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Future Forest Design

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Management of commercial forest resources in North America has undergone two transitions and is about to undergo a third. First is the transition from old growth to second growth which is akin to moving from a “coal mining ethic” to a “hunt and gather society.” Second is the transition from second growth to managed forests. While some old growth still exists, commercial forestry is essentially at the forest management stage. The next transition will be designed forests.

Transition

When Europeans first colonized the New World, forests were a barrier to settlement. Clearing the land was laborious and often discouraging. Wood was a basic construction material, but frequently trees were not considered a resource.

By Revolutionary times, some American forests had become resources. The Broad Arrow policy, which reserved tall, straight white pine for masts in the Royal Navy and similar policies for southern white oak to make hulls, were among the many factors which precipitated a break with England.

Over the next century, old-growth forests were exploited to develop the agricultural and industrial wealth of America. Forests were a cheap, green coal mine which were believed inexhaustible. Only after the Civil War did some eastern leaders perceive that timber famine was both possible and avoidable. Discussions began about the strategic tradeoffs between today and tomorrow.

Then began the transition from old-growth exploitation to second-growth management. Protection from fire and trespass was management’s primary function. The economy of second-growth management is like a “hunt and gather society;” trees are harvested with little thought of future needs, and equilibrium exists only when, by chance, growth and harvest are equal. About 1950, the effect of the remaining old-growth on stumpage values abated and second-growth values rose rapidly in anticipation of future supply/demand relationships. By 1970, precommercial spacing, fertilization, and reforestation were common practices.

In the South, the Third Forest was recognized as a resource which was fundamentally different than the old-growth and old-field second-growth forests. The forest could be managed from regeneration to harvest! Recognition of this management potential in the South, Pacific Northwest, and East signaled the opportunity to design future forests.

Forest Design

A creative profession is distinguished from less mature endeavors by the design activities of its practitioners. Diagnosis and prescription writing, as well as competent implementation of prescriptions are the core of forestry and other professions. Design, however, enables the profession to both respond to changes and cause changes. Design leads to new alternatives. Some new alternatives yield more desirable results in changed social or ecological environments. Over time, the social and ecological environments also respond to new forestry designs. Design efforts will be more productive if they anticipate possible dynamic interactions over time.

Modern agriculture, especially agronomy, is most unlike “hunt and gather” systems in its basic precept—cooperation. Early cultural systems adapt to what is perceived as nature’s competitive model. Survival of the fittest is used as a crude explanatory model for what nature has selected. Man speeds up the selection and breeding processes, simplifies the ecosystems, and eliminates as many pathogens as possible.

A modern cornfield represents a major step beyond a competitive model. Space in the physical sense of area plus light, water and nutrients is fixed. Breeding and other cultural practices optimize the individual plant’s use of space in terms of corn produced. The plant does not produce more corn, however, by "invading" the space of its neighbor, so the whole cornfield produces maximum possible yields.

Foresters are applying this kind of thinking to the design of future forests. There are interesting and conflicting thrusts in the possible designs.

One obvious theme is uniformity. As is true in agriculture, uniformity leads to more rational harvesting and processing stages. Highly mechanized harvesting systems, automated sawmills, and other future images created by engineers usually require more uniform raw materials. The agronomic model of an Iowa cornfield, while not easily duplicated in forestry, is a possible and appealing design. Straightness and roundness continued on page 29

Bill Bentley has been Manager of the Forestry Research Division, Crown Zellerbach Corporation since 1976. Prior to his appointment he was Bullard Fellow in Forestry at Harvard University. He served on the forestry faculties at Michigan and Wisconsin and was on the Iowa State faculty from 1963 to 1966. Bentley earned his B.S. and Ph.D. at California and MF at Michigan.

1. Much of the original thinking presented along this line was done by Dr. John C. Grodon, who was professor of Forestry at Iowa State from 1970 to 1977. See the two Iowa State Journal of Science collections he edited in 1974 and 1975 on intensive culture of forest crops.
quality. At every period in history, it has been the most valuable and the most accessible timber which has been cut. The cutting of 150 year old and older Douglas fir along the Pacific Coast is not matched by the growing of trees of the same age and species. In the Northeast, the growth of lower grade hardwoods is vastly greater than their harvest. And many other specific situations could be cited.

The big, overall, general conclusion is: the United States is not running out of timber, or of forest land. Quite the contrary, we are building up our forests while at the same time the harvest of timber has been increasing.

The discussion to this point has all been in terms of "industrial wood"; that is, wood expressly for fuel (as contrasted with scraps from industrial wood) has not been considered. Interestingly enough, the available data on forests include absolutely nothing about wood for fuel (except as scraps of industrial wood are burned). The foresters have in the past generally ignored fuelwoods in their surveys and inventories, and the available statistics on growth, stand, and harvest do not include species used only for fuel.

Future Possibilities

The domestic demand for industrial wood (as lumber, plywood, and pulp) will continue to rise. There is real possibility that our exports of such wood will also rise, which would help us pay for the oil and other products we import. The demand for wood for fuel will likely continue to rise. Wood may come to be used increasingly as feedstock for chemical processes. Some foresters view these probably increases in demand with alarm. How in the world can we meet such increased demands? My reaction is very different: I view these probable future trends with approval and expectation of favorable developments. They will almost surely mean higher prices for timber and stumpage, and this will draw forth substantially increased supply over the longrun. My studies have convinced me that forest owners as a whole are responsive in the longrun to increased timber prices. One can hardly expect timber growth next year to respond much to timber prices this year, but timber growth 10 or 20 or more years in the future will be greatly influenced by timber prices this year.

The United States has a substantial capacity to grow more timber than we are now growing, even by the practiced. The growth trend of the past 60 years can be continued—more, I believe it will be continued, up to some considerably higher level than we have yet attained. The demands on forests for other purposes, such as recreation, wilderness, wildlife, watersheds, etc. will continue to increase too, but my optimism about future growth takes into account these competing demands for forests.

I have said repeatedly during the past five years that I think forestry should be an exciting and rewarding profession during the next generation. There is so much to be learned, so much to be done, such great opportunities for public service and for a rewarding personal career.

Forest Design

are more desirable than volume increases. Individual trees which optimize productivity in a given space are preferred over excellent competitors.

There are some major disadvantages in this model. High dependence on energy, fertilizer, and pesticides are particularly important. Over the long-term, however, nutrient cycling and productivity relationships may be more critical. Consequently, more sophisticated designs may be required.

Mixed-species models generally have not been favored in commercial forestry because of the complexity of silviculture, harvesting, processing and marketing. Mixed species, however, often can produce more biomass per acre because of better use of total light and nutrients. Nitrogen-fixing hardwoods, like alder, are of greater interest in a world where energy costs are significant. Such hardwoods will become more interesting as nutrient cycling and long-term productivity relationships are better understood. Biological control systems will become more sophisticated and successful. Also, as population dynamics are better understood, the risks and ineffective uses of pesticides will be more obvious.

Similarly, the role and importance of herbicides will change. Dropping broad spectrum herbicides from aircraft is a crude tool. Whether or not current scientific controversies are resolved, the future of herbicides will depend on more species-specific chemicals, probably applied by better trained people. The consequent increase in costs will shift attention to site preparation, superior planting stock and advanced regeneration to cope with competitive competition.

Animal damage has taken on new dimensions since most pesticides were banned for smaller pests and large game management becomes more politicized. While repellents have several advantages, deeper understanding of animal ecology and subsequent manipulation of habitats offers better protection for young forests.

Future forest design need not create all the problems of modern agriculture. It can, in fact, point the way toward more rational means of managing renewable resources.

Comments

Future forest design is strategic in nature. It represents an effort to change and shape the future rather than accept whatever happens. Consequently, such design work should be integrated into strategic planning by corporations and public agencies.

The strategic implications of designing forests are not yet obvious. First, what are biological limits and what are the potential shifts in these limits? Second, what are the tradeoffs between predictability and uniformity in forest resources on the one hand and flexibility to meet future market and other social changes? Third, what are the relationships between short-term investment returns and long-term returns from forest investments?

These and many other practical and conceptual questions will make design of future forests a professional challenge for decades to come.

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