Do American Forest Preservation Efforts Cause a Geographic Displacement of Forest Damage?

a study undertaken for the

Sierra Club

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June 2002

Introduction: Geographic Displacement of Environmental Damage Due to Environmental Regulation

When proposed environmental regulations threaten to raise the cost of natural resource extraction or directly limit that extraction, it is often pointed out that such environmental protection measures may simply be shifting environmental damage from one location to another. Because natural resource production is undertaken to serve commercial markets, when one source of supply is restricted, the demand that it would have met goes unsatisfied and markets can be expected to operate to encourage production at other sites in order to meet that demand. That means that the **net** impact of those environmental regulations on global environmental quality is likely to be smaller than would appear if these market linkages were ignored. In fact, the net impact could even be negative if natural resource production is shifted to environmentally more fragile locations and/or locations where environmental regulations are more lax.

This concern has been raised, for instance, with respect to restrictions on timber harvest in the Pacific Northwest. In the political debate over the appropriate level of harvests on public lands in that region, it has often been claimed that the reduction in harvest to protect the spotted owl and other endangered species has led to increased timber harvests in tropical rainforests and the Boreal forests of Siberia with much greater damage to endangered species and forest ecosystems than would have been associated with the blocked harvests in the Pacific Northwest.

The forest products industry has been especially emphatic about this displacement of environmental impacts. One forest products industry think tank has estimated that in the short run each acre of productive timberland in the US and Canadian Pacific Northwest not harvested could lead to 15 times as many acres being harvested in Siberia.[1] To this "need" to harvest many times more acreage in Siberia for the same amount of wood fiber has to be added the very weak environmental controls found in the former Soviet Union where the Russian government has disbanded the independent State Ecology Committee and the Federal Forest Service by merging their functions with the Natural Resources Ministry. The net impact, we are told, is that the forest environment worldwide is left worse off because of shortsighted forest preservation efforts in the Pacific Northwest. Better to let our ancient temperate rainforest be clearcut.

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[1] "Fact Sheet #5: Trade and the Environment Are Linked," CINTRAFOR, www.cintrafor.org/RESEARCH_TAB/links/Fs/FS05.htm (5/31/02). The more careful research rendering of this concern was that 1.9 acres of forestland would have to be harvested in Siberia because of the lower stocking level of the forestland to which the industry would be forced to turn. Because that alternative forestland also has lower timber productivity and higher rotation ages, over the longer term nearly eight times as much land would have to be harvested to replace the land in the US Pacific Northwest lost to environmental protection. John M. Perez-Garcia, 1995, Global Economic and Land Use Consequences of North American Timberland Withdrawals, ***J. of Forestry***, 93(7): 34-37; John Perez-Garcia, 1993, Global Forestry Impacts of Reducing Softwood Supplies from North America, Center for International Trade in Forest Products (CINTRAFOR), WP43.

This concern about the geographic displacement of forest damage because of restrictions on local logging appeals to both environmentalists and economists. Environmentalists have regularly insisted, "you cannot do just one thing" because "everything is connected to everything else." One change triggers a chain of other changes and the net outcome may be quite different than what was expected. That is as true of market relationships as it is of ecological relationships. Economists, of course, have always emphasized the way markets connect distant and apparently unrelated economic actors and the need to study the full chain of adjustments triggered by any particular change as a new equilibrium situation develops.

In both of these environmental and economic contexts, the concern about the geographic displacement of environmental damage due to environmental regulation has a certain plausibility to it. But that casual plausibility is not sufficient to establish the reality of such potential offsetting adjustments. What is important is the quantitative size of the various adjustments compared to the direct impacts of the initial environmental regulation. In addition, the **full** set of adjustments that may be triggered by those environmental regulations and their market impacts have to be considered, not just a selected subset.

In addition, it is important to realize that decisions about timber harvests in the National Forests are unlikely to have a large impact either in the United States or elsewhere in the world for the simple fact that the National Forests contribute so little to total national and worldwide harvests. In 1997, for instance, only 5 percent of total US timber harvests came from the National Forests. Those National Forest harvests satisfied less than 4 percent of total US consumption of round wood.[2] But the US consumption represents only 17 percent of the world roundwood production.[3] National Forest roundwood production thus represents less than one percent of total world production. Thus a very large change in National Forest harvests represents a very small change in total world harvests. For instance, cutting National Forest harvests in half would represent only a one-third of one percent change in world timber harvests. This basic quantitative relationship severely limits the impact that changes in National Forest harvests can have worldwide. Projecting large worldwide environmental impacts from changes in National Forest timber harvests simply is not plausible.

A Primitive Economic View: Material Requirements

Often only a very limited part of the economic context is considered in discussing the potential geographic displacement of natural resource production by environmental regulation. The demand for timber or copper or oil is assumed to be fixed and/or steadily rising at a fixed rate, tied to the "material requirements" of the expanding national or world economy for those inputs. In the past this approach was used to project the "need" for water in agriculture, industry, or urban settlements. It was also used in estimating future industrial and national energy needs. Input-output modeling, built around fixed technical coefficients, as well as linear programming optimization

[2] 2000 RPA Timber Assessment, Tables 12 and 17.
[3] Statistical Abstract of the United States: 2001, Table 1326.

models, often gave formal expression to the idea that inputs had to be combined in relatively fixed quantitative relationships to produce a unit of output.

Although this may be a useful approach in modeling the short run when technological relationships are fixed, prices are fixed, and there are no substitutions possible, such a "material requirements" approach ignores most of the ways in which markets actually respond to scarcity, responses that operate to minimize the disruptive impact that scarcity might otherwise bring. In that sense, such a "material requirements" approach, while posing as an economic analysis, can be profoundly "anti-economic." It is that possibility that this paper explores.

The Full Range of Market Adjustments to a Decline in One Source of Timber Supply

The geographic displacement of forest damage hypothesis asserts two things:

i. Reductions in the volume of wood fiber harvested from one set of forestlands is completely replaced by increased harvest of trees from some other set of forestlands that otherwise would not have been harvested.
ii. The environmental damage associated with the displaced harvest is at least as great as the environmental damage avoided by reducing the original harvest.

Using the declines in federal timber harvests as an example, this section seeks to explore these hypotheses by outlining the full range of market adjustments that the decline in one source of supply of a natural resource can be expected to trigger.

At least in the United States, commercially productive timberland and the standing inventory of wood fiber is spread over several different ownerships: federal forests (US Forest Service and Bureau of Land Management), private industrial timber lands managed by corporate forest products firms, private forestland owners who hold those lands for a variety of purposes (residential sites, farm and ranch woodlots, recreation land, etc.), state forests, Indian tribal forests, and other miscellaneous ownerships. Environmental restrictions in the Pacific Northwest primarily impacted the harvest of trees on federal lands where harvests fell by 90 percent or more between 1989 and 1999. In Oregon, federal timberlands were the source of 52 percent of the statewide harvest in 1989 but provided only 11 percent of the harvest in 1999. In Washington, the federal contribution to total state harvest fell from 17 percent to 3 percent.

This decline in one of the major sources of regional timber supply would be expected to put upward pressure on regional wood fiber supply prices. That, of course, is exactly what happened. Stumpage prices nearly doubled in real terms during the 1990s, carrying prices back to the high levels of the late 1970s. Those higher raw material prices could also be expected to put upward pressure on the prices of products produced from those raw materials, in this case, lumber and paper products. In fact,

lumber prices increased about 60 percent within the Pacific Northwest and softwood lumber prices nationally approximately doubled during the first half of the 1990s.[4]

Market adjustments to increases in regional raw material supply prices

Regional increases in raw material prices due to the loss of one source of raw material supply can be expected to trigger a series of adjustments that will tend to reduce the impact of the reduced supply. The higher local market value of wood fiber will:

i. Encourage increased harvest on other timberlands within the region, for instance on private industrial and non-industrial timberlands.
ii. Tend to divert flows of wood fiber away from other markets towards the local market. For instance, logs that previously had been exported unprocessed to foreign markets will tend to be attracted to local markets for processing. In addition, logs from other regions (e.g. the inland West, Canada, and other countries) may flow into the local area instead. In the Pacific Northwest, the export of unprocessed logs declined 80 percent.
iii. Increase the incentives to develop new sources of supply both within and outside the region. This could include increased investments in more intensively managing forestlands as well as new wood plantations and/or increased harvest of the standing inventory of trees.
iv. Increase the incentives to more fully utilize existing local wood fiber by, for instance, using smaller trees and trees that are more costly to process, and by putting more labor effort into reducing the waste of fiber in the woods and in the mill. Over the last 50 years the production of lumber and paper per cubic foot of round wood used increased by 39 percent.[5]
v. Increase the incentive to use recycled wood fiber and lumber mill residues in other forest products industries such as pulp and paper and structural and non-structural panel mills. Between 1990 and 2000 the rate of reuse of paper and paperboard increased from 27 to 48 percent.[6]

Market adjustments to final product prices

Reductions in wood fiber supply will tend to raise the cost of products produced from that fiber. Those higher forest product prices will also trigger changes that will tend to reduce the impact of the loss of one regional source of wood fiber supply. Those higher forest product prices will tend to:

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[4] David J. Brooks, 1995, Federal Timber Supply Reductions in the Pacific Northwest, ***J. of Forestry***, 93(7):29-33; "Squaring the Circle: The Role of Technology in Meeting the World's Demand for Wood," Clark S. Binkley, Ph.D. Hancock Timber Resource Group, October 13, 2000. http://www.mwp.org/Binkley.ppt. Also see ***Production, Prices, Employment, and Trade in Northwest Forest Industries, All Quarters 1999***, Debra D. Warren, Resource Bulletin PNW-RB-235, Pacific Northwest Resource Station, US Forest Service, USDA, June 2001.

[5] P. 59, 2000 RPA Assessment of Forest and Range land, FS-687, February 2000, US Forest Service, USDA; p. 23, "Pulpwood Supply and Demand," Peter J. Ince and Irene Durbak, *J. of Forestry*, March 2002.

[6] Ibid.

i. Reduce the quantity of wood products consumed. Estimates of the sensitivity of global demand for logs to changes in stumpage prices indicate that a one percent increase in price results in a one percent decrease in the quantity demanded.[7]

ii. Encourage the development of new wood products that are less wood fiber intensive. For instance wood trusses, glued-laminated beams, or wood "I-beams" made out of laminated veneer lumber and structural panel elements can use 35 to 50 percent less wood fiber.[8]

iii. Encourage the development of new wood products that make more complete use of the wood fiber harvested, for instance the substitution of plywood for wood-board sheathing and, later, the substitution of oriented strand board (OSB) for plywood. One analyst calculates that lumber production used only 40 percent of the log; plywood 50 percent, OSB, 55 percent; but new engineered wood products such as Parallam and Timberstrand use 75 percent of the log.[9]

iv. Encourage the substitution of non-wood products for wood products, for instance the substitution of recycled steel, concrete products, or synthetic material for wood in building construction and the use of kenaf and other fibers for paper.

This extensive list of adjustments that the loss of one regional source of supply could trigger partially confirms the concerns about the geographic shifting of environmental impacts. Although some of the adjustments primarily involve reductions in the consumption of wood fiber, some of the other adjustments could have significant environmental impacts of their own that have to be considered in evaluating the net impact of a reduction in one source of regional timber supply. The changes primarily involve improved utilization, reduced waste, increased recycling, and simply reduced usage and can be expected to have only modest environmental impacts of their own. One timber industry analyst has estimated that these types of market-based adjustments and market supported technological change could allow harvests from natural forests to be reduced by almost 60 percent while meeting the expanding demand for wood fiber.[10] But there remains the question of the environmental impacts of those other market-driven adjustments that do involve geographic shifts in harvests.

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[7] Sohngen, B, R. Mendelsohn, and Rjoger Sedjo, 1999, Forest Management, Conservation, and Global Timber Markets, ***Amer. J. Agr. Econ.***, February, p. 5; Sohngen, B.L., 1996, Integrating Ecology and Economics: The Economic Impacts of Climate Change on Timber Markets in the United States," PhD dissertation, Yale University; Sedjo, R. A. and K. S. Lyon,1990, The Long Term Adequacy of the World Timber Supply. Washington DC: Resources for the Future.

[8] "Engineered Lumber Products," Al Schuler et al., ***J of Forestry***, December 2001, pp. 28-35.

[9] "Squaring the Circle: The Role of Technology in Meeting the World's Demand for Wood," Clark S. Binkley, Ph.D. Hancock Timber Resource Group, October 13, 2000. http://www.mwp.org/Binkley.ppt

[10] "Squaring the Circle: The Role of Technology in Meeting the World's Demand for Wood," Clark S. Binkley, Ph.D. Hancock Timber Resource Group, October 13, 2000, slide H. http://www.mwp.org/Binkley.ppt

Shifting Sources of Timber Supply

Adjustments in the Pacific Northwest

Even within a given region, the reduction in harvest from one ownership can encourage increased harvests on other ownerships. Markets link these harvests because all forestland owners sell into a common market in which there is not an unlimited (perfectly elastic) level of demand. Expanded harvests from one source tend to reduce the incentive to havest from other sources. High levels of National Forest harvest can reduce wood fiber prices that in turn will discourage harvest on private timberlands and investments in increasing the future productivity of those lands. Significant reductions in National Forest harvest can have the opposite impact. This was demonstrated, for instance, by the harvests on non-industrial private forestlands during the period of peak stumpage values in the first half of the 1990s following the reduction in federal timber harvests in both the Pacific Northwest and the Northern Rockies. The expansion of industrial harvests during the 1970s as National Forest harvests fell from their peak level of the late 1960s also demonstrate the linkage between these different sources of regional timber supply. In Montana, for instance, between 1969 and 1994 National Forest harvests fell from about 850 to 350 mmbf but total private harvests increased from about 350 to 750 mmbf.[11] See Figure 1.

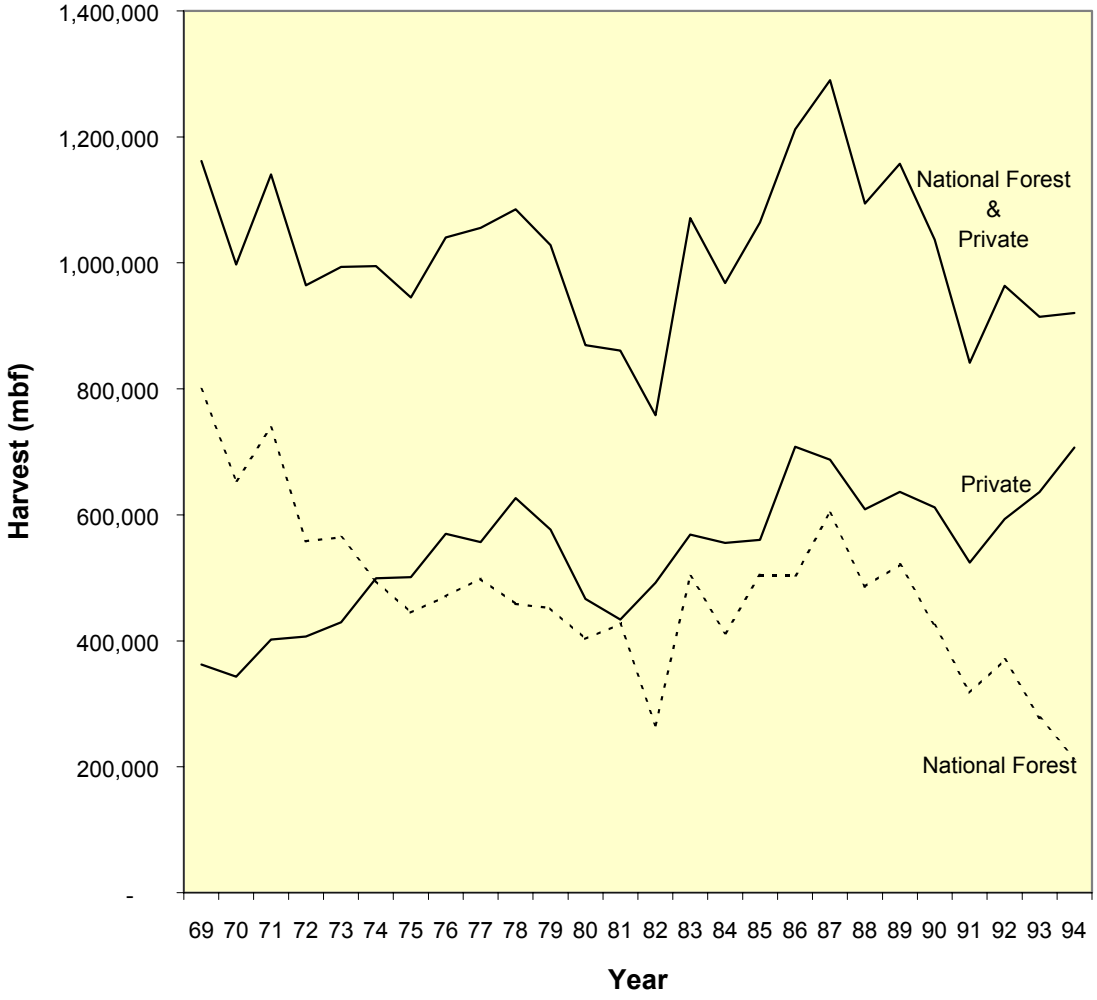
There are two important implications of this economic linkage among harvest from different regional sources of supply. First, central to this paper, the decline in one type of harvest *can* lead to expansions in other types of harvest, even within a particular region. The quantitative characteristics of this linkage, however, are important in understanding the extent of any "displacement" of timber harvests to other ownerships. In Oregon, for instance, although non-industrial private timber harvests initially increased by about 400 mmbf as federal timber harvests plummeted, National Forest harvests declined by 3,000 mmbf, swamping the increase from the non-industrial private lands. Similarly in Montana from the late 60s to the mid-90s, total harvest declined significantly despite the increases in private harvests that partially offset the declines in National Forest harvest. Second, changes in one source of supply do not tells us much about how the overall supply has changed. Changes in other sources of supply are likely to at least partially offset the declines in any one source, cushioning the impact on the total.

The other market responses to higher wood fiber values listed above have also been important in the region. As wood fiber values rose steeply in the early 1990s in the Pacific Northwest, exports of unprocessed logs declined dramatically. Those logs became available for processing in regional mills. The net result was to stabilize the timber supply available for processing in the region.[12] See Figure 2.

[11] ***Montana Business Quarterly***, 40(1), Spring 2002, p. 32, Figure 6.

[12] Of course that meant that the Asian countries, especially Japan, that previously imported logs from the Pacific Northwest states now sought other sources. Japan turned primarily to the Nordic forests of Europe.

Figure 1
Montana National Forest and Private Timber Harvests

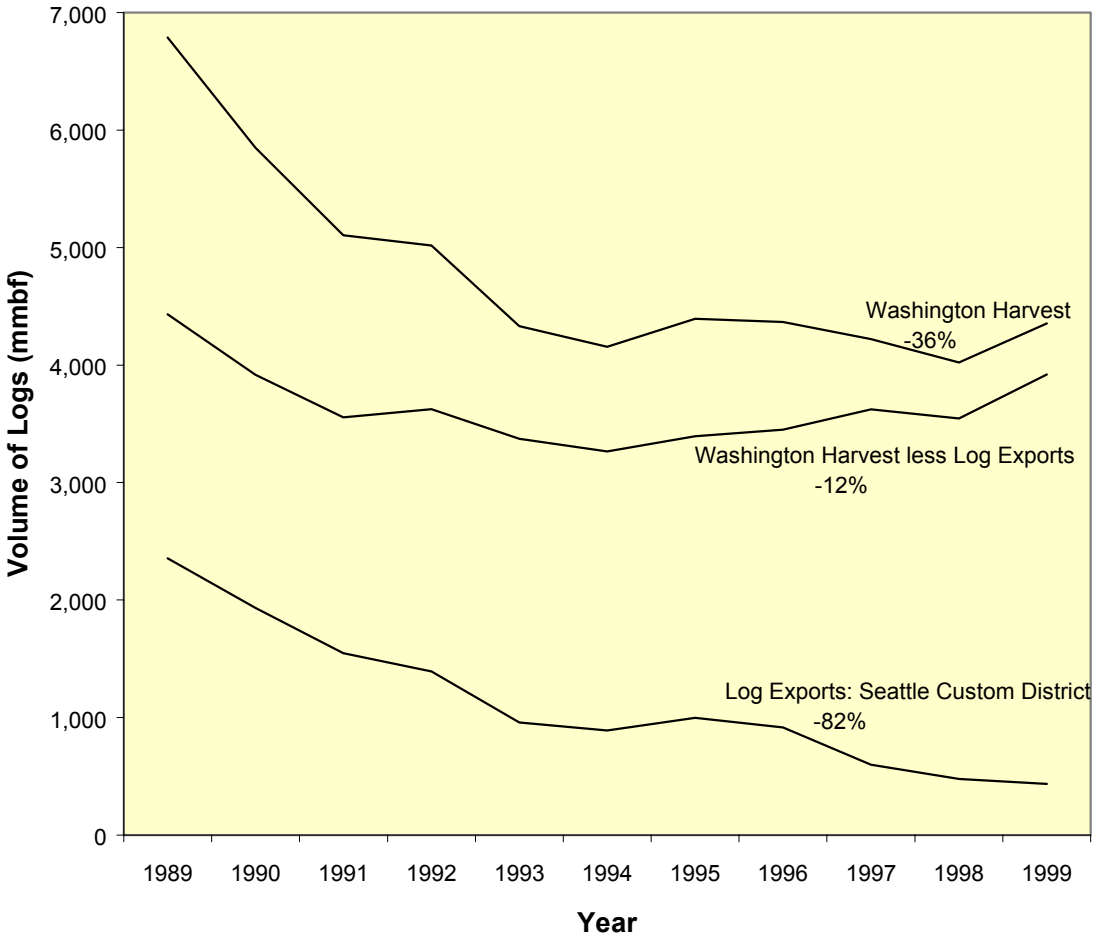


It seems clear that reduced timber harvests on public lands in the Pacific Northwest *did*, among other things, lead to an expansion of harvests on other lands within the region. One estimate of that shifting in the location of timber harvests due to reduction in harvests in the Pacific Northwest because of environmental constraints was that about a fifth of that reduced harvest would be made up within the region. Another fifth would be made up elsewhere in North America. Another fifth would be made up in the Nordic forests of Europe and a small amount in Japan. Almost 40 percent of the harvest reduction would not be made up by harvests elsewhere. See Table 1.

Given the higher value of fiber, the use of round wood in paper production also declined as the round wood flowed to lumber mills first and then the waste products from those mills flowed to pulp and paper mills. In addition, the use of recycled paper fiber in regional mills increased. As a result, despite the dramatic declines in federal timber harvests, both lumber and paper production remained relatively constant during the

1990s in Washington.[13] For the three states of Washington, Idaho, and Montana combined, the 82 percent decline in National Forest harvests was associated with only a 5 percent decline in lumber production. See Figure 3. In Oregon, lumber production also increased after 1994 despite ongoing declines in National Forest harvests. Across the Pacific Northwest, the higher stumpage prices justified more labor-intensive efforts to increase wood fiber utilization, helping to stabilize wood products employment. This was especially clear in Montana and Idaho. 1999 wood products employment in Montana was only 9 percent below the 1988 level of employment despite a 65 percent decline in the federal harvest and a 25 percent decline in total harvest. In Idaho, forest products employment was the same in 1999 and 1988 despite the 72 percent decline in National Forest timber harvest and 24 percent decline in total harvest. See Figure 4.

Figure 2
Washington Harvests and Log Exports, 1989-1999



[13] Washington Mill Survey 1986-1996: Has the Sun Really Set on Washington State's Forest Products' Industry?, Dave Larsen and Phil Aust, Washington State Department of Natural Resources, a paper prepared for the 34th Annual Pacific Northwest Regional Economic Conference, April 26, 2000.

Table 1

Adjustments to a 100 Unit Decline in Timber Harvest in the US PNW and British Columbia in 1995	
Pacific Northwest Decline	100
Pacific Northwest Increase	20.7
Net Pacific Northwest Impact	-79.3
Increased Harvests Elsewhere	
Southern and Eastern US	15.6
Eastern Canada	3.6
Nordic Europe	20.4
Japan	2.1
Increases Outside of the PNW	41.7
Reduced Production	37.5

Source: J.M. Perez-Garcia, Global Economic and Land Use Consequences ***J. of Forestry***, 93(7):34-38, July 1995, Figure 2.

A good deal of the conflict over timber harvest on public lands in the Pacific Northwest has focused on limiting the extension of roads and clearcuts to relatively pristine areas, especially old growth forests. Protection of roadless areas and old growth forests has been the focus of the debate. To the extent that instead of harvesting in roadless areas or old growth forests, harvests shifted to non-industrial timberlands and industrial timberlands that had previously been developed and harvested, there may have been significant ecological gains because the extent of the disturbance caused by timber harvest and road building was contained in already disturbed areas. Projections of future harvests suggests that economic forces will lead to an increased focus on intensively managed plantations on more productive and less costly sites in the Pacific Northwest rather than extensive harvest across the forested landscape and entry into relatively pristine areas.[14] This is likely to significantly reduce environmental impacts. The shifts to overseas locations will be discussed below.

[14] Ralph Alig, John Mills, and Brett Butler, "Private Timber lands: Growing Demands, Shrinking Land Base," J. of Forestry, p. 32-37, March 2002, p. 36, Table 2.

Figure 3
Timber Harvest and Lumber Production: WA, ID, and MT

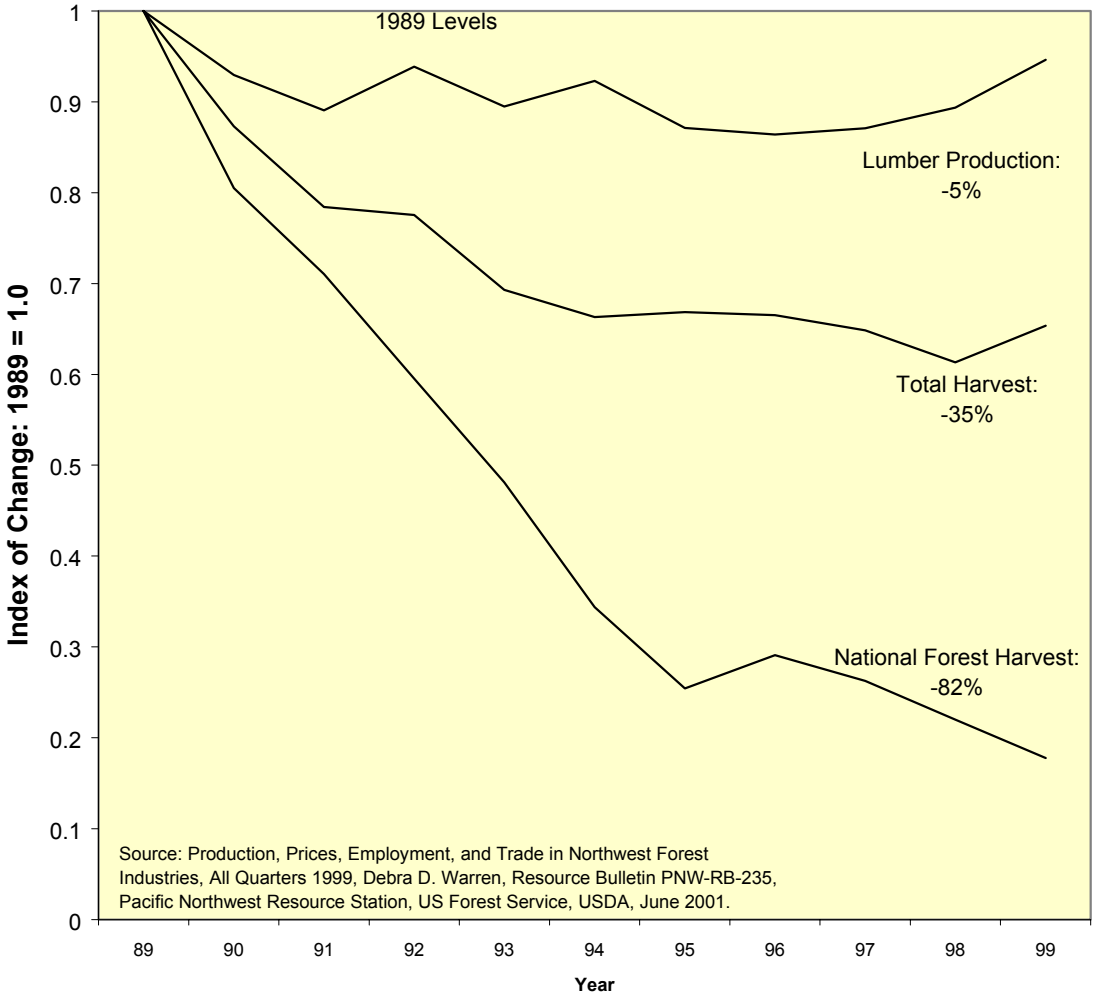
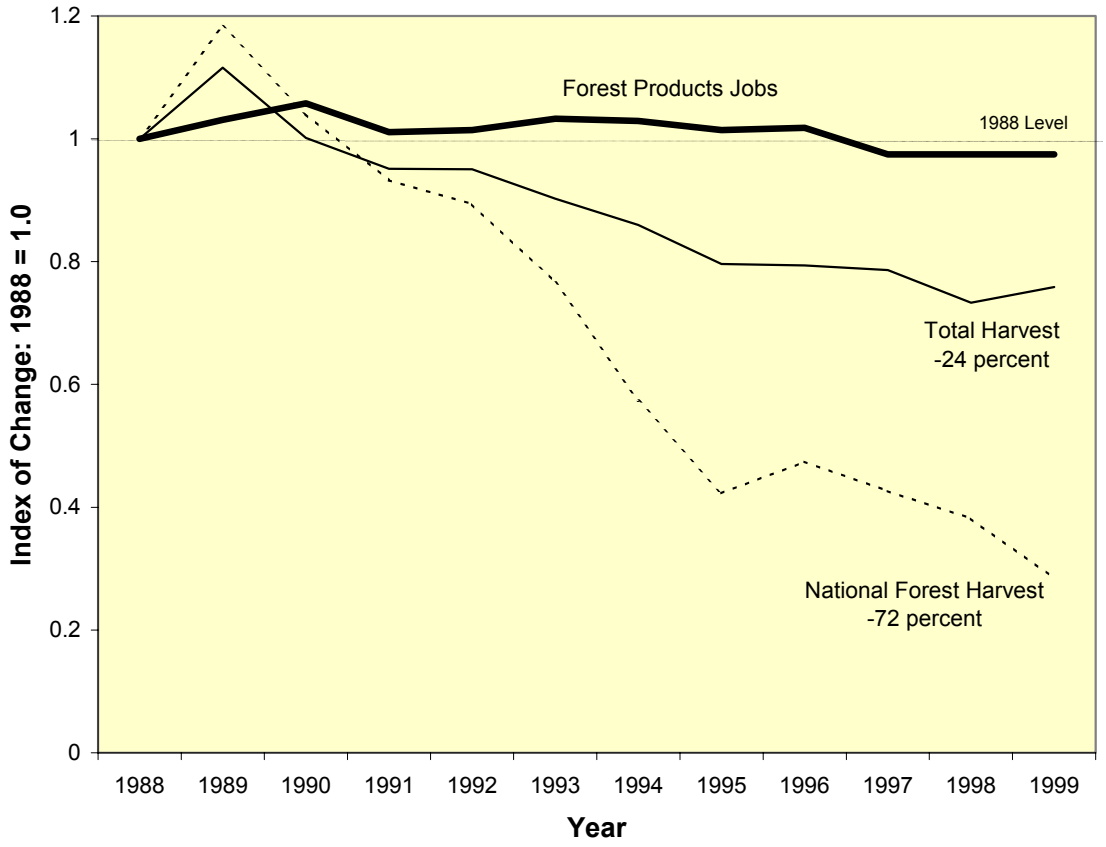


Figure 4: Changes in Timber Harvest and Forest Products Employment: Idaho and Montana



Adjustments within the United States

Although much of the concern about the displacement of forest damage as a result of reduced harvests from the National Forests has focused on damage done by increased harvests in tropical rainforests and the forests of Siberia, analysis of future wood fiber supply and demand in the United States suggests that the primary adjustment that will be made in the source of wood fiber for American markets is **within** the United States. The US will **not** rely heavily on harvests in tropical areas, and, where tropical areas are the source of additional fiber, it will come from plantations, not pristine natural forests.[15]

[15] Richard W. Haynes and Kenneth E. Skog, ***J. of Forestry***, March 2002, p. 11. Also see "The Potential Role of Plantations in Future Timber Supply," January 21, 1999, Brent Sohngen and Roger Sedjo Resources for the Future Working Paper, Washington DC.

One key element in thinking about the impact of a change in the level of harvest from one source of timber supply within the US is the existence of an increasingly integrated national wood products market. Not only are sources of supply within any one region such as the Pacific Northwest competing with each other to serve the same local market, but they are also competing with each other in a national market indirectly through the sale of the wood products they produce. Both the Pacific Northwest and the South sell into regional markets that lie between them; Rocky Mountain and Northern forest regions do the same. As a result there is a relatively well integrated national market that links all American forest regions.[16]

The most recent Resource Planning Act (RPA) "Assessment of Forest and Range Lands" by the US Forest Service modeled the US supply and demand for wood fiber over the next 50 years.[17] That assessment projected a major expansion in American demand for wood fiber and an accompanying expansion in the volume of timber harvested. Most of the increase harvest was projected to come from private plantations in the American South. For instance, softwood harvests were projected to increase 35 percent nationwide, but 78 percent of that increase would take place in the South. Timber harvests in the Pacific Northwest were also projected to increase over the next 50 years, but that harvest would be tied to the maturing of the second growth plantations that followed the harvests over the last 50 years. See Table 2.

The increased harvest will largely be of non-sawtimber that produces wood fiber for composite products, pulp, paper, and paperboard. Oriented strand board (OSB) production will largely displace softwood plywood.[18] The shift to OSB and other wood products making use of wood chips and sawmill residuals along with the shift towards engineered lumber products is projected to reduce the demand for larger sawtimber and shift demand towards wood fiber itself and much smaller trees. It also reduces the amount of wood fiber that is needed to accomplish any given structural objective by 35 to 50 percent. Those engineered lumber products include laminated veneer lumber, oriented strand lumber, and prefabricated wood I-joists using OSB for the web.[19]

[16] See "Federal Timber Restrictions and Interregional Arbitrage in U.S. Lumber," 1998, Brian C. Murray and David N. Wear, ***Land Economics, 74(1):76-91.***

[17] *2000 RPA Assessment of Forest and Range land*, FS-687, February 2000, US Forest Service, USDA; also see detailed discussions of the various component parts of that assessment by the modelers in a series of articles in the March 2002 issue of the ***Journal of Forestry.***

[18] Haynes and Skog, op. cit. p. 10.

[19] For a discussion of the ways in which engineered lumber products reduces the consumptions of wood fiber and large trees see "Engineered Lumber Products," Al Schuler et al., ***J of Forestry***, December 2001, pp. 28-35.

Table 2

2000 RPA Projections of Changes in Softwood Production in the United States 1997-2050 (millions of cubic feet)				
Region	1997	2050	% change	% of Total US Change
South	6,157	8,954	45.4%	78.3%
North	825	818	-0.8%	-0.2%
Rocky Mnt.	612	912	49.0%	8.4%
Pacific Coast	2,507	2,991	19.3%	13.5%
Total US	10,101	13,674	35.4%	100.0%

Source: R.W. Haynes,"Forest Management in the 21st Century," ***J. of Forestry***, March 2002, Table 1, p. 40

Marginal agricultural land and the more productive lands already managed for timber in the South will continue to be converted to intensively managed plantations. The attraction of these lands and this wood fiber production technology is that it is capable of producing a commercially valuable tree in as little as 10 to 20 years while in the Pacific Northwest and Northern Rockies that rotation can take 30 to 50 years. Even within the South, a new generation plantation is many times more productive of wood fiber than a natural stand, yielding at age twenty 29.3 cords of pulpwood **and** 59.5 cords of sawtimber compared to only 6.5 cords of pulpwood from the natural stand.[20] That represents a 14 fold increase in productivity. When costs are accounted for, the profitability per acre per year is almost 12 times as high on the new generation plantations compared to natural stands in the South.[21]

These results indicate why timber production in the Southern US may well be competitive with production in other areas of the world. Just as important in terms of the question of shifting environmental impacts, the land base needed to meet society's demand for wood is dramatically reduced by these intensively managed plantations. One estimate for the Georgia Piedmont region is that if timber were produced on abandoned farmland using current generation plantations, the amount of land that would have to be used would be reduced to less than 20 percent of what is currently being used.[22]

Of course intensive plantation production could involve greater environmental disturbance as a result of more frequent entry, a lower degree of biodiversity, and the use of herbicides and fertilizers. However, when the lands being converted to plantations were previously being used for agricultural production, it is not clear that there is any increase in environmental disturbance at all.

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[20] Runsheng Yin and Roger A. Sedjo, "Is This the Age of Intensive Management?," ***J. of Forestry***, December 2001, p. 14.
[21] Ibid, p. 16, Table 6.
[22] Ibid, p. 17. Also see "Squaring the Circle: The Role of Technology in Meeting the World's Demand for Wood," Clark S. Binkley, Ph.D. Hancock Timber Resource Group, October 13, 2000. http://www.mwp.org/Binkley.ppt

The shift in timber harvests within the US from federal lands to private lands may, however, reduce the role that non-commercial values can play in the management of those forestlands. State laws have increasingly been passed to govern forest management practices within states. The effectiveness of such regulation in protecting non-commercial forest values, however, varies considerably across the nation.[23] Critics of the US Forest Service, however, would make the same point about the Forest Service's performance in the second half of the twentieth century. In any case, the shift of timber harvests from virgin federal forestlands primarily in the mountainous west to previously harvested and/or farmed private lands in the South represents a change in the regulatory regime governing a part of US timber harvests.

Besides projecting future US timber supply and demand, the 2000 RPA assessment also modeled two different dramatic changes in National Forest timber management policy. One was the adoption of a policy that ended all harvest on National Forest land in 2002. The second National Forest management policy that was modeled moved in the opposite direction: Timber harvests on federal land in the inland West would be doubled.[24]

According to these USFS projections of future timber harvests, moving National Forest harvest to zero would result in an annual loss of 700 million cubic feet of logs from this source, about 6 percent of national harvests averaged over the next 50 years. Doubling the National Forest harvest in the inland West would increase harvest from this source by 445 million cubic feet or about 4 percent of projected total national timber harvests. It is important to note that these RPA projections assume that timber harvests from National Forest lands in 2050 would be more than double those in fiscal year 2001. In fiscal year 2001 the harvest from National Forests was only about 383 million cubic feet. Clearly reducing this harvest to zero could have an impact no larger than that harvest level. The RPA modeling, therefore, is significantly exaggerating the likely impact of ending commercial timber harvests in National Forests.

The projected loss of this 700 million cubic feet of federal harvested logs, of course, was not projected to reduce US harvests or US sawtimber consumption by this amount. Markets and 9 percent higher log prices intervened to adjust both supply and demand. As federal harvests declined by a projected 700 million cubic feet, harvests elsewhere in the US, primarily on private lands in the South, increased by 365 million cubic feet. The net reduction in harvests in the US was about half of the reduction in the federal harvest. But that was not the end of the adjustment: Lumber product imports from outside the US, primarily from Canada, increased and overall consumption of lumber products in the US declined because of the price increases. If one traces through the adjustments, for every 100 units of sawtimber not harvested from federal lands, 52 more

[23] See Greene, J.L.; Siegel, W.C. 1994. The status and impact of state and local regulation on private timber supply. Gen. Tech. Rep. RM-255. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

[24] The "inland West" included the eastern part of the Pacific Northwest, the Pacific Southwest, and the northern and southern Rocky Mountain regions.

were harvested on private lands primarily in the South, US consumption declined by about 23, and imports primarily from Canada increased by about 25. On net, the 100 unit loss of federal harvest led to a 23 unit decrease in US consumption of wood products.[25]

If, instead, harvest from National Forest in the inland West were to double, sawtimber prices would decline by 2.4 percent, discouraging private timber harvest and imports, while encouraging increased consumption of sawtimber products. A 100 unit increase in federal harvest resulted in a 67 unit decrease in timber harvest on private land, mostly in the South, so net national harvests increase by 33, not by the 100 unit National Forest increase. Imports of lumber decline by 16 units but consumption increases by 17 because of the lower lumber prices. On net, a 100 unit increase in federal harvest resulted in a 17 unit increase in US consumption of wood products.[26]

Worldwide Adjustments

Recent economic modeling has attempted to deal directly with the question of timber harvests geographically displaced by forest preservation efforts in the United States. Sohngen et al. developed a forward-looking dynamic model of global timber markets in which an expanding demand function captures predicted increases in the future demand for forest products.[27] The timber supply function is a dynamic model in which potential producers in many different and separately modeled regions of the world anticipate future demand and make efficient investments in future timber supplies. Future supply can come from two sources, harvest from currently "inaccessible" areas (natural forests that have not been previously roaded or harvested) and forests already under management, including more or less intensively managed plantations. Forest investment in future timber supplies is endogenous to the model as are changes in the standing inventory. As market conditions develop, each region adjusts harvest levels and investments in future supply allowing adaptations that follow efficient gradual pathways. The model predicts future timber market prices, levels of harvest, forest investments, and the amount of forestlands left un-managed and un-harvested (e.g. that which is effectively "economic wilderness").

Sohngen et al. model a 150-year period during which demand grows initially at 1 percent annually, declining to a steady state at the end of that period. Real global prices rise 88 percent and global harvests respond by increasing 56 percent. The supply response varies by region depending on costs and forest stand condition. Most of the future increases in timber harvests come from plantations in the subtropical regions, not

[25] 2000 RPA Timber Assessment, *An Analysis of the Timber Situation in the United States: 1952 to 2050*, A Technical Document Supporting the 2000 USDA Forest Service RPA Assessment. Chapter 4, p. 5, and Table 22. (Draft --- Currently being edited for final publication. *Revised on 04/02/2002.* http://www.fs.fed.us/pnw/sev/rpa/ .

[26] Ibid.

[27] Sohngen, Brent, Robert Mendelsohn, and Roger Sedjo. 1999. Forest Management, Conservation, and Global Timber Markets, ***Amer. J. Agr. Econ.*** 81(1):1-13; Brent Sohngen, "Forest Management Conservation and Global Timber Markets," Remarks to the Forest Ecosystem Information Exchange and Musungan Conference, Wells Conference Center, University of Maine, May 4, 2000.

from additional harvests in already managed forests in the temperate regions or in currently unmanaged natural forests around the world. In the areas of particular concern in the debate over US harvests displaced by forest preservation efforts to other areas of the world, the boreal forest of Siberia and the tropical forests, commercial timber harvest is projected to lead to a reduction of only 4.5 percent of the currently unmanaged forests of Siberia and 8.9 percent of the unmanaged tropical forests over the next 150 years. Worldwide, 11.4 percent of the currently unmanaged natural forests would be commercially harvested. The pressure on Pacific Northwest's unmanaged natural forests would be greatest; they are projected to decline 58.4 percent and North America's unmanaged natural forests as a whole would shrink 25.5 percent and those in the Nordic regions of Europe would shrink 25.5 percent. Clearly most of the pressure of meeting future timber demand will not be felt in the Siberian and tropical forests. Most of that pressure will continue to be felt in North America and Europe.

In this context Sohngen et al. consider the impact of ambitious natural forest preservation programs in North America and Europe that would set aside 5 and 10 percent of the productive timberland base, 57 and 114 million acres, to be managed for non-timber values.[28]

Sohngen et al. seek to answer directly the question of what impact such extensive forest preservation measures in North America and Europe would have on timber harvests elsewhere in the world. When all of the worldwide market adjustments are worked out, they project that the 114 million acre set aside would lead to the entry of an additional 570,000 acres in Siberia and 3.6 million acres in the tropics. Worldwide, 4.3 million additional acres that would otherwise not have been entered are harvested. Only about 4 percent of the preservation set-aside is offset by additional harvest on lands that otherwise would not have been entered for commercial timber harvest. That is 96 percent of the preservation set-aside is not offset by entry into pristine natural forests to make up the lost harvest. See Table 3 below.

Table 3

The Impact on Remaining Undeveloped Natural Forests of Preserving 5 and 10 Percent of Natural Forests in North America and Europe for Non-Timber Values

	Millions of Acres of Remaining Undeveloped Natural Forests Harvested Because of the Preservation of Forests in NA and Europe					
	North America	Nordic Europe	Siberia	China	Tropics	Total
5% Set Aside (57 million acres)	1.15	0.06	0.26	0.92	2.43	4.82
10% Set Aside (114 million acres)	-1.08	0.10	0.57	1.07	3.61	4.26
Percentage Offset of the Forest Set Asides						
5% Set Aside (57 million acres)	2.0%	0.1%	0.5%	1.6%	4.3%	8.5%
10% Set Aside (114 million acres)	-1.0%	0.1%	0.5%	0.9%	3.2%	3.7%

Source: Sohngen et al. 1999 and Sohngen 2000.

[28] Low productivity forestland that is costly to harvest and not part of the commercial timber base, e.g. much of the National Forest roadless areas, would, assumedly, not be included in these preservation set asides since they are not commercial timberland..

In addition to more acres that would otherwise not have been harvested being harvested, existing managed forestland would also be managed more intensively and entered more frequently. If this is measured in terms of the average years to the next harvest (approximate rotation age), this impact is also quite small, less than one percent.

Finally, stumpage prices rise. This is good for producers and bad for consumers. It also encourages more efficient use of wood fiber, increased recycling, reduced waste, and reduced consumption. But the price increases due to these environmental forestland set asides are also quite small, less than one percent.

For these displaced timber harvests to have as large an environmental impact as those prevented in North America and Europe, the lands where the displaced harvest takes place (e.g. tropical forests, Siberia, or other forests in North America or Europe) would have to be 27 times as important ecologically or the damage associated with that harvest 27 times as great. Although that is possible if particularly sensitive areas are left unprotected and are logged, it is not obvious that this is a likely outcome.

Explanations for the Lack of Harvest Displacement to Tropical and Siberian Natural Forests

More Profitable Alternative Sources of Supply

The primary reason that forest protection efforts in the United States do not have a major impact on tropical and Siberian forests is that entry into currently inaccessible areas for commercial timber harvest is an unnecessarily costly response to reduced supply and increased stumpage prices. There are less costly and more productive and profitable ways of supplementing supply. The more profitable response is increased investments in the establishment of plantations in emerging sub-tropic regions such as Australia, New Zealand, Chile, Argentina, South Africa, and Iberia. In these regions, land productivity is high enough and land costs are low enough to justify additional investment. In addition, within the United States, intensively managed plantations will continue to develop on marginal farm land in the southern states. Finally, as demand and prices rise, more intensive management of northern forests in the US will also be justified.

Entry into tropical and Russia's boreal forests for timber management simply is not as commercially attractive as the other alternatives available. Even without explicit environmental protection efforts, many of the current inaccessibly forestlands around the world will remain "economic wilderness areas" because productivity, entry, harvest, management, and transportation costs do not justify commercial timber harvest in them.

Of course, government subsidies and other policies could act to off set that basic economic rationality and encourage entry and timber harvest despite the net financial losses involved. That certainly has happened on public forestlands in the United States

and Canada and could be part of a broad worldwide pattern too. It is important to note, however, that such uneconomic entry of these inaccessible forestlands is not a market-based response to forest preservation efforts in the United States. In fact, the opposite could be argued. To the extent that the United States government refuses to protect its own ecologically important old growth forests and continues to support below-cost timber harvest on public lands in the pursuit of local economic development objectives, it encourages other nations to do the same and to resist political efforts to reduce the deforestation of tropical rainforests.

The Limited Role Worldwide Timber Markets Play in Tropical Deforestation

The primary source of deforestation in tropical regions is not commercial timber harvest for sale in international markets. In fact, such harvests play only a very small role in the tropical deforestation that is primarily driven by expanding agricultural activity, some of it indigenous subsistence production, some for internal markets, but much of it for international agricultural markets, especially beef, soybeans, palm oil, coffee, and cocoa markets.[29] The trees are removed not for their commercial value but to prepare the land for agriculture. In that sense the deforestation is similar to what took place in 17th through the early 19th centuries in the United States as eastern forests were cleared so that the land could be converted to agricultural production. Trees are also harvested for their subsistence and commercial value in **local** markets. In some regions, charcoal production and fuel wood are important sources of deforestation. In others trees are harvested to provide local building materials for the expanding population but not sold into international markets. In this context it should not be surprising that changes in international timber market conditions do not play a significant role in accelerating or retarding tropical deforestation.[30]

Explanations for Earlier Estimates of Significant Displacement

Most past assertions about the geographic displacement of timber harvest to tropical areas due to American forest preservation measures were not based on any careful economic analysis or modeling. As discussed earlier, they were tied to a rather primitive "materials requirement" approach to raw material markets that assumed away most of the adaptability of a market economy, in particular, substitution, technological change, and investments that boost timber productivity.

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[29] Jared Hardner and Richard Rice, 2002, "Rethinking Green Consumerism," ***Scientific American***, May 2000, pp. 89-95.

[30] "The role of domestic timber markets in tropical deforestation and forest degradation in Ecuador: Implications for conservation planning and policy," Rodrigo Sierra, ***Ecological Economics*** 36(2001):327-340; **"Tropical Deforestation," Malcolm Gillis, President, Rice University, 1996** Rice Environmental Conference**,** Friday, February 2, 1996**,** http://space.rice.edu/hmns/dlt/Gillis.html. Commercial timber harvest activity has an impact that has little to do with commercial timber harvest itself. The roads that are built so that timber can be exported also allow landless people to move into the region and to completely deforest it for agricultural purposes. In that sense very small levels of commercial timber harvest can have very large deforestation impacts.

There have been a few past attempts to carefully model the economic impact of forest preservation efforts on worldwide timber markets. One past modeling effort[31] used the Timber Supply Model (TSM) developed by Resources for the Future. That model however, does not completely model timber supply responses outside of North America. Large parts of the world timber supply (about half) were simply specified as non-responsive to market forces or an arbitrary adjustment was made from outside the model. Much of the supply response to changes in stumpage prices was not endogenous to the model but pre-specified by the modelers. Another effort used the Global Trade Model (CGTM) developed by the Center for International Trade in Forest Products (CINTRAFOR).[32] That model focuses primarily on trade flows and assumes fixed technical relationships between log volume and product yield and a continuation of past harvest patterns in each region. In addition, both of these past modeling efforts did not assume that timber producing regions and firms could foresee changes in overall economic conditions and respond ahead of time with investments that adjust supply. Instead, all adjustments were made year-by-year to prices as those prices actually developed each year. This is not how rational economic actors behave. As a result of these past weaknesses in the modeling, much of the adaptability one would expect from firms and markets was assumed away and the costs of adjusting to changes in supply were higher. It is important to note that one of the coauthors of the 1999 analysis of the impact of forest protection set-asides that was discussed above, Roger Sedjo, also was involved in the earlier, less complete modeling. In that sense, this more recent modeling represents an updating and revision of the earlier efforts.

The earlier TSM projections by Sedjo[33] modeled a permanent 30 percent decline in commercial timberland in the western US and a 20 percent decline in British Columbia. It found that most of the adjustment would take place elsewhere in North America (the southern US and eastern Canada), the Nordic region of Europe, and the emerging plantation regions in the subtropics. About two-thirds of the lost harvest in the western US and British Columbia was made up by increased harvests elsewhere in the world. The environmental impacts associated with the increased harvests were not projected to be high because that harvest would take place on relatively flat lands, in second growth forests, and in plantations established on degraded agricultural lands that had previously been cleared for marginal agricultural production.

The earlier CGTM projections modeled similarly large permanent reductions in timber harvest in the US Pacific Northwest and British Columbia.[34] In that modeling, about 62 percent of the reductions in harvest were offset by expanded harvest elsewhere in the world; the other 38 percent represented permanent reductions in consumption. Most of the increased harvest (64 percent) took place elsewhere in North America, mostly on private lands in the US south and the western states. The rest of the "displaced harvest" took place in Europe and Japan. Reduced US harvest was not shifted to the tropics.

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[31] Roger A. Sedjo, 1995, "Local Logging, Global Effects," ***J. of Forestry*** 93(7):25-28.
[32] John M. Perez-Garcia, 1995, Global Economic and Land Use Consequences of North American Timberland Withdrawals, ***J. of Forestry***, 93(7): 34-37.
[33] Sedjo, 1995, op. cit.
[34] Perex-Garcia, 1995, op. cit.

Because that modeling focused on trade patterns rather than wood fiber production technologies, it did not model any shift to intensive plantation production. Instead, production shifted to less productive, lower stocked, forestland; past production patterns in each region continued. Because less productive and more poorly stocked forestland had to be turned to for the replacement harvests, a much larger acreage of land had to be disturbed. It is exactly that type of fixed extensive response to reductions in one source of supply that the Sohngen et al. analysis discussed above sought to avoid hard-wiring into the model. When the source of new harvests is determined on an economic basis, there is no longer a projected shift of harvests to low-productivity, inaccessible, natural forests.

The Displaced Environmental Damage Hypothesis: Public Policy Implications

Forest protection efforts can be seen primarily as *economic* efforts to make sure that the full range of forest values, not just the commercial forest values, are accounted for in forest management decisions. Environmental regulations tend to increase the commercial cost of logging and/or reduce the level of harvest. In a market setting this tends to lead the price of wood fiber to rise. Part of the impact of those environmental regulations *is* that timber harvests tend to shift to other locations. As that harvest shifts, environmental efforts are likely to shift with the harvest to also minimize the damage to other forest values at those other locations. Those additional environmental efforts will tend to raise the cost of wood fiber still higher. In this market adjustment to forest protection efforts, the price of wood fiber will begin to incorporate more of the non-commercial forest values that are threatened by poor forest management.

From an economic and environmental point of view, this market-based adjustment is not a flaw but a strength. There is no more basic axiom in economics than that responsible production and consumption of scarce resources cannot take place unless the prices of those resources fully reflect **all** of the costs associated with their production and use. If prices do not accurately reflect costs, scarce resources are certain to be used wastefully and economic well being will be reduced.

When wood fiber prices more fully reflect the non-commercial values threatened by timber harvest, those who harvest trees, those who use wood fiber in manufacturing, and the final consumers of forest products all are encouraged to act more efficiently. Logging companies find ways of raising and harvesting trees that do less damage to natural forests. Wood fiber production technology improves. Both logging companies and manufacturing firms that use wood fiber are more careful to fully utilize as much of the harvested wood fiber as possible. Technologies develop that conserve on wood fiber while meeting human objectives. Consumers of wood fiber are encouraged to reduce their waste, increase the amount of wood fiber they recycle, and reduce their overall consumption. Innovators are encouraged to find alternative ways to meet the needs previously met by wood fiber by using less costly substitutes.

These are all positive adjustments to the higher wood fiber prices that result when non-commercial forest values are partially incorporated into wood fiber prices. Markets and

market prices cannot completely solve environmental problems, but they can be used to reduce the scale of environmental problems. When scarce resources, the production of which do serious environmental damage, are purposely under-priced, economically and environmentally irrational behavior is encouraged. At the very least, we should work to see that the prices that guide our production and consumption behavior are not encouraging and rewarding destructive behavior. Prices should be moved so that they fully reflect all costs, including environmental costs. At that point there may still be economic behavior that we consider socially inappropriate, and we may turn to social pressure and/or public regulation to control it. But it would seem appropriate to first correct the economic incentives that we present to our fellow citizens so that they are not effectively being paid to behave destructively. At the very least that type of "moral hazard" should be removed before we turn to other means of correcting human resource behavior. From an economic point of view, that is what forest protection efforts are all about.

During the second half of the twentieth century, the US Forest Service consciously moved to increase harvests so as to reduce the cost of wood fiber. Lower cost lumber would allow the nation to more rapidly rebuild from the damage that the Great Depression and WWII did to America's housing stock. Low lumber prices would mean lower housing costs, and the percentage of Americans who lived in and owned their own detached single-family dwelling could increase.[35] Commercial timber values came to dominate the management of National Forests. This, of course, moved forest management directly away from having timber prices also reflect the non-commercial forest values. The federal government, in effect, subsidized the expansion of timber harvest on public lands by taking on most of the infrastructure costs, running its timber programs at massive losses, and ignoring the other values that were damaged by commercial timber harvests.

Public subsidies that support entry into natural forest that would otherwise not be profitable to road and log have more than just negative local environmental impacts, both in the United States and elsewhere. That subsidized expansion of commercial harvest puts downward pressure on the value of wood fiber and lands managed for wood fiber. The lower value of wood fiber triggers a broad range of economic decisions the opposite of those discussed above for rising wood fiber price, decisions that add to environmental problems. Investments in the intensive management of well-sited plantations is discouraged and the overall productivity of our commercial timberlands declines, increasing the number of acres of forest land that have to be managed for commercial timber to yield any given level of fiber supply. The incentive to recycle wood fiber is reduced and more wood fiber simply gets wasted, only to be made up in additional harvest. The attractiveness of wood fiber substitutes such as recycled light-gauge steel in construction or kenaf in paper production is reduced. Technological change in the development of wood building materials that use less fiber in accomplishing their goals is slowed. Overall, the efficiency with which wood fiber is

[35] See Paul W. Hirt's ***A Conspiracy of Optimism: Management of the National Forests since World War Two***, Lincoln, Nebraska: University of Nebraska Press, 1994, Chapter 3.

produced and used declines and more wood fiber is consumed, and more forest acres are impacted because of the subsidized expansion of harvest on public lands.

Besides this economic dimension, there is also a political dimension to forest protection that needs to be made explicit too. There is a broad consensus that tropical deforestation is proceeding at a destructive and dangerous pace with worldwide environmental consequences. That deforestation will slow or stop only if the people and governments of those forestlands adopt measures that effectively preserve much of the remaining forestlands, especially those of the highest ecological significance. If relatively wealthy countries like the United States conclude that they cannot afford to pass up the commercial opportunities associated with harvesting most of their natural forests, it seems unlikely that the wealthy countries or anyone else will be able to convince much poorer countries to pass up the commercial opportunities associated with harvesting and/or deforesting their own forestlands.

To be politically, economically, and ethically plausible, the United States has to be willing to take firm forest preservation steps with its own forestlands. If it does not, its efforts to slow deforestation elsewhere in the world will be interpreted as simply an extension of colonial policy intended to protect its own affluence at the expense of poorer countries. In that sense, we have to be willing to lead with our own actions before our environmental exhortations to poorer countries will carry any effective weight.[36] Having taken those forest protection efforts in our own country, we stand a much better chance of being successful in encouraging other nations to protect their forests. Such a coordinated international effort will keep shifting forest harvests from also shifting environmental damage from the United States to elsewhere in the world. Instead, coordinated and effective worldwide forest protection efforts will raise forest products prices to more fully reflect all the costs associated with them. That will lay the basis for market changes that will help meet human needs and desires in a more efficient and more environmentally benign fashion.

Conclusions and Qualifications

We draw the following conclusions from the discussion above:

1. Because timber harvests from US National Forests represent such a tiny part of worldwide harvests and because much of the deforestation taking place in the world is not driven by international timber markets, even dramatic changes in National Forest harvests will not have a significant impact on deforestation elsewhere in the world.

[36] More than ethical exhortations will be needed in any case. Ongoing financial payments to these countries tied specifically to forest preservation will be necessary. Given the very low economic returns associated with the destruction of these forestlands, those payments to cover the opportunity costs of preservation are likely to be quite low. See "Rethinking Green Consumerism," Jaren Hardner and Richard Rice, ***Scientific American***, May 2002, pp. 89-95.

2. Reductions in one source of timber supply due to forest protection efforts trigger a complex set of market adjustments led by increases in the value of wood fiber that tend to offset the impact of the reduced supply. These include:
    a. improved efficiency in wood fiber use and less waste;
    b. increased recycling of wood fiber;
    c. development of less costly substitutes for wood fiber;
    d. an overall reduction in the use of wood fiber;
    e. increased investments that raise the productivity of forestland;
    f. increased incentives to manage lands for wood fiber production;
    g. development of forest management techniques that reduce the damage associated with wood fiber production and harvest.
3. Reductions in one source of timber supply due to National Forest preservation measures do result in the displacement of part of that reduction in harvest to other source of supply. But the character of those displacements is quite different from those typically suggested by timber industry spokespersons.
4. National and international market forces are unlikely to support the displacement of US harvests to tropical and Russian Boreal forests.
5. Broad ranging technological change in wood fiber production and in wood fiber use are likely to reduce the international market demand for the outputs of natural forests.
6. Most natural forests that are not currently managed for timber are unlikely to be converted to commercial timber production due to international market forces. There are more cost effective sources of supply.
7. Government policies and subsidies could over-ride the international market forces that will be acting to protect natural forests. US National Forest Policies acted in this manner during the second half of the twentieth century.
8. It is very important to carefully analyze the likely environmental impacts associated with alternative wood fiber production locations and technologies before reaching conclusions about displaced environmental damage. Displaced harvests *could* have much lower environmental impacts than those blocked by harvest restrictions. For instance, wood fiber production may shift from natural forests to plantation located on marginal agricultural lands or timber harvests may shift from more remote and inaccessible old growth natural forests to lands that have long been managed for commercial timber production. Knowing that timber harvests have shifted geographically does not tells that the environmental damage associated with those harvests has also shifted.

Finally, it is important to emphasize that the projections on which some of our results are based are just that, projections tied to simulation models. Those models have several limitations. First, they assume optimizing behavior on the part of firms and consumers and well-functioning markets. The model Sohgen et al. used also assumes that timber producers operate with full information and foresight as they look at the future and anticipate changes in the price of wood fiber and adjust their harvests and investments in new supply accordingly. In the real world governments intervene, firms make mistakes, and markets can be fragmented, imperfect, and artificially constrained.

Second, future technological change in both wood fiber production and in the use of wood fiber are not clearly known or known at all. Given how important changes in technology have been in the past in affecting both timber supply and demand and how dramatic some of the projections are about the potential of future technologies, the projections reported on above have to have a wide margin of error associated with them. However, none of the projections confirm the most often expressed fear that American forest protection efforts will cause major damage to natural forests in the Tropics or Siberia. The threat to those regions comes not from international timber markets but from international agricultural markets, indigenous economic pressures associated with rising populations and expanding local economies, and internal political forces that subsidize environmentally destructive activities. American forest protection efforts cause none of these and may, in fact, lay the political basis for reducing the last of these forces that threaten the world's forests.

Three "Short" Op-Ed Pieces Prepared Along the Way

I. Does Protecting American Forests Harm Forests Worldwide?

The forest products and mining industries often argue that efforts to protect the environment by limiting the damage these industries are allowed to do in the United States is environmentally counter-productive. Such regulations and limits on logging and mining in the US, they argue, simply shifts that logging and mining to other countries where it takes place anyway. Given that many of these countries are desperately poor and have far weaker or non-existent environmental standards, the net effect, so it is argued, is not to protect the environment but to damage it even more than it would have if the logging and mining had been allowed to proceed unhindered in the US.

This argument is built around a "material requirements" view of the economy that natural resource industries believe is "intuitively obvious" and beyond question. For instance, since we all need food to survive and we all need metals for appliances and machinery, if production from one source declines, it has to be made up from another source. Shutting down one source, just forces another, somewhere, to be developed.

Although this view of the economy is often accepted uncritically, it is, in fact, a profoundly anti-economic view. If it were true, our economy in 2002 would closely resemble the economy in 1902, which, of course, it does not. This material requirements view of the economy ignores every major economic force that brought us from the 19th to the 21st century: The development of new technologies, dramatically higher labor productivity tied to much higher education levels, the development of superior substitute goods, and improvements in the efficiency with which we use resources.

Consider the forest products industry and the ongoing debate over the appropriate management of National Forests, especially unroaded, old-growth, public forests. The timber industry argues that protecting these remnant natural forests will cause timber harvest to shift to old growth forests in Siberia and rain forests in the tropics, wreaking environmental havoc in those locations.

Recently, Resources for the Future, a 50 year-old natural resource research organization, analyzed what the impact would be if ten percent of all currently unprotected forest lands in North American and Europe, about 115 million acres, were set permanently off limits to commercial timber harvest.[37] These forest economists modeled world timber supply and demand, studying how this reduced timber supply from the US, Canada, and the Nordic countries would impact timber prices, timber harvests in various countries around the world, and the use of timber products.

What it found was that the reduction in production from these protected areas in North America and Europe would cause timber prices worldwide to rise slightly. In

[37] "Forest Management, conservation, and Global Timber Markets," Brent Sohngen et al., American J. of Agricultural Economics, 81(1):1-10, February 1999; "Forest Management, Conservation, and Global Timber Markets, Brent Sohngen, Agriculture, Environment, and Developmental Economics, Ohio State University, presentation to Forest Ecosystem Information Exchange, Wells Conference Center, University of Maine, May 4, 2000.

reaction to these higher timber prices, greater investment would be made in timber plantations around the world, including in the southern US. Land that previously had been used marginally for agriculture would be converted to tree growing plantations. In addition, those lands already being managed for timber would be managed more intensively, slightly shortening the periods between harvests. Very little virgin forest that currently was not being commercially harvested would be entered to obtain additional timber simply because that would be an uneconomically costly way of obtaining additional timber. The high costs associated with these lands inaccessibility as well as their low timber productivity are what have kept these lands from being managed for commercial timber in the past and the uneconomic character of these lands continues to make them "economic" wildernesses areas because there is no commercial motivation to enter them for timber harvest.

As a result of protecting an additional 115 million acres of forest land in North America and Europe, about 5 million acres of virgin forest would be entered elsewhere in the world. Only one out of every 22 of the acres protected would be offset by the commercial development of wildlands elsewhere in the world.

The additional timber would primarily come from the planting and growing of trees on land previously cleared for agriculture but no longer very profitable in that use. This should not surprise us. During the 18th and 19th centuries much of the forests of the eastern colonies and then states were cleared for agricultural use. But as better soils were developed in the midwestern states, eastern agricultural lands were abandoned and the forests, over time, marched back out to reclaim the land, reforesting much of the eastern US. The lands in the south that were most productive for timber because of temperature, rainfall, soils, topography, and accessibility were often converted to intensively managed plantations. The same has been happening elsewhere in the world and if timber harvests are reduced in North America and Europe, this plantation development will accelerate and be the primary source of expanded timber production. Increased world production of timber will not primarily come from harvesting virgin forests elsewhere in the world.

The driving force in these worldwide adjustments is the higher value of timber that results from reduced harvests from some North American and European forestlands. Those higher costs, of course, hurt consumers. But to the extent that the higher costs are simply more accurately conveying the full costs, including the environmental costs, associated with timber harvest, those higher wood product prices are appropriate and necessary to encourage responsible use of this scarce and valuable resource. Such improved price signals allow all wood fiber producers and users to adjust their behaviors in productive and rational ways. That is not an economic loss but, rather, an efficient economic adjustment.

Imposing rational environmental regulations on economic actors and then allowing them and the rest of the economy to use their entrepreneurial skills to efficiently adjust to these very real environmental costs does not simply shift environmental damage from one location to another. Quite the opposite, it guarantees that scarce and valuable environmental resources that are central to our health and overall well being are not gratuitously damaged and wasted leaving us and future generations significantly poorer.

II. The Shifting US Forest Products Industry

When limits on timber harvests in environmentally sensitive areas of our public lands are proposed, one of the familiar timber industry responses has been that such harvest limits simply shift the lost harvest to other areas. We are often explicitly told that if we collectively are not willing to reduce our consumption of wood and paper products, we cannot ethically put any limits on the harvest of the trees that provide that wood fiber.

What this argument ignores are the ways in which we can increase forest products production without increasing the percentage of our forests that are primarily managed for commercial logging.

Consider the southern states during the first half of the 20th century. Much of the South was a cut-over, exhausted, eroded region that had lost most of its forests to marginal agriculture and overharvest and primarily exported floods of heavily silted water to the nation rather than forest products. Public programs during the Great Depression as well as natural reforestation changed that, recreating one of the most productive forest regions in the world. Marginal agricultural lands in the western part of the South continue to be converted to forestlands today.

Because of the higher temperatures and rainfall, much of the South can be extremely productive for wood fiber production. This has led to high levels of investment in forest plantations on private land. Intensively managed, these lands can produce commercial saw timber and pulpwood in 20 to 30 years while it takes 60 to 90 years to do the same in the Rocky Mountain region.

Over the last two decades southern forest plantations that account for only 15 percent of total timberland have produced 35 percent of the harvests. Recent national projections indicate that fifty years from now 55 percent of softwood harvest will come from such private plantations covering only about 30 percent of the private timberland.

This does not mean that most of the forestland in productive regions will be converted to intensively managed plantations. In the South, over the next 50 years, plantations will go from occupying the current 14 percent of timberlands to 23 percent, but close to 50 percent of a much-expanded southern harvest will come from those lands. The higher productivity of these southern plantations will take the harvest pressure off of natural forestlands both in the south and elsewhere in the nation. Studies in Georgia found that plantations on abandoned farmland were more that five times more productive than natural regeneration of cutover lands. That is, one acre of new plantation on abandoned farmland could free up five acres of natural forest for non-logging purposes.

As a result, total national harvest will **expand** by over 40 percent but the acreage of forestland that is harvested will **decline**. Eighty percent of the increase in harvest over the next 50 years will take place in the South primarily because of its much higher productivity and lower management costs. That does not mean that timber harvest will cease in areas like the Rocky Mountain West. The projections are for growth in harvest here too, but in 1997 we contributed only 4 percent to the total national harvest. Growth in harvest within the Rocky Mountain region will expand as rapidly as the national

harvest, but this will represent a minor contribution then as now. Almost all of that expanding harvest in this region will take place on private lands.

The point is that we can both protect our public forestlands and continue to enjoy the benefits that forest products bring to our lives and economy. This is partially the case because as timber supplies have gotten tighter and wood fiber prices have risen, we have gotten better and better at conserving in the use of wood fiber. Until the 1950s shiplap and tongue-and-groove boards were used for floors and walls in our homes and buildings. Plywood displaced the use of those boards, allowing a greater utilization of the tree. Now oriented strand board is displacing plywood, using wood chips rather than round wood. Similarly, manufactured trusses, glue-lam beams, and wooden I-beams are displacing the use of 2x10s and 2x12s.

But that is just the beginning of the increased utilization of wood fiber much of which had previously had simply been wasted. Consider the pulp and paper business. In 1986 about 50 percent of the wood fiber that was used to produce pulp and paper in the US came from roundwood, trees that were harvested for that purpose. In 1996 that had fallen to 40 percent; by the end of this decade the use of roundwood for pulp is projected to be down to a third and fifty years from now down to a quarter of the fiber used for pulp and paper. The change is the result of the increased utilization of wood wastes from lumber and plywood mills and the increased recycling of paper and paper board. Over the last decade or so we went from recycling less than 30 percent of paper and cardboard consumption to recycling about half of it.

Limiting harvests on environmentally sensitive forest lands tends to raise the price that all wood fiber users have to pay for their raw material. Indirectly, some of the environmental costs associated with timber harvests get incorporated into the cost of wood fiber. As a result of the higher raw material costs, all users of wood fiber are more careful in that use, conserving more of the fiber, stretching it further, recycling it, inventing new products that make fuller use of all the fiber a harvested tree can provide. In addition, production shifts away from the remnant natural forests where access, harvesting, and environmental mitigation are all more costly and non-timber values are higher. The harvest shifts towards areas where intensive wood fiber production can take place more cheaply and where there are fewer conflicts over forest use. Private plantations that reforest abandoned agricultural land and cutover forestlands are examples of these opportunities.

Environmental damage at the levels we currently see is not an inevitable result of a modern standard of living. Often that environmental damage is the result of bad incentive systems and government subsidies that encourage inefficient and destructive behavior. By confidently demanding better performance from those who wish to use our shared natural environments, we trigger economic changes that bring forth entrepreneurial adaptations that allow us to both protect the environment and have a productive economy. Before we start talking about “tragic” economic choices between the environment and the economy, we first should squeeze the extensive resource waste out of the system. We can live prosperously off of that waste for a long time to come.

III. Shifting American Forest Degradation Problems to Tropical Rainforests

One of the more worrisome charges against efforts to protect the habitat of endangered species and old-growth forests in the Northern Rockies and the Pacific Northwest is that such efforts actually drive more species to extinction by supporting the destruction of far more important tropical rainforests.

The basic charge is that when timber harvest is limited in our region, those harvests simply shift to other forests, including tropical forests that are far more important ecologically and home to many, many more endangered species. Because of that, we are told by timber industry spokespersons, forest preservation efforts in our region are self-defeating, leaving the world's forests and endangered species, on net, worse off.

Analysis of how international timber markets adjust to reductions in one source of timber supply, however, clearly indicates that this is not the case. The reductions in National Forest harvest in the Northern Rockies and the Pacific Northwest did not lead to increased harvests in the tropics. Instead it largely shifted production within North American and Scandinavian Europe. Within the United States, harvest shifted primarily to the South.

The reduced federal harvest in our region led to a rise in the value of harvestable trees. This increased the incentives and payoff for private landowners to plant trees and tend those plantations more intensively. Those intensively managed plantations can have much, much higher timber productivity than natural forests. For instance in the southern states plantations are capable of producing a commercially valuable tree in as little as 10 to 20 years while in the Pacific Northwest and Northern Rockies that rotation can take 30 to 75 years. In Georgia, for instance, a new generation plantation is many times more productive of wood fiber than a natural forest, yielding at age twenty 14 times as much wood fiber as an unmanaged natural forest.[38] When the higher costs of managing a tree plantation are accounted for, the profitability per acre is still almost 12 times as high. [39] It is not surprising that timber production in the US is projected to shift to the south and rely heavily on such new plantations.

The same is expected worldwide. Rather than invading virgin tropical forests in the pursuit of new timber supplies, it is the sub-tropical regions of the world, including the American south, New Zealand, Australia, Spain, Portugal, Chile, Argentina, and South Africa, that will be turned to. And it is be modern intensive plantation technology that will be used to produce the wood fiber. There will also be increased harvests in eastern Canada, the Pacific Northwest, and Scandinavian forestlands.

Of course, wherever those harvests take place there will be environmental damage. How do we know that it will not offset whatever was gained by reducing timber harvests in our region? That question can only be answered by looking closely at the environmental impacts of timber harvest in various locations.

Consider the emerging intensively managed tree plantations in sub-tropical areas. Those plantations will use fertilizer, pesticides, genetically manipulated stock, and involve frequent entry to treat, thin, and harvest the trees. One could argue that this

[38] Runsheng Yin and Roger A. Sedjo, "Is This the Age of Intensive Management?," ***J. of Forestry***, December 2001, p. 14.
[39] Ibid, p. 16, Table 6.

intense management has much higher environmental impacts than selectively managing sustainable timber harvests in a natural forest. But that may emphatically not be the case. Most of the new plantations are being established on marginal farmland. Forests are not being cleared for the plantations. Those farmlands are human dominated landscapes where fertilizers, pesticides, and genetically manipulated crops have been used for many years. As cropland they were frequently entered several times a year and provide little or no wildlife habitat. Shifting from food crops to wood fiber production may actually reduce the intensity of the manipulation of the land.

Similarly, if, because the remnant ancient forests of the Pacific Northwest have been protected, harvest shifts to the northern forests of the United States, eastern Canada, and Scandinavia, that harvest will be shifting to much less mountainous lands that have been managed for commercial timber for a century or more. These are lands that were roaded and harvested repeatedly in the past. Even the additional harvests that are expected to take place in the Pacific Northwest will be of second growth on lands roaded and harvested over the last half-century. It is not at all clear that shifting harvest to less mountainous lands already heavily committed to commercial timber harvest while protecting relatively pristine old-growth forests represents an environmental loss.

Finally, it is not international commercial timber markets that are causing the destruction of tropical rainforests. That tragic and destructive deforestation is associated with two quite different economic forces. First, subsistence activities of growing poor populations are leading to the clearing of those lands for subsistence agriculture, fuel wood, charcoal, and local building materials. Second, international agricultural markets for beef, soybeans to feed the beef, coffee, palm oil, and cocoa continue to support deforestation. Americans eating MacDonald's hamburgers play a much more important role in tropical deforestation than forest preservation efforts in the United States.

Timber industry claims that efforts to preserve America's remnant natural forests do more harm than good simply do not stand up in face of the facts. Those efforts to paralyze responsible conservation efforts by arguing that most environmental protection is self-defeating should be seen for what they are: self-interested obfuscations aimed at protection industrial privilege.