FORESTRY AFTER THE END OF NATURE

Clark S. Binkley

Dean
Faculty of Forestry
University of British Columbia
Vancouver, B. C.

Forest Industry Lecturer

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FOREST INDUSTRY LECTURE NO. 26

CLARK S. BINKLEY

Clark S. Binkley holds degrees in Applied Mathematics (AB, 1971) and Engineering (SM, 1975) from Harvard University and a Ph.D. in Forestry and Environmental Studies from Yale University (Ph.D., 1979). From 1978 through 1990, he served on the Faculty at Yale University both in the School of Forestry and Environmental Studies and in the School of Organization and Management. Most recently he was the Frederick K. Weyerhaeuser Professor of Forest Resource Management at Yale.

His principal area of research is the application of economics to problems arising in public and private management of forests. He has served as a consultant to a large number of forest products firms, governmental agencies and private conservation groups. He has lectured at many North American universities as well as those in Finland, Sweden, Germany, Austria, Poland, and the Soviet Union. He currently serves as a consultant to the World Bank on the forest policy, and is a member of the U.S. National Academy of Sciences Panel on the Policy Implications of Greenhouse Warming. Professor. Binkley is also an authority on the population dynamics of the endangered North American whooping crane.

Professor Binkley waa appointed Dean of the Faculty of Forestry at the University of British Columbi[f]a on 1 September 1990.

THE FOREST INDUSTRY LECTURERS

The forest industry in western Canada is cooperating with Alberta Forestry, Lands & Wildlife to provide funds to enrich the Forestry Program of the Faculty of Agriculture & Forestry at the University of Alberta through sponsorship of noteworthy speakers.

The Forest Industry Lecture Series was started during the 1976-77 term as a seminar course. The late Desmond I. Crossley and Maxwell T. MacLaggan presented the first series of lecturers. The contribution of these two noted Canadian foresters is greatly appreciated.

Subsequent speakers in the series have visited for periods of up to a week, with all visits highlighted by a major public address. It has indeed been a pleasure to host such individuals as C. Ross Silversides, W. Gerald Burch, Gustaf Siren, Kenneth F. S. King, F. L. C. Reed, Gene Namkoong, Roger Simmons, Kenneth A. Armson, John J. Munro, Peder Braathe, K. N. Johnson, Vidar J. Nordin, Juhani Paivanen, Conor Boyd, Peter Rennie, John A. Marlow, Gordon Guillion, Hugo Von Sydow, Mary Jo Lavin, Harold Walt, Adam Zimmerman, Mike Apsey, Bjorn Hagglund, Jerry Franklin and John Zasada. The subjects of their talks are listed at the end of this paper.

This paper contains Clark Binkley's major public address given on 20 March 1991.

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INTRODUCTION

Last year Bill McKibben proclaimed **The End of Nature,** first in the New Yorker magazine then in a best-selling book (McKibben, 1990). The concept quickly caught hold in the Boston – to – Washington Cocktail – party circuit, and I suspect also in the salons of Ottawa and Toronto. Those of us in the hinterlands best pay attention to those discussions, as they eventually find their way into the national media, policy and law.

I plan to debate the point — that nature has ended — with an absent adversary; absent being the best kind of adversary, I hasten to add. I start with McKibben's argument and then explain why it is not valid. I conclude with the true importance of the book — which lies in its existence rather than its substance — and with some comments on what this all means to foresters and forestry in British Columbia and probably elsewhere in Canada. This last section also touches on some more specific points of forest management.

The End of Nature

McKibben lives in the Adirondack Park, a region largely deforested during the 1800's to produce land for farming and charcoal for a primitive steel industry. This decimation of the forest set in motion political forces which created, in the late 19th century, the largest "wilderness" area in the coterminous United States, some 2.4 mil-lion hectares a few hundred kilometers north of New York City, declared "forever wild" by New York state's constitution. Remember this bit of history for it will be consequential as my story unfolds.

Here is McKibben's argument:

Through the ages humans have chipped away at nature but did not deliver the shattering blow until recently. McKibben probably shares the anguish that the Western Canada Wilderness Coalition evokes with their pictures of post-slash bum, pre-planting clearcuts on the B.C. coast. But even here he might admit that much land remains unlogged now and probably will forever.

George Orwell put it in his typically cynical way. Standing in the middle of a grimy English mill town around the turn of the century, he commented:

> In spite of hard trying, man has not yet succeeded in doing his dirt every-where. The Earth is so vast and still so empty that even in the filthy heart of civilization you find fields where grass is green instead of grey; perhaps if you looked for them you might even find streams with live fish in them instead of salmon tins. (McKibben, 1990; 56).

The End of Nature occurs not because of these assaults; indeed much of the world's landscape remains unaltered by the direct influence of humans. Instead the End of Nature comes indirectly through the "large-scale geophysical experiment" (as Roger Rev-elle put it) humans are currently performing on the earth. We pump some six billion tonnes of carbon into the atmosphere each year — four-fifths from fossil fuel consumption and most of the remainder from biomass burning of one form or another. About half remains in the atmosphere to enhance the now-familiar greenhouse effect. The fate of the other half is unknown, but recent research suggests that this remaining carbon dioxide, a fundamental plant nutrient, may be absorbed in terrestrial ecosystems (Tans et al., 1990).

Our production of carbon dioxide is not the end of the problem. We produce geophysically significant quantities of other radiantly active gases. Methane comes from anaerobic decomposition in landfills and rice paddies, and from cow flatulence.

Nitrous oxide — not only a greenhouse gas but also a catalyst for ozone destruction — comes from the production of nylon for such prosaic uses as fishing line, cooking spatulas and jogging shorts (Thiemens and Trogler, 1991).

The extra greenhouse gases may produce a 1.5 – 4.5 degree warming of the Earth sometime during the next century. Indeed, all the three major measures of the Earth's temperature concur that last year — 1990 — was the hottest in the 130 – year record (Kerr, 1991). Geophysicists expect greater warming near the poles and less soil moisture in the mid-continental zones. These changes may have profound effects on forests and the forests sector, but I will not treat these here (see Binkley, 1990 a,b).

By changing the atmosphere, humans affect the weather and climate. Unlike Orwell's grimy cities or B.C.'s clearcuts, human impact is no longer localized. From ice cap to ice cap, from sea surface to ocean depth, from valley bottom to mountain top, humans touch every nook of the Earth. Through this pervasive intrusion, humans have destroyed the very **concept** of nature.

In McKibben's words:

> Almost every day I hike up the hill out my back door. Within a hundred yards the woods swallow me up, and there is nothing to remind me of human society — no trash, no stumps, no fence, not even a real path. Looking out from the high places, you can't see a road or house; it is a world apart from man. But once in a while someone will be cutting wood farther down the valley, and the snarl of the chain saw will fill the woods. It is harder on those days to get caught up in the timeless meaning of the forest, for man is nearby. The sound of the chainsaw doesn't blot out all the noises of the forest or drive the animals away, but it does drive away the feeling that you are in another, separate, timeless, wild sphere. Now that we have changed the most basic forces around us, the noise of that chain saw will always be in the woods. (p. 47).

Having defiled the Garden of Eden, how can we restore ourselves to the grace of God? McKibben suggests two alternatives. In one — which he calls "The Defiant Reflect" — we apply human ingenuity and become better stewards of the Earth. In the other, "A Path of More Resistance", he proposes a return to a preconsumer society. After reading much "deep ecology", it is not hard for you or Ito guess which path he advocates.

Before considering these alternatives, let us examine his argument in more detail. t'

Did Nature Ever Exist?

Did Nature as portrayed by McKibben ever exist? Probably not, so it is specious to argue that it has ended.

First a cheap shot: recall that the Adirondacks — the woods behind McKibben's house where he finds a "separate, timeless wild sphere" — were once extensively logged. Evidently, given enough time we can produce "wilderness", and by implication, "nature".

More significantly, humans have influenced the environment as long as we have populated the Earth. Humans first used fire to manipulate the environment one million to 1.5 millions years ago. Savannah fires in Africa, mostly of anthropogenic origin, still comprise the single most important source of carbon dioxide derived from biomass burning, exceeding that from permanent deforestation of the tropical moist forest by perhaps a factor of two or three (Crutzen and Andrae, 1990). Hence, we as a species have influenced the climate since our earliest days.

Of course, human influence on the biosphere goes well beyond the fires we start. A few years ago Chuck Peters and two colleagues published a fascinating paper in the journal **Nature** (Peters et al., 1989). This paper argues that the fruits, nuts and latex produced in part of the Amazon rain forest are worth more than the timber produced on the same hectare. Forget for a moment that the productivity of the site they studied was so low that it would not be classified as "productive" for timber growing in any of the national or international forestry statistics. What was remarkable about this site was the enormous volume of fruit production. Subsequent land-use studies indicate that ancient Mayan cultures established orchards in the rain forest, either by planting fruit-bearing trees or by selectively thinning out those trees which did not bear fruit (Gomez-Pampas, 1990). Just as a grouse hunter finds a fall bonanza in the abandoned orchards or a New England woodlot, so too did these researchers find a bonanza left by pre-industrial humans.

Humans are not alone in influencing the environment. Being in Canada, I probably should tell a beaver story here, but I won't. A recent article in the journal **Science** showed how the kangaroo rats of the genus *Dipodomys* have major effects on

biological diversity and biogeochemical processes of xeric shrublands (Brown and Heske, 1991). As a keystone guild, these desert rats determine the trajectory of the entire ecosystem.

In essence, McKibben must argue that the mere **presence** of human beings is sufficient to produce the end of nature. This argument rests on the man/nature dichotomies which bedeviled the Greeks and others before modem concepts of evolution developed. Indeed, the microbiologist Lynn Margulis (e.g. Margulis, 1990) sees humans as nothing more (or less) than a collection of micro-organisms which banded together for their own mutual survival. From this perspective, humans are little different than the bacteria that produced the oxygen that made human existence possible in the first place.

The Upshot

In short, McKibben chose to define nature in a way that it never existed. His argument is moot. I win the debate on a technical point. We can all go home.

But taking this easy and correct victory is not nearly so enlightening as a bit of deconstruction: what was McKibben really thinking when he wrote this book? What created the public resonance that sold so many copies.

First, the public now apparently understands what Barry Commoner (1971) called the first law of ecology: everything is connected to everything else. Our children chastise us for using plastic bags and wake up with nightmares about the ozone holes. People write letters to the Vancouver **Sun** with concerns about biodiversity and mycorrhizal fungi, with no idea how to measure the former or spell the latter. The public understands that people influence the environment in many and subtle ways even if they do not understand the details.

Second, even if nature has not ended, people now worry that it might. The public is groping with the choice McKibben offered. Returning to a preconsumer society is not very attractive for most of us. Even at the current level of global production — a level the deep ecologists claim is unsustainable — the average income of one of the Earth's inhabitants is about $3,000/year, a figure just between Gabon and Greece in a listing of countries offered by this measure (World Bank, 1988). Compare this to the figure of $14,120 for Canada, and it is not too hard to see why most of us do indeed resist McKibben's "Path of Greater Resistance".

So better stewardship is the preferable answer, and this is where foresters enter the picture.

Recall the roots of our profession. Johnson's dictionary, the earliest dictionary of the English language, defines the verb "to afforest" as to declare an area as a royal hunting preserve. The forester's duty was to protect the "veil and venison". Hence, the first foresters were wildlife managers. Indeed, one of the latter-day saints of the conservation movement is Aldo Leopold, trained as a forester, who founded the scientific study of wildlife management and was one of the co-founders of The Wilderness Society.

Later, forest/water interactions became important. George Perkins Marsh's influential book **On Man and Nature** was published in 1864. **In** it, he described the erosion and water problems associated with deforestation in the Mediterranean. The State of New York established the Adirondack Park to protect water flow into the Erie Canal, and thereby to guarantee the importance of New York City as a port for transportation to the American west. Protecting water for irrigation and navigation was the rationale for the national forests in both the eastern and western United States.

Only since the post-World War II housing boom has timber production become the pre-eminent focus of forestry in North America. The forest products industry has been a powerful engine for increasing standards of living in such places as British Columbia. Having managed game for kings and having protected water for farmers, the forester became responsible for supplying one of the world's most important industrial raw materials.

But now the public wants more than game, water and timber. And as foresters, we know the outlines of how to provide what the public wants. We under-stand the complicated linkages among parts of the ecosystem, and we know something about stewardship. But the public is skeptical about our commitment to apply what we know. Recall that the "snarl of the chainsaw" is McKibben's symbol for the end of nature; the public associates a forester with that chainsaw.

Forester's will gain public standing only when we reflect and lead the public's growth certainty that use of the forest involves obligations as well as economic benefits. The obligations comprise what Aldo Leopold calls quite simply "the land ethic". Speaking of the soils, water, forests and wildlife, he says:

> A land ethic of course cannot prevent the use of these "resources", but it does affirm their right to continued existence, and, at least in some spots,

> their continued existence, and, at least in some spots, their continued existence in a natural state. (Leopold, 1966; 240).

In operational terms this means a commitment to ecosystem management in the fullest sense of those words. What will it take to accomplish this?

First, extant knowledge about the structure and function of managed forest ecosystems is inadequate. This is not too surprising as we have spent comparatively little effort on gathering and producing the requisite information. In British Columbia, we spend one sixth the amount of money on forestry research as does Sweden, figured on the basis of gross sales of the sector (Binkley, 1990c). An increasingly knowledgeable and skeptical public asks questions which current knowledge cannot answer with a suitable degree of certainty. Interest groups fill the information vacuum with politically convenient interpretations of "truth". Since the latitude for choice is wide and the objective capacity to screen alternatives is limited, the policy environment becomes unstable.

Second, we need to insure that all professional foresters work with the very latest knowledge and technology. Well-established and respected professions such as medicine or law may provide some insights: they require continuing studies as a matter of continued professional registration; the entry-level degrees require seven years or more to attain. We are planning to offer one-year specialized Master's Programs and a program of continuing studies to respond to these clear needs.

To get a sense of the need for continuing studies, consider current concerns for biological diversity, and let us examine what fraction of the forestry profession might reasonably have **any** formal training in this critical area. The major treaties that lay the scientific groundwork for the subject were all published about 20 years ago. Chris Pielou's book **An Introduction to Mathematical Ecology with** its systematic, textbook discussion of how to measure biological diversity appeared in 1969. The first edition of Robert May's classic **Stability and Complexity in Model Ecosystems** is dated 1973. MacArthur and Wilson published their **Theory of Island Biogeography** in 1967.

Assume that foresters enter the work force in their early 20's and retire in their mid 60's, with very good survivorship between these two ages. Assume further — and perhaps unrealistically — that the population of foresters follows a stationary age distribution, so young and old ones are represented in proportion to their survivorship. If so, the average forester is working with an education which is about 20 years old. Or, to put it in the worst possible light as our critics would do, the average forester

may have an education which is 20 years out of date. Recall that the basic concepts of biological diversity were laid out about 20 years ago. Even if we imagine that these concepts from ecology — reasonably advanced for their time — were translated directly and instantaneously into forestry instruction, it is unlikely that even half of today's practicing foresters have any formal training in this key aspect of ecology.

In short, public concerns have raced far ahead of the education possessed by many of the foresters who are responsible for managing the public's land.

Third, foresters will have to produce more with less. Those lands managed for timber production will need to grow more wood per unit area and do it in an environmentally acceptable manner. Can the 1989 harvest level in British Columbia of 87.4 mm cum be sustained or expanded on a land base of 20-30 million hectares? This would comprise some 20-30% of total, leaving a large area — far exceeding the Brundtland Commission guidelines — for parks and natural areas. Doing so will require a mean annual increment of between 2.9 and 4.4 cum/ha/year as well as careful management of the existing inventory. These yields seem reasonable in light of British Columbia's climatic and edaphic endowments.

In the late 1970's the Weyerhaeuser Company analyzed theoretical timber yield for trees from the perspective of their biochemical efficiency in turning sunlight into wood (Farnum, et al., 1983). They applied this model to two sites where they practice some of the most intensive forestry known anywhere in the world, one in the Pacific Northwest and one in the southeastern United States. These plantations were site prepared, bedded, fertilized, planted with genetically improved/mycorrhizal-inoculated seedlings, optimally spaced and repeatedly thinned and fertilized. Yet the production of these sites achieve only 40% to 50% of the theoretical yield, and natural stands in these areas grow at about 10% to 25% of the theoretical yields. Since B.C.'s forests are managed much less intensively than these two study sites, I believe that there is considerable latitude for increasing the growth of our forests.

In British Columbia, and perhaps elsewhere in Canada, our capacity to analyze the effects of such intensive management is quite limited. There are few, if any, widely accepted yield models for managed stands. Some of the analysis is done on individual stands without consideration for important forest-level constraints which may drastically alter the measured economic returns. Some of the forest-level analyses rely on the heuristic harvesting policy of "oldest stands first" despite Peter Berck's (1976) mathematical proof that this strategy is not necessarily optimal even for simple harvest-scheduling problems.

Finally, foresters need to lead the identification and management of those areas where timber production will be sub-ordinate or absent altogether. Preserving unique ecosystems or species is not necessarily well-served by simple administrative designation alone; it is a grave ecological and political mistake to imagine that is so.

In a recent talk in Vancouver, the eminent ecologist John Harper gave an interesting example of the problem. A rare form of buttercup was found in an isolated field in England. Well-meaning people interested in the fate of the organism fenced the area to keep people and animals out. The buttercup population declined. It turned out that reproduction of the species required the disturbance created by cows walking across the field and crushing the plants.

The vanguard of the preservation movement understands the need for a new paradigm for the management of parks and natural areas. The paradigm is based on the ecosystem concept with management principles taken from applied conservation biology. It was recently articulated in the National Parks and Conservation Association's (1990) critique of the US National Park System, a study entitled "From Vignettes to an Ecosystem Perspective". Foresters understand this perspective and have much to add to the debate.

These natural areas — properly measured and monitored —_ will ultimately contribute much to the practice of forestry on more intensively managed landscapes. As Leopold (1966; 190) put it, "To keep every cog and wheel is the first precaution of intelligent tinkering".

As inveterate tinkerers, foresters need a well-designed system of research natural areas as the baseline for scientific studies of management intervention.

Conclusion

Where does this leave us? The fuzzy-headed hypothesis that nature has ended is clearly false. But the public is concerned. They know they have not seen the obituary, but they believe they should send cards and flowers to the hospital. And they wonder about the competence and motives of the doctors.

Foresters have a great deal to contribute to the public debate and decisions about the fate of nature. We need to show how we can expand timber production on a much smaller land base to continue to fuel the engine of economic growth in British Columbia and elsewhere in Canada. We need to lead in the preservation of forested landscapes. In short, we need to demonstrate the commitment of our profession to stewardship — a commitment which reaches back over hundreds of years.

Foresters manage literally millions of hectares of the Earth's surface. Humble in the face of this monumental responsibility, we best heed the injunction given by Edwin Robinson, a Pultizer-prize winning poet, who wrote in 1927:

> Whether you will or not
> You are a King, Tristram, for you are one Of the
> time-tested few that leave the world, When they
> are gone, not the same place it was. Mark what
> you leave.

So, foresters, let us mark what we leave.

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