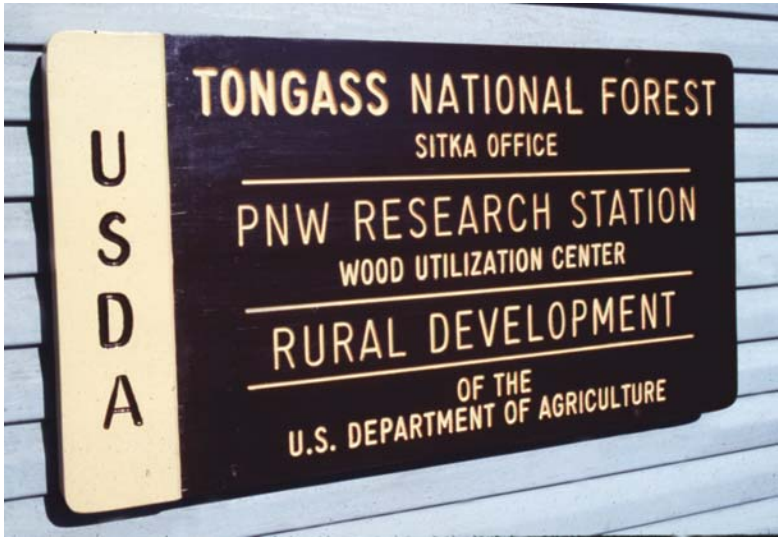
The Station continued to maintain a close liaison with the FPL. The FPL and the Station have a long history of cooperation, dating from the 1920s and 1930s. This early collaboration dealt largely with determining the physical properties of the myriad species available in Station territory, such as strength properties, shrinkage factors, machinability, and finishing characteristics.

This type of information was of great use to industry in directing their production to the highest and most profitable end uses. Later, as the larger diameter log supply dwindled, millwork and molding studies determined the recovery of small clear pieces available from different grades of lumber for use in end- and edge-gluing, through the machine-testing of structural lumber to create new forms of engineered wood products.

Such development work has been most frequently initiated at the request of industry, and completed through close collaboration with private companies, their managers and Station technologists.



With the Forest Products Laboratory, the strength properties and other wood characteristics of trees in the Northwest were determined in the 1920s and 1930s. Birds eye pine.



In 1999, the Wood Utilization Center was established in Sitka, Alaska, to identify and evaluate opportunities for forest products in Alaska.

Even before their Northern Research Station was merged with the PNW Research Station in 1963, Alaskans called on the Station's forest products specialists to assess manufacturing issues such as treatability, drying schedules, and machining properties of their species. A series of feasibility studies followed on use of more Alaska wood within Alaska, then of manufactures that might be economical in the face of high labor costs and monopoly power within the Alaska timber industry. In addition to its long history of assessing timber markets in Alaska, the Station does short-term demand forecasts as part of the requirements of meeting the Tongass Timber Relief Act.

With the Alaska Statehood Act and the Alaska National Interest Lands Act, state agencies and native corporations were allowed to select lands from Federal holdings. Forest Inventory and Analysis data were used extensively in this process, identifying the location of high-quality accessible lands that could be harvested and added to the overall economic base of the industry.

VALUING THE TIMBER

In the earliest days of the Station's existence, the task at hand was to comprehend the forest—to understand and measure and report on this vast Western resource that was still such an unknown, yet was threatened by the rapacious saws that had leveled its Eastern counterparts. Finding out how it grew and what its immense capacity was occupied much of the work in the decades before the war. Overwhelmingly, even before serious cutting began on Federal forests, the component of interest was timber.

So the challenge was to count it, measure it, calculate how it grew, where it grew, and why it grew, and then run the numbers. At first, the numbers were almost exclusively about timber. Economic research was first about potential production, then about actual production. People had not yet found any other way of thinking about the forest.

It wasn't until the 1940s that a field called forest economics was even identified, and its first practitioners were not initially trusted by industry. Nonetheless, they began to be called on to address problems for which there was barely yet a cohesive set of principles.

The Station gathered the first significant grouping of economists within Forest Service research largely because Northwest timber provided half the

In the 1950s, economists developed grade-yield information as a basis for new log grades in the West, a practice later adopted in the East and South.

Oh, What a War

The Pacific Northwest's production of lumber, plywood, and woodpulp grew along with the armament program as war loomed closer, so Station researchers began studies of lesser grades and species of trees than had formerly been used. The supply of Sitka spruce was surveyed for use in aircraft production in 1919. Threatening machinery shortages amidst huge lumber demands and developing labor problems ramped up the importance of reports on the industry's economic condition.

Odd needs and quirky demands produced some new lines of research during World War II. The Station was asked to do a study of the rubber tire supply needed by logging and milling industries in the region. A special survey assessed the amount of sawmill waste available for conversion to ethyl alcohol. What was the wood supply needed to box agricultural products to be shipped to the front? Could Port Orford cedar be used to make separation walls in submarine batteries? How many barrels would it take to pack the Northwest's fruit crop? Could Douglas-fir bark be used to make cork? Tannin was needed, so hemlock bark supplies were estimated.

However, perhaps the greatest wartime task was ramping up the annual reports on the wood industry to a monthly basis. The war effort demanded ceaseless information on the status of shipments of Douglas-fir pontoon lumber, ship decking, spruce, and lesser grades of plank, on plywood production and log inventories of various timber regions. But already in 1943, postwar planning had begun, and concluded, "The most urgent need is public regulation to stop destructive cutting."

Nation's softwood lumber and drew from an inventory worth several times the value of the rest of the country's forests.

Demand for wood had exceeded supply during much of the 1950s, so marketing wood products was not a matter of promoting goods: it meant finding ways to harvest and manufacture more cheaply and produce higher valued products. Rising timber values only added to swelling interest in tree farming, an enterprise now appearing quite practical, with successful regeneration, extensive plantations, and fire protection in place.

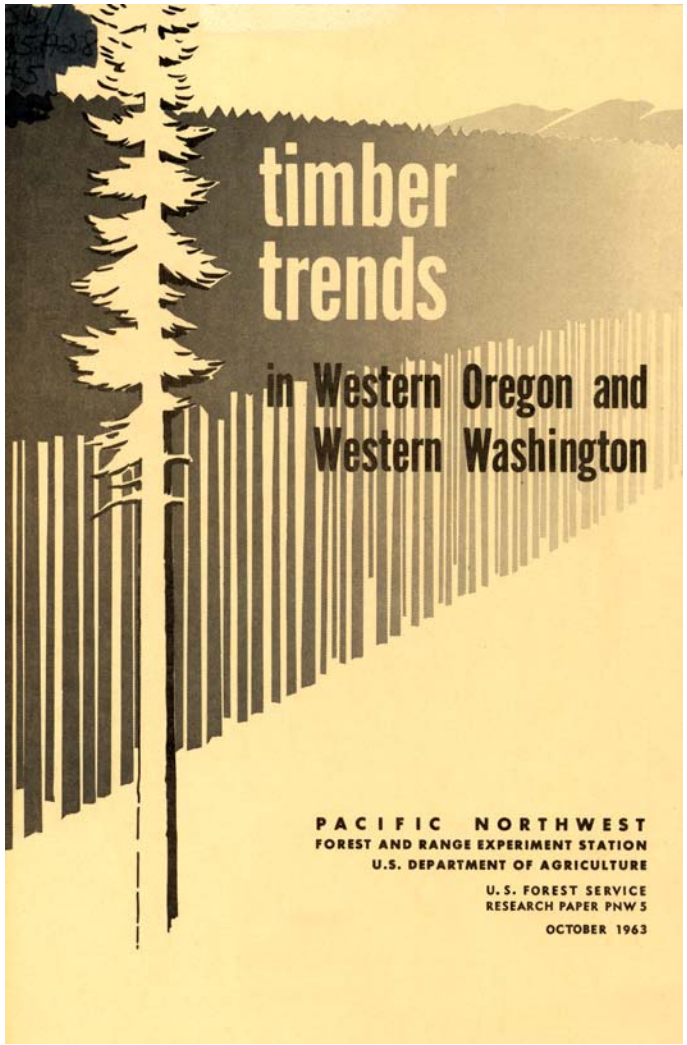
During this period of rising demand, and thus rising values, both buyers and sellers of standing timber needed a sound and better method of evaluating stumpage. At the time, timber appraisals on National Forests were based on the selling price of logs. But there was no true log market. Neither were there any product-yield data from various grades of logs, thereby leaving Federal agencies without a basis for changing to new appraisal standards.

In the mid-1950s, the Forest Service and BLM requested that the Station embark on a research program to develop the needed grade-yield information. Industry was a willing cooperator in this endeavor and provided use of mills to process study logs, as well as costs of logging, manufacturing, and marketing. Subsequently, all the Western regions made the shift to the new appraisal system.

An outgrowth of the product grade-yield studies formed the basis of new log grades for the major species in the West; the idea was later picked up in the East and South.

Reviewing economic opportunity

The decision was made in 1961 to assess economic forestry opportunities on all ownerships in the Douglas-fir region. Two years later, *Timber Trends in Western Oregon and Western Washington* contained individual



In 1961, *Timber Trends in Western Oregon and Western Washington* provided calculations for site, stocking, and age classes, and an appendix of the most comprehensive managed-yield tables ever produced for Western softwoods.

calculations for site, stocking and age classes, and an appendix of the most comprehensive managed-yield tables yet produced for Western softwoods.

As the practice of forestry struggled into maturity in the 1960s, new ways of looking at its economics were produced at the Station, with lasting effect on financial management of forest resources in the Northwest. The time cost of money, rates of return and present net worth, as well as emphasis on high net return rather than least-cost management, were matters that occupied Station economists and their eager clients.

"Financial maturity" was a concept based on the notion that forestry could be profitable if stands were harvested when their rate of value growth declined to the current rate of interest. This idea brought into play the potential profitability of harvesting on high sites in the Douglas-fir region. On the east side, economic guides for managing ponderosa pine stands, and dwarf mistletoe control were similarly popular. *Toward Complete Use of Eastern Oregon's Forest Resources*, published in 1963, advanced the idea that product diversification and refinement by the timber industry would prove essential to future growth and development.

The most-demanded publication from the Station may still be the Quarterly Report, begun in 1963 and called *Production, Prices, Employment, and Trade in Northwest Forest Industries*. It is valued both for its current data and its consistent long series, and each quarter offers hundreds of new data elements.

The early 1960s also brought attention to hardwood management. Station economists showed that by targeting opportunities, conversion to Douglas-fir could be economically attractive in some circumstances but should be foregone in others. This finding brought some financial discipline to the millions of acres of alder conversion in the 1960s and 1970s.

Putting supply information to work

Timber-supply forecasting, an arena in which the Station played the lead from the beginning, became controversial as the pressure on the resource mounted into the 1970s. The Douglas-Fir Supply Study grew out of a directive to the Forest Service to answer questions about increased supply from National Forests in the Western United States. The issues to be studied included accelerated road programs, intensive management, and reduced conversion periods for old growth. Economists were discouraged from considering nontimber outputs, but chose to include the Forest Service's first wide-ranging study of the environmental effects of timber options. They also gauged community and employment effects, and conducted price forecasts, an innovation in resource management. This major study had a demonstrable impact on the 1976 National Forest Management Act (NFMA).

A key finding of the Douglas-Fir Supply Study, which had been mentioned by others earlier but now received full attention, was that a shortfall in timber supply was inevitable for the National Forests. Economists noted that only its timing and magnitude could be adjusted. A subsequent study, *Two Projections of Timber Supply in the Pacific Coast States* (1975), showed that a dip in supply was likely for both public and private lands, without much hope of help from changes in the old-growth harvest schedule.

The resulting furor included attempts to discredit the methods used in the study, accusations of political vulnerability, an industry association's attempt to commission a counter analysis, and a series of alternate studies that ultimately failed to refute the Station's findings. This reaction was not the first or last time the Station would come under attack for producing unpopular research results and need to defend its scientists and their work from public castigation.

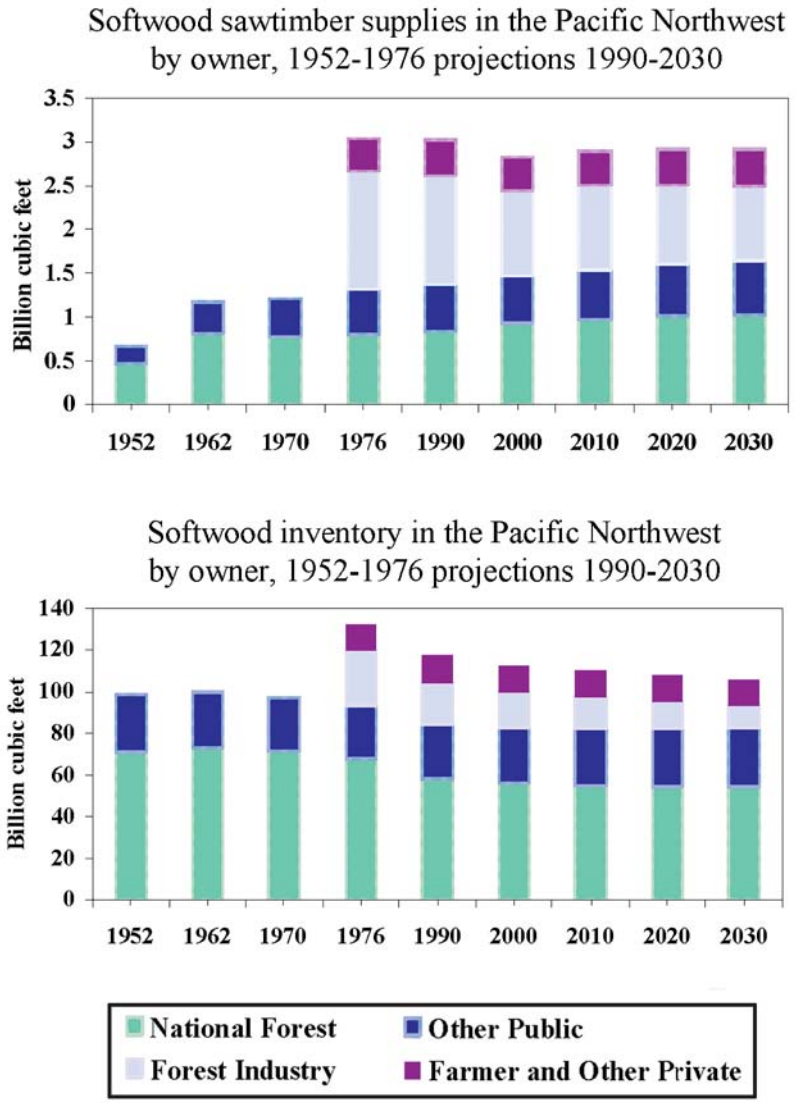
When the projected shortfall indeed occurred in the late 1970s, some years after the fuss had receded, surprise was the reaction, and pressure increased on the National Forests to harvest more timber.

Timber supply studies expand

In contrast, by the time of the next major timber supply analysis in 1982, resignation rather than hostility greeted the projections of steadily diminishing supply of softwood sawtimber through 2030. The methods described in the report also broke new ground, illustrating as they did the interdependence of prices and flows, regions, and stumpage, with products.

"The Forest Economics group has been a long-standing source for RPA assessments, analyzing national and global wood, timber, pulp, and paper supplies. Their numbers are used by partisans on both sides of the environmental debate, demonstrating their absolute value. In testimony, once I cite the source as the PNW Station, there are no further questions: it's an irrefutable data set."

—Jeff Olson, program director, Ford Foundation



A major timber supply analysis in 1982 showed a steadily diminishing supply of softwood sawtimber through 2030 in the Northwest; this type of information continues to be used by policymakers from multiple ownerships across the country.

A 1984 update was even more sophisticated, with more intricate projections: various scenarios were analyzed, including alternative assumptions about housing starts, export restrictions and tariffs, processing efficiency, forest management, and National Forest departures from even flow.

Timber supply analyses continue to be relied on by regional and national planning teams of the National Forest System, as well as by large companies and industry associations, and many national environmental groups looking to understand how forest products markets function.

Of crucial importance in all studies after the early 1970s was the timber assessment market model (TAMM), which projected long-term demand for timber. This model was developed to fill the vacuum between regional analyses and national assessments that treated the country either as the sum of its regions or as an entity of few facets. It has been used in many key policy assessments and has helped develop clearer pictures of future stability and sustainability of supply.

Similarly, the timber inventory projection system known as ATLAS (aggregate timberland assessment system) has been used for broad-scale assessments for all private lands in the United States. It is also used in fulfilling RPA requirements and such state assessment efforts as the western Washington timber supply study.

The *Roadless Area-Intensive Management Tradeoffs on Pacific Northwest Forests* study, completed in 1978, is an example of taking models into increasingly complex sets of decision requirements. The roadless area study, a joint effort with the Station and other collaborators, was a major national effort aimed at integrating the economics of resources such as fisheries, recreation, scenic resources, and wildlife, with those of timber. It allowed managers to weigh the return on investment of roadbuilding in roadless areas against the return on reallocating funds to reforestation, release, and thinning in areas outside roadless zones. It also estimated the employment, financial, environmental, and multiple-use implications if the alternative were adopted.

The numbers generated by Station and other researchers established the same result on each of the seven Western forests studied: reallocating funds from roadless area development and using them for intensified timber management on accessible lands would not make up the harvest lost if the roadless areas were left undeveloped. At the time, it seemed, spreading the harvest base was a better economic decision for the communities involved.

The many economic models that have been developed at the PNW Research Station cannot be adequately described here. Together, some of them paved the way for FORPLAN, the multiple-use planning model now used by most National Forests. Knowing that all models have their limitations, Station economists have continued to work on increasing the sophis-

tication of the tools they use, which are available to clients around the region, the Nation, and the world. This is far from an idle claim: international trade questions, for example, can now be answered to a finer degree, over a longer time, and with more variables than ever before, thanks to continuing model development.

Should we export logs?

The log export story, worked on by Station economists since the early 1960s, provides an excellent example of ongoing work called on continually for answers to ever-changing questions.

The recurring question asked what would happen if log exports were banned from Federal lands, all public lands, or all lands? In the early 1960s, the answer was that Northwest log prices would go down, and Northwest lumber prices would go up. In a highly unionized region, the question of effects on jobs was critical, and Station data were crucial to the debate. Ten years later, the answers included both price changes and regional shifts in shipments, with consequences in Japan, the principal log-trading partner.

The Station provides information about quality products and markets for small-diameter wood from pruning, thinning, and managing stands.

By the early 1980s, Station economists were modeling price effects in eight key countries, along with changes in their imports from not only the United States but also all their other suppliers, and for lumber as well as logs, by grade. Economists by then could predict with some precision how wood products markets react to national income and exchange rates, and how soon.

Economists predict how wood products markets react to the national income and exchange rates of foreign countries.

In this issue as in many others, the Station has become recognized as an impartial provider of accurate data, compiled with numerous collaborators. It is routinely called on by the Ports of Portland and Longview, by consortia of export traders, and by special interest groups with money interests in the outcome of legislative debate. Station economists have been called on as lead witnesses in congressional testimony on the log export issue.

The Station's trade work is not, of course, restricted to log exports. It includes participation in the Forest Sector project at the Institute of Applied Systems Analysis, the European timber trends studies, and work with the European Forestry Institute. Such roles in international policy and research arenas are familiar to Station scientists across multiple disciplines.

Work from economists at the PNW Research Station remains in high demand, including inputs into regional assessments both in the design and analysis stages. Inventory work has been central to the Station's production of economic information from the first assignment of a Forest Survey. Today, more data, more computing power, and more demand for the studies because of ever-scarcer trees and ever-higher prices keep this output from the Station vital to the radar screens of many kinds of clients.

The production of reliable social and economic projections has placed Station economists high on resource lists of regional and national planners, managers, and the media, as well as international clients and colleagues who recognize the value of both predictive models and hard data emanating from the Station's economics program.

In the 1960s, Station scientists started investigating the residual effects of pesticides and helped develop the biological pesticide, *Baccillus thuringiensis*.

Continue