A Perspective on People, Wood, Wildlife, and Environment in U.S. Forest Stewardship

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MUCH ADO ABOUT FORESTS

Americans are concerned about the future of forests. This is good, given the value of forests to the nation's environment and economy.

But media coverage of forest issues in the U.S. has distorted the real story and public perception of choices. Media stories often stress "war in the woods" (Mitchell 1990), "rage over trees," the "death of nature" (McKibben 1990), or alleged mismanagement of public forests (Baden 1991, Knize 1991, Knudsen 1991).

Sensationalism appears to be the order of the day.

The continuing debate about U.S. forest issues often leaves an impression of pending environmental doom or the imminent loss of the last great forests in the nation. This is not the case.

But there are valid reasons for concern over the conditions of American forests and how our society's institutions carry out their management. Ecological and social systems are affected by forest conditions. Some of those conditions are declining. Others are improving.

The conditions, trends, and potential future for U.S. forests have significant economic, social, environmental, and aesthetic ramifications. But what is the true situation regarding U.S. forests and their associated products and values? What are the policy choices for forest uses and management during the 1990s and beyond? What are the implications of those policy choices for forest management and research?

The knowledge needed for informed choices about forest policies includes valid information on global, national, and regional economic and environmental conditions. In addition, we must understand how these are influenced by forest conditions and how we use forest products or substitutes for forest products.

We also need to understand how to motivate people to use sustainable forest practices, and how particular forest and human communities might respond to protection, restoration, or other kinds of management. Any proposed action must also reflect understanding and sensitivity to the plight of individuals and families caught by changing economic and environmental conditions.

People need this information to determine the future of forests in their economy and global environment, and to select the most effective ways to attain that future.

FOREST TRENDS

Forests and woodlands now cover an estimated 31 percent of the planet's terrestrial surface, or 10.1 billion acres, according to World Resources Institute (1990). People number about 5.5 billion. In historical terms, each person had an average of about 30 acres of forest resource in 1750, while in 1990 each person has only an average of 1.8 acres (Figure 1).

This means less potential forest area for the growing human population. This general trend applies to all resources in the biosphere (Figure 2).

Yet, it is precisely this growing human population and its intellectual capacity and ingenuity that is the source for improving both environmental quality and standards of living for all people.

HOW PEOPLE USE WOOD

Wood use has long been a major influence in the relationship between people and forests (Clawson 1979, Williams 1989, Perlin 1991). Both global and U.S. wood production and use continue to rise.

People in developing countries know their relationship with forests first hand. They use them to meet their basic needs (Marsh 1864, Thomas 1956, Toynbee 1976, Perlin 1991). People in the U.S. did the same until well into the 20th century (Clawson 1979, Williams 1989). In a typical developing country, about 70 percent of the wood people gather is used

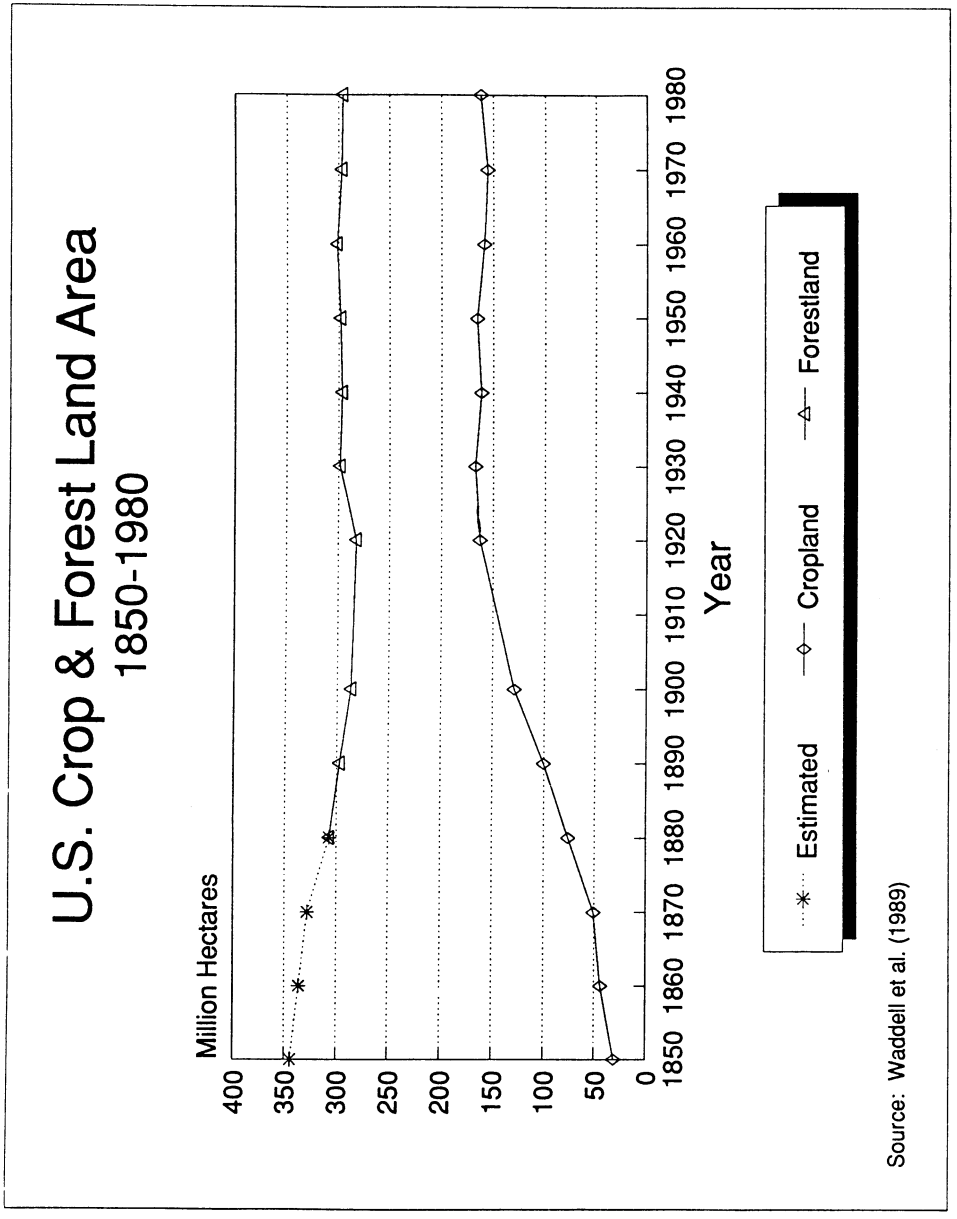

Figure 1. Land area of the U.S. in crop and forest cover from 1850 to 1980. Data from Waddell et al. (1989).

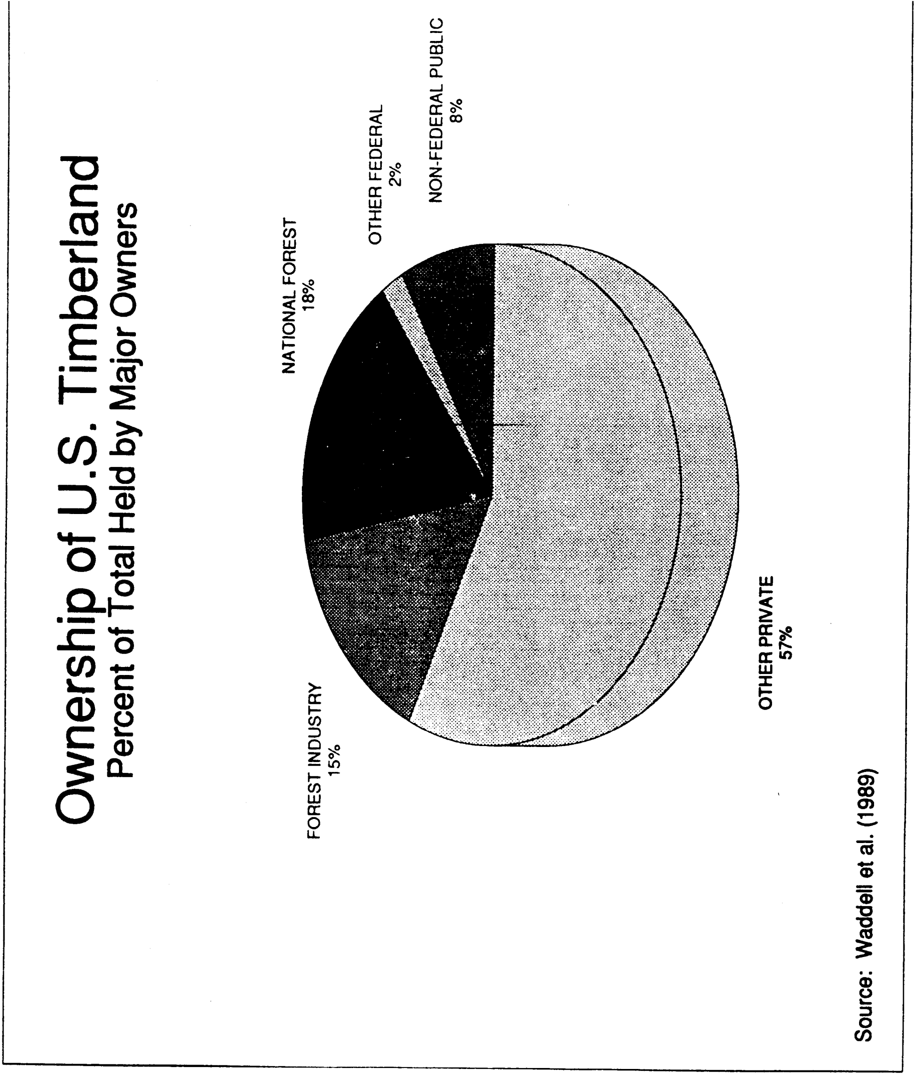

Figure 2. U.S. forest ownership as a percentage of total forested land in 1987. Source: Waddell et al. (1989).

for heat. Food, shelter, medicines, and fuels are taken from the forests until the forests are gone or until economies develop to the point where people can afford forest conservation.

Wood use in the U.S. has changed over time. In 1850, wood provided about 95 percent of the domestic and industrial energy used in the U.S. Today, it is much reduced. Instead, the U.S. uses mainly oil, coal, and natural gas. Only 22 percent of the wood produced is used for fuel, much of it in industrial processes. Forty-four percent is used in construction. About 27 percent goes into producing pulp and paper (USDA Forest Service 1990) (Table 1).

Table 1. U.S. consumption of timber products for selected years. Data from Bowyer 1991a and U.S. Bureau of the Census Statistical Abstract of the United States (110th ed.).

Year	Total domestic consumption (million cubic meters–roundwood equiv.)	Per capita consumption
1970	340	1.7
1975	314	1.5
1980	369	2.0
1981	346	1.9
1982	338	1.9
1983	387	2.0
1984	420	2.2
1985	419	2.2
1986	451	2.3
1987 (est.)	468	2.3

The U.S. produces 25 percent and uses 33 percent of the world's industrial roundwood. It uses about 50 percent of the world's paper production (Haynes and Brooks 1991).

In 1987, as a percentage of total consumption, the U.S. imported 12 percent of its wood pulp and 16 percent of its wood and wood products (Ulrich 1990). About 27 percent of the lumber used in the U.S. was imported from Canada in the late 1980s.

U.S. per capita, non-fuel use of wood is one and a half times that of other industrial nations, and is as much as 100 times that of some developing nations (Postel and Ryan 1991). U.S. wood use increased by 20 percent during the latter half of the 1980s, due primarily to increased use for construction, home heating, and industrial power systems.

The U.S. is the biggest total and per capita user of wood in the world (Postel and Ryan 1991). Paradoxically, many Americans behave as if wood does not come from cutting trees or that it should come from cutting trees in someone else's forests.

MATERIAL ALTERNATIVES TO WOOD

Using wood is not bad for the environment. Comparatively, wood is one of the most environmentally benign of all construction materials. It is virtually the only renewable resource that is economically suitable for structural and architectural purposes (Koch 1991). The alternatives to wood in those uses—steel, aluminum and other metals, concrete, and plastics—are not renewable (though they are recyclable at varying energy costs).

Substitutes use considerably more energy per unit of production than wood. As an insulator, wood is also more energy-efficient than many manufactured substitutes, paying energy dividends throughout a building's life (Table 2).

Table 2. Estimated energy required in the manufacture of various wall systems for building construction. Estimates include energy consumption involved in logging (or extraction), manufacture, transport to the building site, and construction. Data from CORRIM (1976) as cited in Bowyer (1991b).

Type of wall	Energy to construct 100 square feet of wall (million BTU oil equiv.)
Plywood siding, no sheathing, 2x4 frame	1.99
MDF siding, plywood sheathing, 2x4 frame	2.54
Concrete building block, no insulation	17.09
Aluminum siding, plywood, insulation board, 2x4 frame	4.95
MDF siding, plywood sheathing, steel studs	5.11
Brick veneer over sheathing	17.89

MDF = medium-density fiberboard

Because of these factors, Koch (1991) estimates that for each billion board feet of wood replaced with manufactured substitutes, annual energy consumption would increase by about 720 million gallons of oil and carbon dioxide emissions would increase by 7.5 million tons. Replacing any significant percentage of wood with manufactured substitutes could have a substantial effect on both national energy consumption and global carbon dioxide emissions.

In addition, actively growing forests are great carbon "sinks." American forests sequester the equivalent of about 9 percent of total carbon dioxide emissions from all sources in the United States (M. Fosberg pers. comm.). No other materials provide this ecological service.

FOREST GROWTH

Today, U.S. forests have recovered substantially from a low point around 1900. In the aggregate, forests in the U.S. are now

more productive than at any point in the century (Figure 3). In fact, they have been increasing in growth and standing volume since the early 20th century in response to forest and conservation policy choices and technology improvements (Fedkiw 1989).

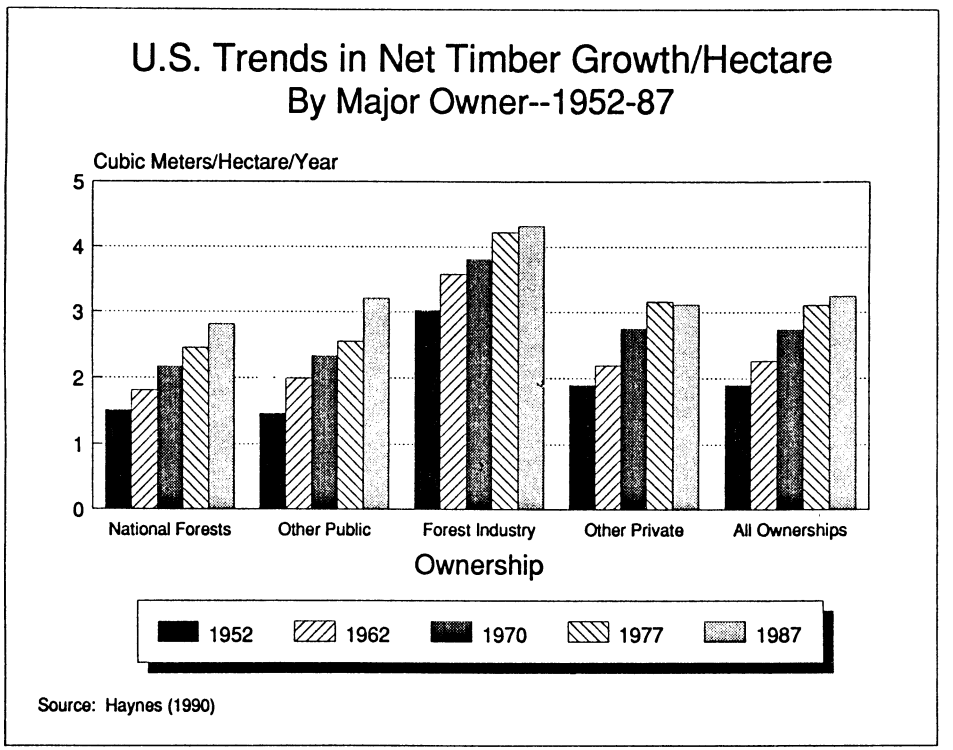

Figure 3. U.S. trends in net forest growth by major owner from 1952-1987. Data from Haynes (1990).

Due to forest fire control and investments in reforestation and forest management, tree growth in the U.S. today is three and a half times what it was in 1920 (Fedkiw 1989). Tree planting was at record levels throughout the 1980s with more than 26 million

acres planted. This is a planting area the size of the state of Virginia. Last year, for every child born in the U.S., more than 400 trees were planted.

Today, timber growth in the U.S. exceeds harvest by 37 percent (Figure 4). The total volume of wood in U.S. forests is now 25 percent greater than in 1952.

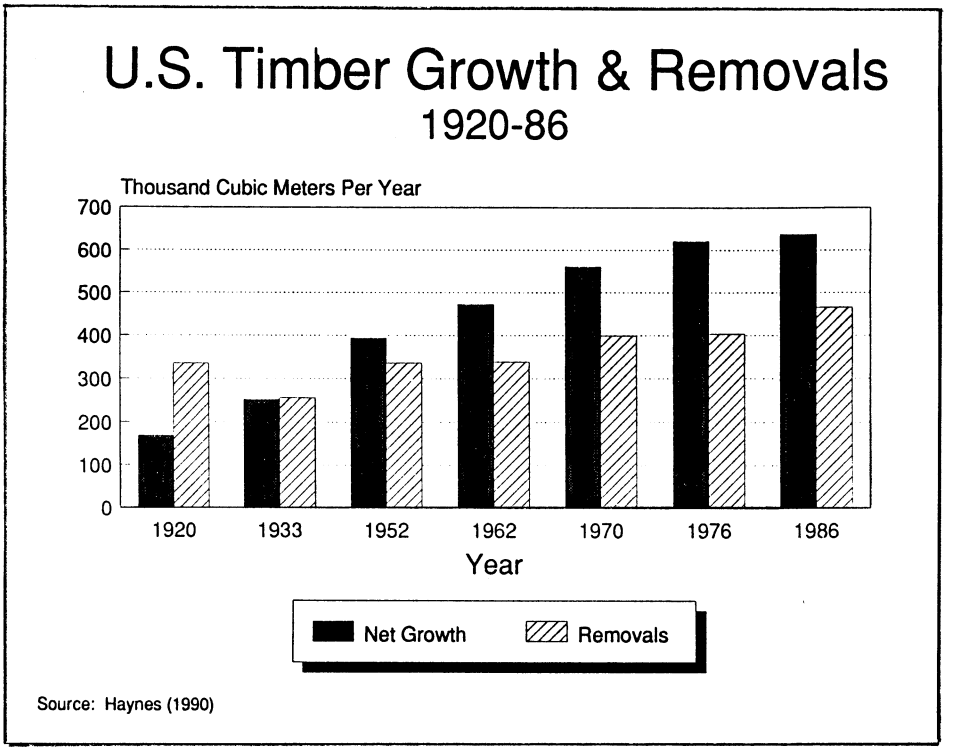

Figure 4. U.S. timber growth and removals from 1920 to 1986. Data from Haynes (1990).

FOREST PRESERVATION

Because American forests are so abundant and productive, the nation has chosen to protect more of its forests for their environmental services, aesthetic values, and amenity uses. The area of productive forest land in parks, wilderness areas, and similar reserves where timber harvest is prohibited has increased significantly in recent years.

About 34 million acres of productive forest lands in the U.S.

have now been designated for nontimber values and uses. This is nearly double the area in such designations in 1970 (Waddell et al. 1989) and an area the size of the state of Florida.

EFFICIENCY OF WOOD USE

Harvest and manufacturing efficiencies have also shown tremendous increases since the turn of the century. Logging residues have decreased, use of dead standing trees has increased, and log use for lumber or veneers has increased. Advanced technologies such as thinner saw blades, electronic measurement systems, and computer-assisted milling have all contributed to better utilization.

New technologies for increasing the usable wood from a forest, preserving it, and recycling it have taken significant pressure off U.S. forests for raw material. All of these efforts have reduced by hundreds of thousands of acres the area of annual harvest that otherwise would have occurred to supply the U.S. with wood products.

There are opportunities to do even more in the future to improve wood utilization and encourage recycling (Ince and Alig 1991). Postel and Ryan (1991) estimate a potential for conservation technologies and recycling to reduce raw material demand by up to 50 percent.

FOREST WILDLIFE TODAY

Several species of wildlife became extinct because of forest changes and human uses during this century, including the passenger pigeon, heath hen, and great auk. Many others on the brink of extinction in 1900 have staged remarkable comebacks. Most forest wildlife are both more abundant and more widespread than they were in 1900 due to actions that were set in motion in the early decades of this century.

The pattern that has emerged since the 1930s is a substantial increase in wildlife that can tolerate a relatively broad range of habitat conditions. The numbers and distribution of the so-called "habitat generalists" have increased dramatically. Fortunately, most U.S. forest-wildlife species are habitat generalists. One reason may be the natural dynamics of North American forests and the frequency of disturbance in the natural regime (Williams 1989, Botkin 1990).

But saying that many wildlife species have staged remarkable comebacks does not imply the absence of problems. Species with specialized habitat requirements are increasingly of concern today. Examples include:

- The red-cockaded woodpecker and gopher tortoise, which are natives of fire-created southern pine savannas and woodlands.
- The Kirtland's warbler, which is native of young jack pine forests in Michigan.
- And, of course, the northern spotted owl, which is resident of old-growth Douglas-fir forests in the Pacific Northwest.

While many wildlife species need large, contiguous areas of habitat, such as grizzly bears, wolves, elk, and forest-interior birds, not all habitat specialists are threatened by loss of old-growth or "ancient" forests. Some require active management of young forests for their survival, e.g., Kirtland's warbler (Botkin 1990). Others, although needing mature forests, require specific habitat conditions, such as open savannas and woodlands which are created by frequent ground fires, e.g., red-cockaded woodpecker.

Even the old-growth, Douglas-fir forests required by the northern spotted owl are sub-climax forest types that will eventually move toward different forest conditions without occasional, stand-replacing wildfires. Providing for the needs of habitat specialists will require purposeful and often active forest management, though not always for early-successional habitats.

FRAMING THE ISSUES AND POLICY CHOICES

There will soon be six billion people on earth. In 50 years, about 300 million people will live in the U.S., many of them recent immigrants.

It is inevitable that more resources will be consumed than now. They will have to come from somewhere (Chappelle and Webster 1991). With more consumption, more wastes will likely be produced. They must also go somewhere or be dealt with in some way.

On the positive side of this challenge, the U.S. today has almost four times the population it had a century ago, living at a substantially higher standard of living. Yet our forests and wildlife are, for the most part, in significantly better condition today than they were in 1890.

American forests and related wildlife now have an abundance, diversity, and productivity far beyond what was imagined by early conservation leaders. It is that abundance that has greatly expanded the range of choices available for today's forest and wildlife conservation.

Those gains are a direct result of the relative affluence and technological capacity of Americans and conscious policy choices made in the past. The choices made by this generation will influence future economies and environments, probably also in some ways that we do not now envision.

This leads to the difficulty of framing natural resource issues for the public in ways that informed choices can be made. The communication media's focus on sensational stories of alleged environmental disaster have left the public largely unaware of the significant environmental gains that were made in recent decades and of the effectiveness of policy decisions on their behalf.

Similarly, the coverage of specific environmental issues is often framed so narrowly as to make it impossible for the public to understand in meaningful terms the full dimensions of the choices available to address them, or even what those choices are.

For instance, much of the public debate over old growth has focused on the relatively narrow questions of how it should be defined, how much remains, and what the likely impacts would be of either harvesting or not harvesting it. These are important questions.

Yet, there are also national and perhaps global implications to choices concerning forests in the Pacific Northwest. For instance, if they are removed from production, most of the wood they would have produced will either come from somewhere else or be replaced by non-wood materials.

These concerns are rarely included in the debates over policy. It is important to consider how the choices for protecting and managing old growth in the western U.S. relate to regional, national, and global timber supply, the energy and greenhouse gas implications of use of substitutes for wood, and biodiversity in other timber supply regions.

The difficulty of obtaining public understanding of the full dimensions of forest policy choices are significant. For example, some relevant considerations that are seldom discussed include: how much and where should forests of all ages and types be sustained to protect environmental values? How much and where might they contribute forest products to local, regional, national, and global human communities?

These questions do not imply that an "either/or," "protect or produce," choice must be made in all cases. Forest management options are being developed to supply combinations of these goals in many circumstances (Gillis 1990).

The old-growth issue is similar to other hard choices the U.S. faces regarding forest policies. How should forest management occur? What kind of forest conditions should remain after harvest? What technologies will be needed? What are prudent investments in environmental assessments, research, and monitoring to support those decisions?

Appropriate answers resist simplistic analysis and simple choices, such as preserving public forests and producing more wood from private lands. Nor are they simple issues of saving this or that species or promoting this or that industrial development. They are complex questions that inherently integrate many social values and needs. Before answers can be found, questions must be posed correctly (Clark and Stankey 1991).

Scale is an increasingly important issue in framing the questions and choices on forest policies. This is not just for technical reasons. What people do in their backyard forests affects their economic well being, environmental quality, and biological diversity. What people don't do in their backyard forests also affects these things. This is because markets and environments are global.

Instead of looking only at the inner workings of a forest to determine how to sustain the forest as an ecological system, perhaps we should also look outside the forest to understand the inner workings of the societies of people (Clark and Stankey 1991),

economies (Binkley 1991), and global dynamics that forests influence (Botkin 1990, Silver and DeFries 1990). Such a global perspective may yield opposite conclusions from a local or regional perspective.

For example, if steel, concrete, or aluminum materials are substituted for the wood protected for environmental values in American old-growth forests, how much additional carbon dioxide will be added to the global atmosphere? If wood from somewhere else is substituted, will that be better or worse for global biological diversity? The local or regional consequences of protecting old-growth forests for endangered species include water quality, jobs, aesthetics, wood prices, and biological diversity. The global consequences may include greenhouse gases and someone else's biological diversity.

In the long run it will do little good to conserve biodiversity in local or regional forests if human consumption depletes the same in someone else's forests. Global responsibility does not necessarily result from the accumulation of actions in backyard environments that ignore global ecological dynamics (Botkin 1990, Bowyer 1991a, Bowyer 1991b).

LINKING PEOPLE, FORESTS, WOOD, WILDLIFE, AND CONSERVATION

When all is said and done, the choices regarding what to do about U.S. forests must address the desired present and future conditions of local, regional, national, and global *environments*, human *economies* at the same scales, and *social norms and ethics*. These are inseparable: people cannot solve for the environment in isolation of economies or norms of social behavior. Marion Clawson (1975) presented a version of this in "Forests for Whom and for What." This remains the essential question facing societies about their forests.

Forest conservation means protecting the environment and meeting people's needs for forest products and services. The philosophical challenge is not to see whether a nature-first (Devall and Sessions 1985) or rights-of-nature philosophy (Nash 1989) can overcome a humans-first philosophy, but perhaps to accept something that has been known for a very long time: humans are integral parts of a larger natural whole (Prabhavananda and Isherwood 1944, Leopold 1949, Gia-Fu Feng and English 1972, Easwaran 1985, Weatherford 1988, Sahtouris 1989, Wall and Arden 1990).

Perhaps understanding that our temporal economies operate inside a larger global economy of life might help us see that people are indeed part of the solution to our challenges (Berry 1987). The human cultural diversity of the planet is as important to the future as is its biological diversity.

Given the global wood supply, the large capacity to grow more wood in managed stands, and the potential for conservation, people may reasonably question the wholesale cutting of native old-growth forests, including those of other nations. But it is not uneth-

ical to grow and cut trees in ways that leave soils, waters, and ecosystems in healthy condition for the future.

What is environmentally unethical and globally irresponsible is to use amounts of wood that we are not willing to produce as prudent land stewards, either in our own backyards or elsewhere, or to ignore the environmental implications of the use of substitutes for wood that use far more energy to produce and are not as recyclable or biodegradable as wood (Bowyer 1991a).

The ultimate challenges in forest conservation, or sustainable forestry, are not saving old growth, jobs, spotted owls, roadless areas, endangered species, or even biodiversity. These are only symptoms of the real challenge: to manage forests for desired conditions, uses, services, values, and products, framed in a global context with full consideration of local and regional human economic and social dimensions.

MANAGING FOREST ECOSYSTEMS FOR BROADER BENEFITS: A RICHER FOREST

A broader view of forestry is emerging in the U.S. (Franklin et al. 1989) and elsewhere (Plochmann 1989). The Swedish call it *Rikare skog*, a "richer forest" (Skogsstyrelsen 1990). A richer forest means management for a wide variety of values, uses, and services. The foundation for this broader view of forestry is the role of biological diversity in overall land health and productivity (Society of American Foresters 1991, The Keystone Center 1991, Salwasser 1991a, Hansen et al. 1991). Some ideas about "A Richer Forest" can be found on the next page.

Robust biological diversity is one element in healthy ecological systems. In the larger sense, ecological systems are places where the plants, animals, soils, waters, climate, and processes of life work as an integrated whole. They are constantly undergoing change, whether induced by humans or not (Thomas 1956, Burgess and Sharpe 1981, Shugart 1984, Waring and Schlesinger 1985, Botkin 1990). Forests are ecological systems. So are ponds and lakes and rangelands and estuaries.

The new perspective is to manage forest ecosystems to sustain a wider variety of their uses, values, and services (National Research Council 1990, USDA Forest Service 1990). This means providing for a richer diversity of native plant and animal species and communities and their processes of life so that the system produces a wider array of benefits and sustains a broader adaptability to environmental change, so that it is more resilient in the face of stress (Salwasser 1991b). Naturally, this also means that less of the primary productivity of the system will be channeled to a single or few products of choice. Thus, wood volume or game-wildlife yields may be lower in the short run, but the system's ability to sustain a wide array of values, uses, and services should be higher in the long run.

Managing forest ecosystems for a richer set of values, uses, and

Box 1

A Richer Forest . . .

- Has a high diversity of native trees, shrubs, herbs, and animals;
- Sustains human diversity and economic prosperity;
- Sustains its health, diversity, and productivity largely through natural processes;
- Is full of the sights, sounds, smells, and feels of a wild place;
- Is pleasing to look at;
- Sustains productive soils, clean water, clear air, and a rich biota;
- Has abundant animal inns (snags), lizard lodges (fallen, rotting logs), nuts, berries, fruits, seeds, and nectar for wildlife diversity;
- Has a variety of age classes, habitats, and biological communities that are well-connected and -distributed across the landscape;
- Is resilient to stress and adaptable to long-term change;
- Contributes to a healthy, productive global environment;
- Produces high-quality and good yields of products, uses, and services that people want and need;
- Is a place where people can invest their creativity and learn about relationships and responsibilities to the land and other people;
- Is managed with the best available technologies according to the best available scientific knowledge;
- Yields benefits and values that exceed the costs and resources involved in its management.

A RICHER FOREST IS A JOURNEY, NOT A DESTINATION.
OUR GOAL IS TO TRAVEL, NOT ARRIVE.

A LAND STEWARD MANAGES FOR RICHER ECOSYSTEMS.

services does not mean that all sites receive the same treatment or serve identical purposes (Forman and Godron 1986, Hunter 1990). Thus, scale enters as a major factor. Because each site can potentially serve different purposes, the challenge is to determine the balance of purposes and the mosaic of sites in watersheds and landscapes that will best provide for all the desired conditions, values, uses, and services. This requires that managers and scientists interact with people who depend on the forest to determine how best to provide that balance. Integration of goals and actions, coordination of plans and projects across multiple spatial and temporal scales, and collaboration among all the interested parties are necessary elements of managing forest ecosystems for broader benefits.

Although people might like to define many legitimate purposes for resources, the purposes are not inherent in the resources themselves but rather in people's expectations for using them. Thus, there is no "highest and best use" for any resource, except in the minds of human beholders. When people are factored into ecosystems as interactive elements, the false dichotomy of "higher" and "lower" uses of land no longer has a place in managing for multiple values, uses, and services.

People are part of all ecosystems. Resources must come from somewhere. Some places must be managed to protect unique environmental values. Therefore, all places in the ecosystem and all potential practices that serve multiple resource goals are equally valuable. Parks, wilderness areas, wildlife refuges, and wild rivers are no more or no less important to the whole than are campgrounds, oil wells, ski trails, game ranges, and tree farms (Figure 5).

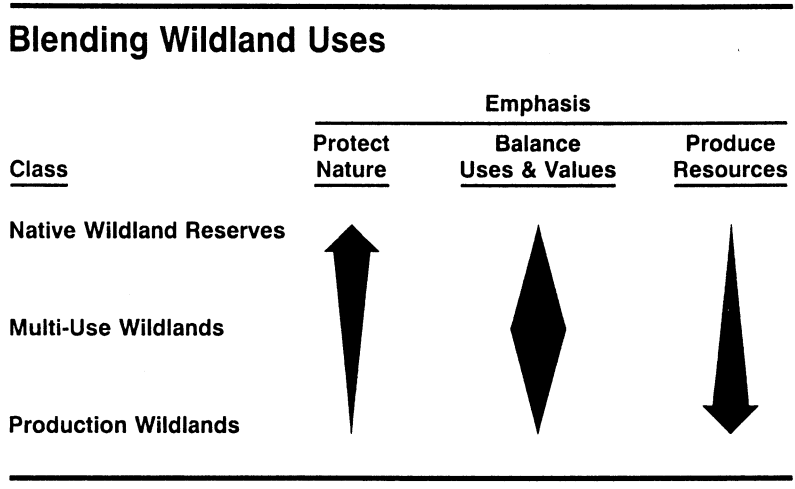

Figure 5. Managing forests as ecosystems to sustain all desired values, uses, products, and services requires the blending of different approaches to forest protection, restoration, management, and enhancement.

PRINCIPLES AND GUIDELINES FOR SUSTAINING RICHER ECOSYSTEMS

A fire requires fuel, oxygen, and heat. Take any one away and the fire goes out.

Similarly, sustaining richer forest ecosystems requires ecologically sound, socially desirable (which implies politically possible), and economically feasible management. Take any one away and the desired ecosystem conditions will not be sustainable—the integrity of the system is broken.

To assure that management results in sustainable ecosystems, four principles are useful guides:

Principle 1. "Take Care of the Land" by protecting or restoring the integrity of its soils, air, waters, biological diversity, and ecological processes.

Principle 2. "Take Care of the People and Their Cultural Diversity" by meeting the basic needs of people and communities who depend on the land for food, fuel, shelter, livelihood, recreation, and spiritual renewal.

Principle 3. "Use Resources Wisely to Improve Economic Prosperity" of communities, regions, and nations by producing natural resources such as wood, fiber, genetic material, water, minerals, energy, forage for domestic animals, and recreation opportunities.

Principle 4. "Strive for Balance, Equity, and Harmony Between People and Land" across interests, across regions, and across generations by sustaining what Aldo Leopold (1949) called the land community, meeting this generation's resource needs, and maintaining options for future generations to also meet their needs. The World Commission on Environment and Development (1987) called this "sustainable development."

Working guidelines for ecological system management appear on the next two pages.

SUMMARY: CONSERVATION IS STILL THE RIGHT APPROACH

The current debate over the future of our forests and other natural resources is often tinged with overtones of despair and imminent catastrophe. Calls are being made for a wholesale change in our institutions and societal priorities to address the situation. Such debate is healthy in a democratic society. But before we decide where we should go, we should seek to understand where we are, and how we got there.

To address the resource depletion of the late 19th century, conservation was offered as the paradigm for ethical behavior regarding forests and forest resources. There is overwhelming evidence that, while some problems remain and others have emerged in the last few years, on balance, the condition of U.S. forests, wildlife, rangelands, agricultural lands, and related resources have improved dramatically during the last century.

These trends continue to show an improving situation. This is an indication that past conservation policies and practices have, in large measure, served the nation well. These policies and

Box 2

Working Guidelines for Ecosystem Management

1. FOCUS ON DESIRED PRESENT AND FUTURE CONDITIONS OF THE LAND AND ITS HUMAN COMMUNITIES. Focus management actions to achieve desired current and future conditions of the land at multiple scales (Caplan 1992), always seeking to balance goals for the land:

- the beauty of the land,
- the stability and fertility of its soils,
- the quality and flows of its waters,
- the clarity of the air,
- the diversity of plants, animals, and biological communities, and
- the interconnectedness and character of habitats and landscapes

that provide for the health and resilience of ecological systems and processes;

with goals for the people:

- the prosperity, diversity, health, and vitality of the people who depend on the land for their livelihoods, recreation, and spiritual development.

Desired conditions must take into consideration economic feasibility and the health, productivity, and resilience of the land over time in the face of unplanned and uncertain future events such as fires, storms, and insect epidemics (Waring and Schlesinger 1985, Botkin 1990). They must also consider continental and global economic and environmental effects of choices made at local and regional scales, e.g., the energy costs of alternative materials.

2. INTEGRATE THINKING AND ACTIONS AT MULTIPLE SPATIAL AND TEMPORAL SCALES. Think about the effects of proposed actions at several geographic scales and through time (Forman and Godron 1986): at least one scale larger and one scale smaller than the scale you are working at and at least for several decades in the future; more and longer if possible.

3. BE ESPECIALLY CAREFUL IN SENSITIVE AREAS. Protect special places such as wetlands, endangered species, rare plant populations, and cultural resources.

4. EMPLOY THE ECOLOGICAL CAPABILITIES AND PROCESSES OF THE LAND. Work within the ecological potential of sites and landscapes, maintain native diversity, and employ nature's processes to the greatest degree possible.

5. GET PEOPLE INVOLVED IN PLANNING AND CARRYING OUT PROJECT WORK. Involve interested and affected people in the full process of making decisions about common resources; plan as if you are in a fishbowl to make sure everyone who wants to has access and knows what is going on; make conservation partnerships the rule rather than the exception.

(continued next page)

Box 2 (continued)

6. INVOLVE SCIENTISTS THROUGH ADAPTIVE MANAGEMENT. Monitor research, interpret, and adapt–integrate research with operational management and set resource management up as the continual experiment and learning opportunity that it always has been and always will be.

7. INTEGRATE RESOURCE MANAGEMENT FOR OPERATIONAL EFFICIENCY. Integrate resources, integrate actions across geographic scales, and build a community of interests–integrate everything and all the time but not necessarily everything on every acre at all times–this is biologically impossible and, therefore, technically infeasible.

practices have provided us with a resource situation that offers a much broader range of choices than would have existed had they not been put into place. As we consider changes in forest policy direction for the future, this historical dimension should not be forgotten.

Conservation, in a broad sense, is still the right approach, though it is much abused by those who would twist it to mean either unfettered exploitation or no human use at all. The challenges in sustaining richer forests in the face of a growing human population call for renewed vigor in pursuit of the ideals for conservation laid down more than a century ago by the likes of George Perkins Marsh, Gifford Pinchot, John Muir, and Theodore Roosevelt.

They call for continuing to bring Aldo Leopold and Bob Marshall's visions into the fold: to restore and sustain the diversity, integrity, and beauty of the land and to protect our wildest areas in their wildest state (Robertson 1991). They also call for renewing the sense of community between the people, the land, and the resources of life (Bruchac 1991, Sirmon 1991).

To better understand the roles of biological diversity in sustaining forest ecosystems, research and monitoring must address large-scale, long-term dynamics in landscapes and the linkages between economic, cultural, and ecological diversity.

To help an urban society understand the role of land in their livelihoods and their responsibilities to the land requires increased attention to education and interpretation, perhaps even direct participation in resource management projects.

Most importantly, people must come to realize that they do not operate apart from nature or that nature can be preserved apart from people. We exist within the context of the global environmental economy and we have a great influence on its future.

Regardless of local or regional sets of objectives, this new era of forest conservation in the U.S. in-

cludes purposeful roles for a balance of forest preservation, forest restoration, and sustainable uses of the many goods and services of productive forests.

Some large forested areas are being restored and protected for native ecosystems and rare elements of biological diversity (Johnson et al. 1991). In these areas, natural processes are encouraged, although some human intervention is necessary to create ecological conditions as they existed in presettlement times. For example, prescribed fires are used to create ecologically important resource conditions.

Other areas are being managed as resource conservation areas with appropriate, and at times considerable, intervention to achieve specific objectives. For example, these include wildlife refuges managed for groups of featured species, Kirtland's warbler habitat management areas, and ungulate winter ranges (Botkin 1990).

More of our forest land will contain substantial amounts and distributions of so-called "biological legacies" for long-term diversity, productivity, and resilience of the ecosystems, such as large live trees, standing and fallen dead trees, native hardwoods, riparian areas, the complex flora and fauna of the soil, and the seeds of diversity from native forests (Box 2, Franklin et al. 1989, Skogsstyrelsen 1990, Hansen et al. 1991, Swanson and Berg 1991).

There are also substantial areas where economically efficient production of wood, energy, minerals, water, recreation, and fiber serves the nation's needs (Bingham 1991). But even these intensely managed areas provide considerable environmental services and values, such as clean water, carbon sequestration, habitat for early successional wildlife, and outdoor recreation.

Ideally, people will consider the juxtaposition and relative purposes for all lands on the landscape, one to another. They will see the importance of nature preserves, resource conservation areas, resource production areas, and other lands taken as a complementary whole. Only in this way can we sustain a landscape mosaic that provides for our needs, contributes to regional and national environmental goals, and is resilient and productive over time and space.

Coupled with improving our land stewardship must be increased efficiencies in the production, utilization, and conservation of renewable natural resource products. Forest conservation is not possible without economic prosperity. Both are essential for a healthy global environment. Education, economic development, and conservation to improve the lives of people are essential parts of a global stewardship ethic.

REFERENCES

Baden, J. 1991. Spare that tree! Forbes. December 9, 1991, pp. 229-233.

Berry, W. 1987. Home economics. North Point Press. San Francisco, CA. 192 pp.

Bingham, C.W. 1991. Forest resource availability and use: wood and timber from a U.S. perspective. Society of American Foresters National Convention. San Francisco, CA. 15 pp. plus figures.

Binkley, C.S. 1991. The global economy and rising expectations. Wood Product Demand and the Environment Conference. Forest Products Research Society. Vancouver, BC. November 13-15, 1991. 9 pp.

Botkin, D.B. 1990. Discordant harmonies: a new ecology for the twenty-first century. Oxford University Press. New York, N.Y. 241 pp.

Bowyer, J.L. 1991a. Responsible environmentalism—the ethical features of forest harvest and wood use. National Conference on Ethics in America. Long Beach, CA. 8 pp.

Bowyer, J.L. 1991b. Resource management: a need for realistic assumptions, global thinking. National Stewardship Conference. Duluth, MN. 8 pp.

Bruchac, J. 1991. Native American stories. Fulcrum Press. Golden, CO.

Burgess, R.L. and D.M. Sharpe (eds.). 1981. Forest island dynamics in man-dominated landscapes. Springer-Verlag. New York, NY. 310 pp.

Caplan, J.A. 1992. Striding into elephant country. The George Wright Forum. Vol. 8(4):44-54.

Chappelle, D.E. and H.H. Webster. 1991. Natural resources and societal prosperity: linkages, opportunities and dangers. Wood Product Demand and the Environment Conference. Forest Products Research Society. Vancouver, BC. November 13-15, 1991. 25 pp.

Clark, R.N. and G.H. Stankey. 1991. New forestry or new perspectives? The importance of asking the right question. Forest Perspectives. Vol. 1(1):9-13.

Clawson, M. 1975. Forests for whom and for what? The Johns Hopkins University Press. Baltimore, MD. 175 pp.

Clawson, M. 1979. Forests in the long sweep of American history. Science. Vol. 204:1168-74.

CORRIM. 1976. Wood for structural and architectural purposes. Committee on Renewable Resources for Industrial Materials—National Research council. Wood and Fiber. Vol. 8(1):1-72.

Devall, B. and G. Sessions. 1985. Deep ecology. Peregrine Smith. Salt Lake City, UT. 267 pp.

Easwaran, E. 1985. The Dhamapada. Nilgiri Press. Petaluma, CA. 208 pp.

Fedkiw, J. 1989. The evolving use and management of the nation's forests, grasslands, croplands, and related resources. USDA Forest Service. Rocky Mountain Forest and Range Experiment Station. GTR-RM-175. Fort Collins, CO. 66 pp.

Forman, R.T.T. and M. Godron. 1986. Landscape ecology. John Wiley and Sons. New York, NY. 619 pp.

Franklin, J.F., D.A. Perry, T.D. Schowalter, M.E. Harmon, A. McKee, and T.A. Spies. 1989. Importance of ecological diversity in maintaining long-

term site productivity, in D.A. Perry, B. Thomas, and R. Meurise (eds.) Maintaining the long-term productivity of Pacific Northwest forest ecosystems. Timber Press. Portland, OR.
Frederick, K.D. and R.A. Sedjo (eds.). 1991. America's renewable resources: historical trends and current challenges. Resources for the Future. Washington, D.C. 296 pp.
Gia-Fu Feng and J. English. 1972. Lao Tsu: Tao Te Ching. Vintage. New York, NY.
Gillis, A.M. 1990. The new forestry: an ecosystem approach to land management. BioScience. Vol. 40(8):558-562.
Hansen, A.J., T.A. Spies, F.J. Swanson, and J.L. Ohmann. 1991. Conserving biodiversity in managed forests. BioScience. Vol. 41(6):382-392.
Haynes, R.W. and D.J. Brooks. 1991. Wood and timber availability from a Pacific Rim perspective. Society of American Foresters Annual Convention. San Francisco, CA. Proceedings in press.
Hunter, M.L., Jr. 1990. Wildlife, forests, and forestry. Prentice Hall. Englewood Cliffs, NJ.
Ince, P.J. and J.T. Alig. 1991. Wastepaper recycling and the future timber market. Annual Outlook Conference. USDA. December 2, 1991.
Johnson, K.N., J.F. Franklin, J.W. Thomas, and J. Gordon. 1991. Alternatives for management of late-successional forests in the Pacific Northwest: a report to the U.S. House of Representatives; Committee on Agriculture, Subcommittee on Forests, Family Farms, and Energy; and the Committee on Merchant Marine and Fisheries, Subcommittee on Fisheries and Wildlife, Conservation, and the Environment. 59 pp.
Keystone Center, The. 1991. Final consensus report of the Keystone Policy Dialogue on Biological Diversity on Federal Lands. Keystone, CO.
Knize, P. 1991. The mismanagement of the national forests. The Atlantic. Vol. 268(4):98-112.
Knudsen, T. 1991. The Sierra in peril. The Sacramento Bee. Special Report. Sacramento, CA.
Koch, P. 1991. Wood vs non-wood materials in US residential construction: some energy-related international implications. Working Paper 36. Center for International Trade in Forest Products. University of Washington. Seattle, WA. 38 pp.
Leopold, A. 1949. A Sand County Almanac and sketches here and there. Oxford University Press. New York, NY. 228 pp.
Marsh, G.P. 1864. Man and nature; or, physical geography as modified by human actions. Scribners. New York, NY. 560 pp.
McKibben, W. 1990. The death of nature. Bantam. New York, NY. 229 pp.
Mitchell, J.G. 1990. War in the woods. Audubon, pp. 84-121.
Nash, R.F. 1989. The rights of nature: a history of environmental ethics. University of Wisconsin Press. Madison, WI. 290 pp.
National Research Council. 1990. Forestry research: a mandate for change. National Academy Press. Washington, DC. 84 pp.
Perlin, J. 1991. A forest journey: the role of wood in the development of civilization. Harvard University Press. Cambridge, MA. 445 pp.

Plochmann, R. 1989. The forest of Central Europe: a changing view. The Starker Lectures. Oregon State University. Corvallis, OR.
Postel, S. and J. C. Ryan. 1991. Reforming forestry, in L. Starke (ed.) State of the world 1991: a Worldwatch Institute report on progress toward a sustainable society. W.W. Norton. New York, NY. pp. 74-92.
Prabhavananda, S. and C. Isherwood. 1944. The song of God: Bhagavad Gita. Vedanta Press, Hollywood, CA. 179 pp.
Robertson, F.D. 1991. The next 100 years of national forest management. Transactions of the North American Wildlife and Natural Resources Conference. Wildlife Management Institute. Washington, DC. Vol. 56:19-21.
Sahtouris, E. 1989. Gaia: the human journey from chaos to cosmos. Pocket Books. New York, NY. 252 pp.
Salwasser, H. 1991a. New perspectives for sustaining diversity in the U.S. National Forest System. Conservation Biology. Vol. 5(4):567-569.
Salwasser, H. 1991b. Roles for land managers in conserving biological diversity, in D.J. Decker, M.E. Krasny, G.R. Goff, C.R. Smith, and D.W. Gross (eds.) Challenges in the conservation of biological resources. Westview Press. Boulder, CO., pp. 11-32.
Shugart, H.H. 1984. A theory of forest dynamics: the ecological implications of forest succession models. Springer-Verlag. New York, NY. 278 pp.
Silver, C.S. and R.S. DeFries (eds.). 1990. One earth one future: our changing global environment. National Academy Press. Washington, DC. 196 pp.
Sirmon, J.M. 1991. A new ideal of leadership in natural resources. National Forest Centennial Futures Conference. Atlanta, GA. 5 pp.
Skogsstyrelsen. 1990. Rikare skog. 90-Talets Kunskaper om Naturvard och Ekologi. Jonkoping, Sweden.
Society of American Foresters. 1991. Biological diversity in forested ecosystems: a position statement of the Society of American Foresters. Bethesda, MD.
Swanson, F. and D. Berg. 1991. The ecological roots of new approaches to forestry. Forest Perspectives. Vol. 1(3):6-8.
Thomas, W.L., Jr. (ed.) 1956. Man's role in changing the face of the earth: an international symposium under the co-chairmanship of Carl O. Sauer, Marston Bates, and Lewis Mumford. University of Chicago Press. Chicago, IL. 1193 pp.
Toynbee, A. 1976. Mankind and mother earth: a narrative history of the world. Oxford University Press. New York, NY. 641 pp.
Ulrich, A.H. 1990. U.S. timber production trade, consumption, and price statistics 1960-88. USDA Forest Service Miscellaneous Publication No. 1486. Washington, D.C. 80 pp.
USDA Forest Service. 1990. The Forest Service Program for forest and rangeland resources: a long-term strategic plan. USDA Forest Service. Washington, DC.

Waddell, K.L., D.D. Oswald, and D.S. Powell. 1989. Forest statistics of the United States, 1987. USDA Forest Service. Pacific Northwest Research Station. PNW-RB-168. Portland, OR. 106 pp.
Wall, S. and H. Arden. 1990. Wisdomkeepers: meetings with native American spiritual elders. Beyond Words. Hillsboro, OR. 128 pp.
Waring, R.H. and W.H. Schlesinger. 1985. Forest ecosystems: concepts and management. Academic Press. New York, NY. 340 pp.
Weatherford, J. 1988. Indian givers: how Indians of the Americas transformed the world. Fawcett Columbine. New York, NY. 272 pp.
Williams, M. 1989. Americans and their forests: an historical geography. Cambridge University Press. New York. 599 pp.
World Commission on Environment and Development. 1987. Our common future. Oxford University Press. New York, NY. 400 pp.
World Resources Institute. 1990. World resources 1990-91. Oxford University Press, New York, NY. 383 pp.