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Thinking Inside the Box: Looking for Ecosystem Services within a Forested Watershed

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**THINKING INSIDE THE BOX:
LOOKING FOR ECOSYSTEM SERVICES WITHIN A
FORESTED WATERSHED**

JANET NEUMAN*

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I. INTRODUCTION: ALONG THE RIVER AND THROUGH THE WOODS

Oregon's Tillamook State Forest lies about halfway between the city of Portland and the Pacific Ocean. A visitor heading southwest from Portland drives out of the densely-populated Willamette River Valley, past the suburban campuses of Nike, Intel, and Tektronix, and through rolling fields with signs advertising "u-pick" berries, "u-cut" Christmas trees, and a winery or two. Less than an hour's drive from downtown Portland, the fields give way to the foothills of the Coast Range Mountains, and a short time later, the road enters the Tillamook State Forest. Steep, wooded ravines angle away on either side of the highway, occasionally leveling off to reveal a vista of ridgelines nearly all the way to the coast. The visitor could drive almost another hour before leaving the Tillamook, even without exploring the many side roads heading off into its 550 square miles of forest and meadows.

The main highway through the Tillamook follows the course of the Wilson River for a good part of its length. The Wilson eventually flows into Tillamook Bay on the northern Oregon coast. The Wilson does not have the Tillamook State Forest to itself, however. Other rivers share the territory—the Nehalem, the Kilchis, the Miami, the Trask, and the Tillamook—all rushing down from the coastal mountains to the ocean. The rivers coursing through the state forest divide into two major watersheds, the Tillamook Bay Watershed and the Nehalem Bay Watershed, depending on which of the ocean bays they end up in.¹

The Tillamook State Forest and its encompassing watersheds are many things to many people. As with other natural resources, that very fact may be its undoing. The Tillamook is *so* many things to *so* many people that the demands on it are becoming unsustainable. Without appreciation of the area as a functioning ecosystem, the Tillamook State Forest's future is certain to be troubled. The tug of war will continue between those who want timber and those who want trees, between those who want steady flows of revenue and those who want steady flows of clean water. Yet, with some recognition of what the Tillamook needs in order to keep producing desired goods and services, along with a bit of moderation in the demands, perhaps the Tillamook could indeed satisfy most of the people most of the time. Although this path is untested, and there is no guarantee of success, the alternative outcome *is* guaranteed: further conflict and degradation of the very

1. The Oregon Water Resources Department groups the two watersheds as the North Coast Basin for purposes of water management. See OR. ADMIN. R. 690-500-0010, 690-501 (2007).

resources people want from the forest.

This paper uses the Tillamook State Forest as a case study to explore the potential for applying an ecosystem services model to future management of a forested watershed with numerous interested constituencies. Part II describes the richness of the Tillamook regional ecosystem, its importance far beyond the immediate vicinity, and the many resulting demands on the forest. Part III discusses the current management model, based on multiple uses competing in the political arena for short-term gain, and then considers an alternative model based on managing the Tillamook with the goal of producing a steady stream of ecosystem services over the long-term. Part IV concludes with a call for “re-forestation” of the Tillamook State Forest and other similar lands by managing for long-term watershed and forest health.

II. THE TILLAMOOK STATE FOREST’S BIG TENT: SOMETHING FOR EVERYONE

A. *The State’s Forest*

The Tillamook State Forest was officially designated in 1973.² The dramatic version of the Tillamook’s creation story is that of a phoenix rising magically from the ashes. Before being designated a state forest, the area was known simply as The Tillamook Burn.³ In truth, the state forest’s origin was a long and somewhat accidental process, the result of making the best of a bad situation. In the early 1900s, much of the land that is now within the state forest boundary was owned by private timber companies.⁴ In 1933, the first of several devastating wildfires swept through the region, dealing a severe blow to the landscape and to the local economy.⁵ The fires kept coming with terrible regularity — every six years through 1951 — all together burning 355,000 acres of land and over 13 billion board feet of timber.⁶

2. For the history of the Tillamook State Forest, *see generally* OR. HISTORICAL SOC’Y, THE OREGON HISTORY PROJECT, THE TILLAMOOK BURN (2006); OREGON LEGISLATIVE COMMITTEE SERVICES, ISSUE BRIEF: TILLAMOOK BURN: HISTORY, REFORESTATION & ECONOMICS (November 2001); OR. DEP’T OF FORESTRY, “TILLAMOOK STORY,” *available at* http://egov.oregon.gov/ODF/TSF/tillamook_story.shtml (last viewed December 20, 2006); J. LARRY KEMP, EPITAPH FOR THE GIANTS; THE STORY OF THE TILLAMOOK BURN (1967); HOMER LYON, HISTORICAL SKETCH OF THE GREAT TILLAMOOK FIRE (1940); and OR. STATE DEP’T OF FORESTRY, TILLAMOOK BURN TO TILLAMOOK STATE FOREST (1993).

3. *See generally* OR. DEP’T OF FORESTRY, TILLAMOOK BURN TO TILLAMOOK STATE FOREST, *supra* note 2.

4. *Id.* at 8-9.

5. *Id.* at 5-6.

6. *Id.* at 6, 12-13, 22. The destroyed timber ranged in age from 150 to 400 years old; many trees were up to 300 feet tall and seven feet around. LEGISLATIVE COMMITTEE SERVICES, *supra* note 2, at 1, and ELLIS LUCIA, TILLAMOOK BURN COUNTRY 6 (1983).

The timber companies, already reeling from the Great Depression, staggered and fell, unable to recover from the devastation.⁷ The companies could not pay their property taxes, and the surrounding counties eventually foreclosed on thousands and thousands of acres of ravished land.⁸ The counties—land rich, but revenue poor—looked to the state for help.⁹ Eventually the state and the counties reached an agreement that was designed to bring back the forest and make the counties whole. The counties gave the foreclosed lands to the state; the state created the state forest; the public was enlisted to help replant the burned-over lands; and the state promised to share two-thirds of the future timber revenues with the counties.¹⁰

Thousands of Oregonians helped in the reforestation effort. Schoolchildren and other volunteers came to the Coast Range by the busload and planted seventy-two million seedlings.¹¹ As the seedlings grew, so did the kids who planted them, and the Tillamook became the state's forest in more than just name. Many of those who helped replant the forest feel a special attachment to the fruits of their labor.¹² Some of the kids grew up to be loggers, business owners, school teachers, and county commissioners in the small towns sprinkled around and through the forest. Now that the trees are big enough, these residents are ready and waiting to reap the benefits of the harvest.¹³ Some of the kids grew up to be fishermen, conservationists, and scientists, and they now look to the Tillamook for fisheries and wildlife habitat rather than for timber harvest.¹⁴ Even newcomers to the state who know nothing about the Tillamook's past have a stake in the forest. The forest provides recreational opportunities accessible to the booming popu-

7. See Sinclair Albert Wilson, *The Tillamook Fire: Staggering Losses in Oregon's Big Forest Fire Estimated*, THE FOUR L LUMBER NEWS, Sept. 15, 1933.

8. OR. DEP'T OF FORESTRY, 2005 OREGON FORESTS REPORT at 14 (OR. FORESTS REP.), available at www.oregon.gov/ODF/PUBS/docs/Oregon_Forests_Reports/05OFR.pdf.

9. See WILSON, *supra* note 7 (noting that prior to the 1933 fire, timber value accounted for 58% of Tillamook County's tax base).

10. OR. FORESTS REP., *supra* note 8. For example, in the 2003-05 biennium, the revenues to Tillamook County from this arrangement totaled approximately \$19,266,500, down slightly from \$19,463,770 in the previous biennium. *Id.*

11. See TILLAMOOK STORY, *supra* note 2.

12. See, e.g. Nick Budrick, *The Coast is Clearcut: the Northwest's Next Eco-War will be Waged in Portland's Backyard* WILLAMETTE WEEK, March 6, 2002, available at <http://www.wweek.com/popup/print.php?index%2519>. ("To replant the charred moonscape left by the fires, Portland school children, a young Leonard [Portland city commissioner, Randy Leonard] among them, were trucked to the Tillamook in school buses for two decades, planting what would become state forest land. It was 40 years ago, but Leonard . . . still vividly recalls those trips . . . 'I have this sense of ownership— . . . It's a funny thing when you plant something and it grows.'")

13. See Cassandra Profita, *Timber Revenue: It's a Guessing Game* DAILY ASTORIAN, Dec. 6, 2006 (discussing interest of county and local governmental entities in state forest revenue).

14. See PORTLAND AUDUBON SOCIETY, FORESTS: TILLAMOOK AND CLATSOP BACKGROUND (noting the forests' importance to open space, clean water, clean air and recreation).

lation of metropolitan Portland, as well as to the whole northwest corner of the state.¹⁵ With both wild and tame areas, the Tillamook has something for everyone—fishing, hunting, hiking, camping, mountain biking, all-terrain vehicle trails, and driftboating.¹⁶

The Tillamook State Forest, due to its origins, its location, and its resources, has thousands of shareholders. The shareholders all have visions of what “their” Tillamook represents. The stage is set for conflict, and that’s only the beginning of the story.

B. The Loggers’ Bonanza

The Tillamook State Forest reforestation effort lasted from 1949 into the 1960s.¹⁷ The first trees planted have now passed the half century mark, making them ripe for harvest in the eyes of many.¹⁸ Indeed, the Tillamook’s vast swaths of hand-planted, even-age, second growth timber resemble some commercial forests whose goal is to produce easily-harvested clear cuts on fairly short rotations.¹⁹ Timber companies, both large and small, have been banking on the Tillamook trees coming on line for quite some time.²⁰ Although large timber companies like Weyerhaeuser, Georgia Pacific, Louisiana Pacific, and other publicly held companies operating in the northwest often own large land holdings, many of these lands were heavily cut over by the 1990s, thus leaving both large and small companies dependent on federal and state public forestlands to keep their mills operating.²¹ The timber supply from Oregon’s federal forests has taken a nosedive in recent years, in response to changing management directions under federal law, thus creating even more pressure on state lands.²²

15. OREGON DEPARTMENT OF FORESTRY, NORTHWEST FOREST MANAGEMENT PLAN 2-64 to 2-67 (2001), available at http://egov.oregon.gov/ODF/STATE_FORESTS/nwfm.html (final forest management plan adopted by Board of Forestry in January 2001).

16. OR. FORESTS REP., *supra* note 8, at 14. The funds for maintaining the recreational sites such as trails and campsites come from timber harvest revenue. *Id.*

17. THE TILLAMOOK STORY, *supra* note 2.

18. *See, e.g.*, Testimony of Tim Josi, Tillamook County Commissioner and member of Forest Trust Land Advisory Committee, at the July 28, 2006, Board of Forestry Meeting (urging greater harvest levels, closer to what would be done if forest privately owned).

19. NORTHWEST FOREST MANAGEMENT PLAN, *supra* note 15, at 2-22, 3-5 (about 57% of Northwest state forests are between 35 and 65 years old; 25% are over 65).

20. *See* OR. STATE ARCHIVES, A STATE OF CHANGE: OREGON AFTER WORLD WAR II, available at <http://arcweb.sos.state.or.us/exhibits/ww2/after/oregon.htm> (describing small “gyppo” timber operators and large vertically-integrated timber companies operating in Oregon); *See also* Kathie Durbin, *Tillamook Burn Becoming Bright Spot in Oregon’s Timber Picture*, OREGONIAN, Dec. 20, 1990, at A-7 (discussing intensifying interest in expected jump in Tillamook harvest in the next several years, as federal land harvests were reduced and the Tillamook trees came of age).

21. *Id.*; *see also* U.S. DEP’T OF AGRIC., TIMBER HARVESTING, PROCESSING, AND EMPLOYMENT IN THE NORTHWEST ECONOMIC ADJUSTMENT INITIATIVE REGION: CHANGES AND ECONOMIC ASSISTANCE (1999); F.D.L. CONWAY & G.E. WELLS, OR. STATE UNIV. EXTENSION SERVICE, TIMBER IN OREGON: HISTORY AND PROJECTED TRENDS (1994).

22. Until about ten years ago, federal forestlands in Oregon were the source of most of the state’s

C. *The Salmon's Nursery*

During the past 50 years, the Tillamook State Forest has been growing more than trees. The area has been identified as one of a few "salmon hot spots" in the Cascadia Bioregion where relatively undisturbed rivers offer crucial habitat for fish species that are struggling throughout the Pacific Northwest.²³ The Tillamook and Nehalem Bay watersheds are identified as "major southern strongholds" for Chinook and Chum salmon and steelhead, with combined escapements from these watersheds of nearly 70,000 fish.²⁴ The Wild Salmon Center and other fish conservation groups have targeted the Tillamook and Nehalem watersheds for creation of watershed sanctuaries and salmon "refugia" to provide anchor habitat for restoration of threatened and endangered salmonid species.²⁵ The stated goals of the groups who are working to protect these areas include protecting 250,000 acres of public forest land.²⁶ Some of the threats they are concerned about include road-building and timber cutting, putting them directly at odds with the loggers.²⁷

D. *The Murrelet's Bedroom*

The Tillamook provides habitat for a number of terrestrial at-risk species as well. In spite of the devastating wildfires, some pockets of old growth forest survived in the area, and these pockets provide habitat for marbled murrelets, spotted owls, bald eagles, peregrine falcons and several other creatures that are rare or

timber harvest. Since the eruption of endangered species controversies and the adoption of the federal Northwest Forest Plan in 1994, federal land timber cutting has declined steeply, and now private forestlands produce the majority of the state's harvest. 2005 OREGON FORESTS REPORT *supra* note 8, at 9. Federal forestland constitutes 59% of Oregon's 30 million forested acres, while industrial private forestland is only 20% and state forestland is only 3% of the total. *Id.* at 22. The pressure is thus concentrated on a much smaller acreage. What happens in Oregon and other Pacific Northwest forests is of more than just local or regional interest. In recent years, Oregon has been the nation's number one producer of lumber and plywood. OREGON STATE UNIVERSITY, *supra* note 20, at 6.

23. The Wild Salmon Center has identified the Tillamook State Forest area and its associated watersheds as one of three North American salmonid strongholds on which to concentrate its conservation efforts. See WILD SALMON CENTER, NORTH AMERICA WILD SALMON STRONGHOLDS, http://www.wildsalmoncenter.org/programs/north_america/coast_ranges.php. The Center's priority watersheds for salmonids in the Oregon Coast Range include the Nehalem, Salmonberry, Kilchis, Trask, and Wilson rivers, all within the state forest. WSC identifies the Tillamook Forest as the largest expanse of unprotected, contiguous rainforest in the lower 48 states, containing several endangered and threatened species, including such terrestrial species as the marbled murrelet and the Northern spotted owl. *Id.* The Pacific Northwest temperate rainforests are thus national natural resources, not purely local ones.

24. *Id.*

25. *Id.* The WSC's focus on the Tillamook is part of their comprehensive global program of wild salmon protection, which also includes work around the Pacific Rim in British Columbia and Russia. Once again, the Tillamook's importance extends far beyond its boundaries.

26. *Id.*

27. *Id.*

threatened.²⁸ The murrelet is particularly interesting in its use of coast range forests. Murrelets are sea birds who fish in the ocean but come inland to nest. The birds fly 30 miles or more inland seeking old growth coniferous forests where they build nests on the low spreading branches of very large, old trees.²⁹ During the nesting season, they make daily roundtrips to the ocean for food.³⁰ With logging planned for both the post-fire second growth timber and some of the older pockets,³¹ murrelet habitat is also at risk.

E. Portland's Playground

The Tillamook State Forest is only 35 miles west of the Portland metropolitan area, which is home to over a million people and growing rapidly. The state forest contains seven developed campgrounds, 150 miles of “some of the best Off-Highway Vehicle trails in the Pacific Northwest”, and miles of hiking, mountain biking, and horseback riding trails.³² The State Forestry Department’s management plan for the forest says that the North Coast region and the area around Portland have the “greatest need in the state for additional recreation facilities.”³³ Recreation on these lands is also important to certain sectors of the local economies.³⁴ Many Portland area voters supported a 2004 statewide ballot initiative drafted by a coalition of conservation groups that sought to put 50% of the Tillamook State Forest into reserves protected from logging.³⁵ Portland drivers sport bumper stickers proclaiming “Save the Tillamook.”³⁶

F. The Coastal Communities' Water Supply

The Tillamook and Nehalem Bay watersheds supply municipal

28. NORTHWEST FOREST MANAGEMENT PLAN, *supra* note 15, at 2-28-2-32 (noting that bald eagles, peregrine falcons, marbled murrelet, and spotted owls are all listed as threatened or endangered under federal and/or state laws, and listing numerous other species of concern).

29. *See generally*, Sustainable Ecosystems Institute, *About the Marbled Murrelet*, <http://www.sei.org/murrelet.html>; NORTHWEST FOREST MANAGEMENT PLAN, *supra* note 15, at 2-30 and Appendix E-16.

30. *Id.*

31. NORTHWEST FOREST MANAGEMENT PLAN, *supra* note 15, at 2-64.

32. OR. DEP'T OF FORESTRY, TILLAMOOK STATE FOREST: RECREATION, <http://egov.oregon.gov/ODF/TSF/Recreation.shtml>.

33. NORTHWEST FOREST MANAGEMENT PLAN, *supra* note 15, at 2-64.

34. *Id.*

35. Oregon Ballot Measure 34 (2004), *available at* http://www.sos.state.or.us/elections/nov22004/g04_meas.html. The ballot measure would have allowed timber harvest on only one-half of the Tillamook State Forest lands, requiring the other half to be managed for restoration of native old growth forest. Although the measure failed to pass statewide, voters in Multnomah County (where Portland is located) approved it by a margin of 178,681 to 154,989. <http://www.sos.state.or.us/elections/nov22004/abstract/m34.doc>.

36. Author's personal observation.

water to tens of thousands of people. The Cities of Tillamook, Wheeler, Nehalem, Vernonia, Manzanita, and many other small communities get their drinking water from rivers, streams, springs, and interconnected groundwater within these watersheds. The City of Wheeler holds a water right to several wells that are tributary to the Nehalem River, Tillamook has a number of water rights to the Tillamook River or its tributaries, and Manzanita, Nehalem and Vernonia have municipal rights from tributaries to the Nehalem.³⁷ Many individual wells exist in the watersheds as well.³⁸

When the rivers leave the forestlands and flatten out on the coastal plains, they provide water for the Tillamook dairy industry. The dairy industry has been an important part of the Tillamook area's economy since the 1800s.³⁹ Many small farms in the coastal plains supply the Tillamook County Creamery Association (a cooperative), which produces over 78 million pounds of cheese a year for global markets.⁴⁰ The Tillamook Cheese Factory near the town of Tillamook attracts nearly a million visitors annually.⁴¹ Indeed, Tillamook County's motto is "the land of cheese, trees, and ocean breeze."⁴²

Even when the waters reach the ocean, their work isn't done. The estuaries of Tillamook and Nehalem Bays support shellfish production. In the 1990s, local groups became concerned about the water quality in the bays and estuaries.⁴³ Contamination from pollutants and sediment had resulted in several closures of the lo-

37. See, e.g., water rights permits G 12196 (Wheeler), S 30192 (Tillamook), S 41438 (Tillamook), S 45008 (Nehalem), and certificates 33251 (Tillamook), 8480 (Nehalem), 44775 and 82159 (Manzanita), 10099 and 23480 (Vernonia) OREGON DEPARTMENT OF WATER RESOURCES, WATER RIGHTS INFORMATION SYSTEM, available at <http://apps.wrd.state.or.us/apps/wr/wrinfo>. This is not a complete list of all of these municipalities' water rights, nor does it cover all domestic water suppliers, some of whom do not even hold water rights. See GAIL ACHTERMAN, RENEE DAVIS-BORN, IRENE ROLSTON, & LISA GAINES, OREGON COASTAL COMMUNITY WATER SUPPLY ASSESSMENT 18 (Or. State Univ. Institute of Natural Resources, 2005). Non-coastal communities' water supplies are also dependent on the Tillamook State Forest. See, e.g., Laura Gunderson, *Spotted Owls Delay Timber Sale*, OREGONIAN, Sept. 9, 2002, at E-1 (discussing concerns over the potential impact of timber harvest in the Tillamook on sedimentation of the City of Forest Grove's drinking water supply).

38. See, e.g., WATER SUPPLY ASSESSMENT, *supra* note 37, at 18.

39. In 1854, three local farmers built a wooden ship to take their butter to Portland. In 1894, the first cheese processing plant was built, and in 1904, a Tillamook cheese won an award at the St. Louis World's Fair. TILLAMOOK COUNTY CREAMERY ASSOC'N, HISTORY AND TRADITION, <http://tillamookcheese.com/OurStory/HistoryAndTradition.aspx>. The area dairy farmers formed a cooperative, the Tillamook County Creamery Association, in 1909. As of 2006, the cooperative's member families numbered more than 150. <http://www.tillamookcheese.com/OurStory/>

40. TILLAMOOK CHAMBER OF COMMERCE, AREA ATTRACTIONS, <http://www.tillamookchamber.org/attractions.htm#top>.

41. *Id.*

42. TILLAMOOK COUNTY, <http://www.co.tillamook.or.us/>

43. See generally Tillamook Estuaries Partnership (part of the National Estuaries Program), <http://www.tbnep.org/>.

cal commercial shellfish beds.⁴⁴

The municipal water suppliers, the dairy farmers, and the shellfish harvesters are at the downstream end of the watersheds that encompass the Tillamook State Forest. Their location in the lower river reaches and in the estuary and coastal plains means that they are affected by logging practices and other activities upstream. Erosion, sedimentation, pollution, and flooding threaten their operations. At the same time, these groups can be contributing to the same problems as upstream actors. The shellfish producers and commercial fishermen point fingers at the dairy industry as well as the timber industry for damaging both riverine and estuarine habitat.⁴⁵ The municipalities need clean water for domestic supplies, but their diversions can also deplete the area's water resources, especially since they operate in the coastal zone, where the delicate balance between saltwater and freshwater is crucial to watershed health.⁴⁶ Individual dairy farmers who divert surface water or pump water from their own wells may also be affected by their own industry's pollutants.⁴⁷

G. The Counties' Battleground

When the state took over the Tillamook Burn reforestation effort in the late 1940s, it also took over ownership of the tax-foreclosed lands from the counties. The arrangement that was created was a trust of sorts, whereby the state would hold the land, manage the timber, and pay two-thirds of the eventual revenue to the counties.⁴⁸ The counties thus have an understandable interest in maximizing timber revenue from these lands. In 2005, the state's payments to the three counties that include the Tillamook State Forest exceeded sixty million dollars; in 2006, the amount was about forty-three million dollars.⁴⁹ County commissioners keep close tabs on the state foresters, frequently lobbying

44. *Id.*

45. *See, e.g.*, Letter from Jesse Hayes, President, Hayes Oyster Co., to Pacific Coast Shellfish Growers Association, July 17, 2000 (criticizing dairy industry pollution of estuary). A single dairy cow produces 160 pounds of manure a day. OR. STATE UNIV., OSU DAIRY NEWS June 15, 1998, at 4. *See also* Glenn Spain & Zeke Grader, Pacific Coast Federation of Fisherman's Associations, *Why Forests Matter to Fishermen*, FISHERMEN'S NEWS, October, 1999 (criticizing forestry practices that harm fish and shellfish habitat).

46. WATER SUPPLY ASSESSMENT, *supra* note 37, at 33 (discussing information needs on saltwater intrusion, tidal influence, and other freshwater/saltwater interface issues.)

47. *See, e.g.*, Water Certificates No. 47194 and 58486 (supplying water from a tributary of the Tillamook River for domestic use, stock, dairy facilities and milk parlor clean-up); *see also* WATER SUPPLY ASSESSMENT, *supra* note 37, at 28-29 (discussing water quality challenges for coastal communities).

48. *See* OREGON LEGISLATIVE COMMITTEE SERVICES, ISSUE BRIEF, *supra* note 2.

49. OR. DEP'T OF FORESTRY, 2005 and 2006 OR. FORESTS REP, *supra* note 8.

for increased timber production.⁵⁰ This pressure has become particularly insistent in the past few years, as the state's approach to the Tillamook has changed to accommodate several endangered species in the forest and to respond to new demands for protecting many other values besides timber.⁵¹

H. The Feds' Neighbor

The Tillamook State Forest's immediate neighbor to the south is the federal government. The US Forest Service manages several units of the Siuslaw National Forest adjacent to the state lands, and the Bureau of Land Management manages many scattered sections of "O & C" land — checkerboard parcels of land originally granted to the Oregon and California Railroad and later forfeited back to the federal government.⁵² In 1994, in response to the virtual shutdown of federal timber sales in the Pacific Northwest due to litigation under the Endangered Species Act,⁵³ the federal government adopted the Northwest Forest Plan to govern federal forestlands in the region.⁵⁴ Timber cutting on Oregon's federal lands, which had topped out at nearly five billion board feet in 1988, dropped drastically in the years following the plan's adoption.⁵⁵

Many interest groups have put pressure on the state forestlands to increase timber harvesting to make up for the decrease in federal timber sales.⁵⁶ Although the largest private timber companies in the Northwest own a great deal of their own timberland, many smaller timber operators rely on the public lands for their timber supply, and even the larger companies were stung by the reduction in federal timber availability because many of their pri-

50. See Profita, *supra* note 13; and Josi, *supra* note 18.

51. See generally Associated Oregon Loggers, <http://www.oregonloggers.org/index.html> (describing the trade association's mission to advocate for contract loggers who harvest timber on state and federal lands).

52. 43 U.S.C. §1181a. See generally ELMO RICHARDSON, BLM'S BILLION-DOLLAR CHECKERBOARD: MANAGING THE O & C LANDS (1980).

53. More than a dozen lawsuits and three court injunctions created a virtual management gridlock in Pacific Northwest federal forests in the 1990s. REGIONAL ECOSYSTEM OFFICE, NORTHWEST FOREST PLAN OVERVIEW, <http://www.reo.gov/training/historic01.htm>

54. Record of Decision, Northwest Forest Plan, April 13, 1994. The NWFP applied to 22.1 million acres of federal forestland managed by the Forest Service and BLM in Washington, Oregon and northern California. The plan designated 10 million acres of those lands as "late successional reserves" (LSRs) or riparian reserves where habitat would be the primary management objective, with timber harvest only allowed when it accelerates habitat development.

55. See OREGON FOREST RESOURCES INSTITUTE, OREGON FOREST FACTS: 25-YEAR HARVEST HISTORY, 1977-2001 (OFRI), available at [http://www.oregonforests.org/factbook/Harvest_History\(24\).html](http://www.oregonforests.org/factbook/Harvest_History(24).html).

56. See Durbin, *supra* note 20 (discussing intensifying interest in expected jump in Tillamook harvest in the next several years, as federal land harvests were reduced); Cf. 2005 OR. FORESTS REP., *supra* note 8, at 2-15 (describing "reserve" management strategy on federal lands; contrasting with management of private and state lands).

vate lands had been cut over many years earlier.⁵⁷ The State Department of Forestry has adopted a middle ground position, promoting its lands as multi-use lands operating somewhere between the federal “reserve” lands on one hand and the private “wood production” lands on the other hand.⁵⁸

I. The State’s Laboratory

In 2001, the State Board of Forestry adopted the Northwest Forest Management Plan to govern the Tillamook State Forest.⁵⁹ This management plan incorporated a completely new and different approach to managing the lands. The most unique and controversial component of the plan is “structure-based management”.⁶⁰ The aim of structure-based management is to transform the Tillamook’s even-aged, mostly-single-species tree plantations into structurally diverse forests containing everything from open areas to older forest structure such as that provided by old growth forests.⁶¹ If the variety of species and different layers of structure create an environment similar to naturally diverse forests, this technique could provide a diversity of wildlife habitats, trees that are more resilient to disease, erosion protection, and many other benefits.⁶²

The proposed approach of structure-based management involves several significant changes to previous management regimes. Instead of using timber harvest targets as the major planning goal, growing diverse forests becomes the driving goal, and timber harvesting is one tool among many to achieve this goal.⁶³

57. See OFRI, *supra* note 55 (noting that private land timber harvest in Oregon peaked at 7.3 billion board feet in 1952, and the federal land harvest took over the lead. But when the federal harvest dropped in the 1990s, the private lands output remained relatively stable at then-existing levels); see also Kathie Durbin, *Spotted Owl or Red Herring?* HIGH COUNTRY NEWS, Mar. 20, 2006, at 4 (noting that the Pacific Northwest timber industry’s decline from a peak in the 1980s was driven by mill automation, log exports, and overcutting of private lands in the 70s and 80s, as well as by changing federal land management).

58. See note 56, *supra*.

59. NORTHWEST FOREST MANAGEMENT PLAN, *supra* note 15. The author was a member of the Board of Forestry at that time (from June 1998 — June 2002) and voted with a unanimous board to adopt the plan. The Board is a gubernatorily-appointed citizen policy board established by statute. OR. REV. STAT. §526.009.

60. *Id.* at 4-5 through 4-8.

61. *Id.* at 4-5 (“SBM is the application of silvicultural tools in a manner that is designed to attain a desired landscape condition. . . .Specifically, it is designed to produce and maintain an array of forest stand structures across the landscape”) and 4-7 (describing the “desired future condition” of “a dynamic mosaic of slowly shifting stand types” including areas of older forest conditions and areas of high timber production).

62. *Id.* at 4-7 - 4-8 (describing the goals of “a broad range of ecosystems and wildlife habitats” to restore and maintain biodiversity and “long-term forest productivity”).

63. *Id.* 4-5 — 4-10 (describing how “active management,” including thinning, harvest, and other activities, will be used to achieve “a balance of social, economic, and environmental benefits from the forest over time”).

The plan proposes much longer harvest rotations than had been previous practice; instead of harvesting trees at 60-80 years of age, the rotation period is increased to over 100 years.⁶⁴ Pre-commercial and commercial thinning would take the place of clear-cutting in many areas.⁶⁵ The premise of the plan is that by pursuing structure-based management, the Tillamook will be able to grow healthy trees that will provide significant timber value over time, while also providing enhanced fish and wildlife habitat, improving water quality, protecting the watershed for water supply, and accommodating recreational uses.⁶⁶

The structure-based management approach generated controversy in several ways. The affected counties and the timber industry representatives reacted critically to the longer harvest rotations and the reduced timber volume that the Tillamook would produce in the near term; they felt betrayed because they had been expecting considerable timber harvest now that the earliest Tillamook Burn plantings had reached the 60 year mark.⁶⁷ Other groups, such as environmentalists and fisheries advocates, are skeptical of structure-based management because it is essentially experimental and includes an active management approach to almost every acre of the state forest.⁶⁸ No one knows if in fact older forest structure can be successfully created in 100-year-old stands by thinning and other intensive forestry practices.⁶⁹ The state's 2001 proposal to use the Tillamook State Forest as a laboratory for trying out experimental forestry techniques seemed to make no one happy.

The Tillamook State Forest, though only a small portion of one state's land, is a big tent, holding wondrous riches of timber, fisheries, wildlife habitat, water supply, and recreation, of importance far beyond the forest's boundaries. But the tent is crowded with interest groups vying for all those riches. As the groups jostle for control, they run the risk of pulling the tent down around them.

64. *Id.* at Appendix I-6 (showing average age at harvest of 114 years for the plan's recommended future harvest scenarios).

65. *Id.* at Appendix C-49 to C-62 (describing use of precommercial and commercial thinning and other silvicultural practices to achieve desired stand types).

66. *Id.* at 3-2 — 3-8 (describing the plan's guiding principles).

67. *See, e.g.*, Tom Bennett, *Timber Harvest Levels Fall Short of Plan: Oregon Board of Forestry Re-examines Forest Plan as Counties Face Cuts in Revenue*, DAILY ASTORIAN, Sept. 14, 2006 (describing Tillamook County Commissioner Tim Josi's call for "complete overhaul" of the state forest plan and scaling back of the "structure-based management 'experiment'").

68. *See* Mike Stark, *Will Logging Save the Spotted Owl?* HIGH COUNTRY NEWS, Mar. 12, 2001 (discussing conservationists' criticism of the new forest plan).

69. *Compare* NORTHWEST FOREST MANAGEMENT PLAN, *supra* note 15, at Appendix 11 (noting that unmanaged forests start to display old growth characteristics at 175-250 years in age) with 4-17 (describing "older forest structure" with no reference to age of trees).

III. HOLDING UP THE BIG TENT: THE TILLAMOOK STATE FOREST AND ECOSYSTEM SERVICES

A. Today's Management Model: Spending Down the Principal

The current approach to managing the Tillamook State Forest is similar to the approach to much public lands management. The lands are managed for multiple uses, which often means managing in response to interest group pressures. The power and influence of the various interest groups change from year to year, but the modus operandi is the same no matter which interest is in vogue. Constituencies with the most to gain or lose from particular management decisions pay close attention to what the decision makers are doing and lobby hard to protect and promote their immediate interests.⁷⁰ Oregon's former Governor John Kitzhaber described this cycle of conflict succinctly:

Environmental interests sue the natural resource industries and governmental agencies for failing to meet . . . standards and regulations. They strive to strengthen environmental laws through legislative action. In return, economic interests that are subject to . . . regulation, challenge these regulations in the courts and seek to repeal or weaken them through legislative action. Each side tends to look for opportunities to advance their agenda when the [a]dministration . . . is in their favor, while the other side relies on the courts to form a defensive front against changes that might imperil their interests.⁷¹

The resulting management choices seem perfectly rational and satisfactory from the perspective of whichever constituency is "winning" at any point in time. The groups who have succeeded in maximizing their short-term gains are happy, while the losers regroup for the next battle, hoping that the next time they'll be victorious and then be able to hold on to their gains for a reasonable period of time.⁷²

Stepping back from the immediate perspective of the competing interest groups and taking a broader and longer view, however,

70. See generally, Michael Blumm, *Public Choice Theory and the Public Lands: Why "Multiple Use" Failed*, 18 HARV. ENVTL. L. REV. 405 (1994) (discussing the disproportionate influence on policy making of small and well organized interest groups).

71. John Kitzhaber, M.D., former Governor of Or., Speech to the Ecological Society of America (Aug. 6, 2004) available at <http://www.lclark.edu/org/kcenter/ecosocamerica.html>.

72. *Id.*

exposes this approach as irrational and ultimately self-defeating for those involved. First of all, this approach produces, at best, see-saw management, and, at worst, gridlock.⁷³ This short-sighted approach is akin to spending down the principal of an endowment instead of limiting spending to the interest income. Pretty soon, there is no more income, and the principal itself is gone. An endowment that might have provided a stream of income for many purposes for years to come has been destroyed.

To expand the endowment analogy to include competing interest groups, think of hostile siblings fighting over their parents' estate, an estate that consists of a large parcel of appreciating real estate and a nicely balanced stock portfolio. If the squabbling kids focus on their disagreements and on maximizing their short-term gain, they may end up forcing partition of the real estate and liquidation of the portfolio in order to get immediate cash flow. The stronger their antipathy, the harder they'll try to get more than their fair share at their siblings' expense, and the less they'll think clearly about how to maximize long-term gain for all of them and their own children. The most rational choice, from the perspective of long-term maximum gain, might well be to hold the assets rather than to distribute them, taking smaller short-term gains in the form of rents, interest, and dividends while allowing the property and the portfolio to increase in value.

But making that choice requires cooperation, as well as agreement on the goal of improving the returns for all of the beneficiaries over a longer time period.⁷⁴ Polarized (or cash-strapped) siblings are unlikely to behave so sensibly. Unfortunately, however, once they've liquidated the assets, they may quickly spend their share and soon have nothing to show for their once-valuable inheritance. At least that will spare their own children the same fate, since they won't have anything to fight over, but that's a pretty thin silver lining in an otherwise dark cloud.

Public land management as exemplified by the Tillamook State Forest is currently following the same trajectory. The commercial fishers, the loggers and mill owners, the county commissioners, the environmental groups, the dairy farmers, and all the other interest groups are the squabbling siblings. For the most part, each group insists on a particular product from the Forest, *now*, and fights against others who demand different goods. Meanwhile, the Forest itself is the estate and the endowment.⁷⁵ Unless the endow-

73. *Id.*

74. Of course, if one of the parties has serious immediate financial needs, agreement on a longer-term goal will be even more challenging and some concession to that need may be required.

75. *See generally* THOMAS PRUGH ET AL., NATURAL CAPITAL AND HUMAN ECONOMIC SURVIVAL

ment is managed for robustness and growth, the interest and principal will both diminish and eventually disappear, leaving behind all losers and no winners. “We sue each other, we label each other, we battle it out in the halls of Congress while our rural mills close, our forests burn, and ever more species edge toward the brink of extinction.”⁷⁶

Is there a better way? In contrast to the current campaign-cycle forest management model, what would a model look like that “grew” the endowment’s principal, thereby guaranteeing a growing stock of natural capital and a steady and increasing flow of future interest income as well? More importantly, how could state forest managers get there from here, given the political world they live in?

*B. Tomorrow’s Management Model: Preserving and Investing
in the Principal*

In the financial world, endowment models are fairly well understood. Returning to the analogy of the fighting siblings, for example, suppose that they made out like bandits by selling their inherited real estate and splitting the proceeds. Feeling well-to-do and magnanimous, the family decided to put the rest of the estate’s assets into a trust to create an endowed scholarship fund to support annual scholarships. Their goals are to protect the endowment in perpetuity, to prevent the principal from losing value, and ideally to increase the principal value over time, in order to fund more scholarships every year on a growing stream of endowment income. The endowment is seeded with the estate’s stock portfolio. The investment adviser is directed to manage the portfolio pursuant to a moderately conservative growth strategy. The investment adviser will then suggest to the trustee and the scholarship award committee a percentage rate of annual spending from the fund to support the yearly scholarship grants. This spending rate number will be calculated based on the historic performance of similar portfolios, as well as on the actual performance of this portfolio over time. The key to determining the rate of allowable spending is choosing an amount that will support an acceptable number of scholarships each year, but will also allow for annual reinvestment of some of the income into the principal, so that the fund’s base assets will continue to grow. Assuming that

44, 102-103 (2d ed. 1999) (discussing the need to keep stocks of natural capital, such as forests, intact in order to maintain sufficient flows of income in the form of goods and services over time; depletion of the natural capital will eventually destroy both the stock and the flow of income).

76. Kitzhaber, *supra* note 71.

the portfolio's value increases at a rate greater than the "spending from endowment" rate chosen, the number and amount of scholarships fundable will steadily increase even without changing the percentage spending rate.

How does this translate into natural resources management? Good question. The earlier discussion about the groups seeking to influence management of the Tillamook suggests that differences complicating smooth translation are more apparent than similarities. First, the endowed scholarship model has only one output, cash. Any disagreement about output will probably focus only on the amount of cash—in this example, the proper number of scholarships to fund. In the Tillamook, the menu of desired outputs is long, varied, and competing. Second, a scholarship endowment fund has three clear decision-making entities: an oversight body serving as the trustee for the endowment, an investment adviser, and a scholarship award body. All three have distinct and clearly-defined roles but, to a significant degree, the same goals. Arguably, all three have fiduciary duties as well. By contrast, in the natural resource management context represented by the Tillamook State Forest, the decision-makers are many and their roles are not so clearly defined. Nor are their fiduciary duties well understood, if such duties exist at all.

Third, in the financial setting, the investment market histories and predictive equations to optimize both income stream and principal growth have been around for decades and are well tested. That is not the case in the natural resource management field. Although relatively short-term predictive equations exist for commodities such as timber, predictive models simply do not exist for jointly optimizing timber harvest, clean water, fish and wildlife habitat, recreation, and other goods and services over a long time horizon.⁷⁷

Does this mean that the idea of "growing the principal" in natural resource management has to be abandoned as hopelessly lost in translation? Not necessarily. The emerging field of ecosystem services provides both a dictionary and possible equations.⁷⁸

Ecosystem services as a discipline focuses attention on the

77. See Robert Costanza and Carle Folke, *Valuing Ecosystem Services with Efficiency, Fairness, and Sustainability As Goals*, in *NATURE'S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS* 64 (Gretchen C. Daily, ed., 1997) (describing the "need to develop truly integrated assessments and models of the quality, quantity, and spatial and temporal dynamics of ecosystem services and the various aspects of their connection to human well-being in the long run"); see also James Salzman, *Valuing Ecosystem Services*, 24 *ECOLOGY L. Q.* 887, 896-898 (1997) (discussing difficulty of valuing ecosystem services).

78. See Salzman, *id.* (discussing the potential to borrow methodology for valuing ecosystem services to some degree from financial markets).

valuable goods and services that healthy functioning ecosystems produce for us, essentially free of charge.⁷⁹ In contrast, an unhealthy or disrupted ecosystem cannot perform these important services or produce these valuable products, some of which have no cost-effective substitutions.⁸⁰ In a forested watershed like the Tillamook State Forest, these goods and services include such things as supplies of fresh water, fisheries, forest products, and carbon dioxide sequestration.⁸¹ The remainder of the paper examines these components as they might be applied in the Tillamook State Forest, and by extension, to similar ecosystems with similar challenges.⁸²

C. The Ecosystem Services Model Applied to the Tillamook State Forest

The Tillamook State Forest is an excellent laboratory for applying a new management model based on ecosystem services. First, the boundaries of the state forest are closer to a useful ecosystem boundary than most ownership parcels. Second, the land is in public ownership and its governing law requires management of the lands for the “greatest permanent value” to the state. This language cries out for an appreciation of ecosystem services. Third, the suite of resources that interest groups and the public want from the forest, though numerous and varied, all depend on a healthy, functioning ecosystem for continued production.

1. Inside the Box: The Ecosystem of the Tillamook State Forest

In order to manage the Tillamook State Forest for maximum long-term health and productivity, the forest needs to be understood as an ecosystem in all of its complexity. But as a legal entity

79. See generally Gretchen C. Daily, *Introduction: What Are Ecosystem Services?*, in NATURE'S SERVICES, *supra* note 77, at 1-6. The first mention of ecosystem services has been credited to a report titled *The Study of Critical Environmental Problems* that was published by MIT Press in 1970. See Harold A. Mooney & Paul R. Ehrlich, *Ecosystem Services: A Fragmentary History*, in NATURE'S SERVICES, *id.* at 14. The crossover of ecosystems services into the legal field as a suggested basis for natural resource management has occurred only in about the last decade. See Salzman, *supra* note 77, at 898-903.

80. Daily, *supra* note 79, at 5.

81. *Id.* at 3-5. These are only some of the most obvious ecosystem services. Daily lists many more, including: air and water purification; flood and drought mitigation; decomposition and detoxification of wastes; generation and renewal of fertile soil; pollination; pest control; dispersal of seeds and nutrients; maintenance of biodiversity which supports human agriculture, medicine, and industry; protection from the sun's radiation; climate stabilization and moderation of temperatures; support of diverse cultures; and aesthetic beauty and intellectual stimulation.

82. “Site-specific case studies” can help translate abstract ecosystem service values into tangible terms connected to “real people in real socioeconomic settings.” Andrew Wilcox & John Harte, *Ecosystem Services in a Modern Economy: Gunnison County, Colorado*, in NATURE'S SERVICES, *supra* note 79, at 311.

for management purposes, the Tillamook State Forest is defined by lines drawn on a map without regard for any underlying natural boundaries, processes, or interrelationships. This mismatch is a common problem in natural resource management, where political jurisdictions rarely coincide with natural systems.⁸³ Fortunately, however, the boundaries of the Tillamook are reasonably congruent with the outlines of two watersheds—the Tillamook Bay and Nehalem Bay drainage basins. Although the congruence is by no means a perfect overlap, this feature makes viewing and understanding the Tillamook as an ecosystem somewhat easier than doing so with many other natural resource management units. Furthermore, a good deal of information already exists about these forested watersheds. Until recently, however, most studies have emphasized silviculture in aid of maximizing timber growth, and only in the past few decades has the focus shifted to examine other values and products.⁸⁴

The Tillamook State Forest ecosystem is part of the Oregon Coast Range physiographic province, which consists of “low mountains...covered by highly productive, rain-drenched coniferous forests;” in other words, the Tillamook State Forest is a low-elevation temperate coastal rain forest.⁸⁵ These coastal forests are among the most productive forest ecosystems *in the world*—even surpassing many tropical forests, thanks to lots of precipitation, long frost-free growing seasons, and moderate temperature swings between mild winters and relatively cool summers.⁸⁶ This very productivity and robustness is of course what makes the area of interest to both timber companies and fish and wildlife groups. Furthermore, this world-class ranking of forest productivity means that the area’s importance is considerably greater than its size and location would otherwise suggest, and its role in carbon sequestration and climate stabilization cannot be ignored.⁸⁷

83. See generally, Janet Neuman, *Dusting off the Blueprint for a Dryland Democracy: Integrating Water Availability and Watershed Health into Land Use Decisions*, 35 ENVTL. L. REP. 10236 (2005).

84. See, Stephen D. Hobbs & Thomas A. Spies, *Introduction*, in *FOREST AND STREAM MANAGEMENT IN THE OREGON COAST RANGE I* (Stephen D. Hobbs, et al. eds., 2002) (discussing the wealth of new interdisciplinary research performed in the Oregon Coast Range since 1987).

85. *ATLAS OF OREGON 172-179* (William G. Loy, ed., 2d ed. 2001). The highest points in the Oregon Coast Range are just over 3,000 feet. *Id.* at 252. Annual precipitation averages nearly 200 inches in some parts of the forest. *Id.* at 154. A comprehensive discussion of the Tillamook ecosystem is both beyond the scope of this paper and beyond the scope of my expertise; this section simply sketches out some basic elements to demonstrate the forest’s complexity and to illustrate that management decisions cannot focus narrowly on how many trees should be cut or even on how many fish should be grown.

86. See generally Thomas A. Spies, et al., *The Ecological Basis of Forest Ecosystem Management in the Oregon Coast Range*, in *FOREST AND STREAM MANAGEMENT*, *supra* note 84, at 43-45.

87. See generally Susan E. Alexander, Stephen H. Schneider, & Kalen Lagerquist, *The Interaction of Climate and Life*, in *NATURE’S SERVICES*, *supra* note 79, at 71; Norman Myers, *The World’s Forests and Their Ecosystem Services*, in *NATURE’S SERVICES*, *supra* note 79, at 215. (Though primarily discussing tropical, rather than temperate, rainforests, both pieces emphasize the critical role of such forests in

Prior to the intensive logging and devastating fires of the past century, the Tillamook was primarily a mixed conifer forest containing Douglas fir, western hemlock, and Sitka spruce, along with a number of hardwood species, the most widespread of which were alder and maple.⁸⁸ Pollen records suggest that this species composition had been relatively stable for as long as 6,000 years.⁸⁹ The physical historical record also demonstrates how various species play particular roles in the ecosystem. For instance, deciduous trees are especially important for fixing nitrogen, promoting faster nutrient cycling than conifers alone, stabilizing riparian zones, providing important wildlife habitat, and supporting lichens.⁹⁰ The complex and highly productive forest contains hundreds of non-tree plant species and provides habitat for a wealth of fish and wildlife as well, including some sixty-three species of mammals, one hundred forty-seven species of birds, thirty-two reptile and amphibian species, and twenty-eight fish species.⁹¹

Once the Coast Range became important to the timber industry, and particularly after the fires of the mid-1900s, the mix and distribution of species in the Tillamook began to change. Primarily Douglas fir seedlings were used for the post-fire replanting because of their rapid growth rate and their desirability for lumber.⁹² The reforested Tillamook is thus largely made up of even-age Douglas fir, without the historical mix of other conifers and hardwoods. Homogeneous replanted forests are more vulnerable to certain pests and diseases, such as Swiss needle cast, which is taking a drastic toll on the region's Douglas fir stands.⁹³ The decreased variety in vegetation also diminishes habitat and weakens the food web for both plants and animals, helping to explain why dozens of

stabilizing local, regional, and even global climate).

88. Spies, *supra* note 86, at 39-41.

89. *Id.* at 39.

90. *Id.* at 39-41.

91. NORTHWEST FOREST MANAGEMENT PLAN, *supra* note 15, at 2-28 and 2-61.

92. *Id.* at 35 (noting that Douglas fir is the foundation of timber management throughout the Coast Range) and 54 (intensive forest management tends to shift stand composition to the most valuable timber species, including Douglas fir).

93. *Id.* at 35-36; *see also, generally* Walter G. Thies & Ellen Michaels Goheen, *Major Forest Diseases of the Oregon Coast Range and their Management*, in FOREST AND STREAM MANAGEMENT, *supra* note 84, at 191-212. The vulnerability of the Douglas fir plantings in the Tillamook Burn may have been exacerbated by use of seed stock from outside the Oregon Coast Range. Many of the seedlings came from Washington state and although they were similar to the trees in the Tillamook's pre-fire forests, they were not identical. The Washington seed stock was adapted to the somewhat different environment a few hundred miles north. *See* LUCIA, *supra* note 6, at xxiv and 175 (noting that "in the early years the state forestry scrounged both [seedlings and seed] from any available source" and stating that nearly 2 million trees came from Washington). In keeping with the citizen reforestation effort, Oregon residents were also encouraged to gather pine cones and bring them to the foresters, who would pay them for the cones. Don Hamilton, *Oregon Students Helped Transform the Landscape*, OREGONIAN, Nov. 21, 1996, at WZ 1. (quoting then-Secretary of State Phil Keisling about gathering seed cones for the Tillamook reforestation with his family when he was young and taking them to the weigh station to be paid).

species of animals and plants are officially considered “species of concern”.⁹⁴ Thus, the picture that emerges of the Tillamook today is of an ecosystem somewhat simplified by human management, but still hugely productive and with a known and recent history of an even higher level of complexity and resilience.

In one of the recent studies of the Oregon Coast Range, a phalanx of scientists synthesized several years of research on wildlife habitat, fisheries habitat, forest health, and a number of other important topics.⁹⁵ A reader approaching the compendium on its own terms would likely come away feeling satisfied and informed, as the volume is a veritable encyclopedia of data about the current mosaic of vegetation across the landscape, the fish and wildlife that are found in various locations, the current distribution of major forest diseases, and many other data points. But a reader approaching the volume seeking a more holistic view of the ecosystem’s functioning and how the various parts of the system interact may instead come away disappointed. This feeling is not due to any failure on the part of the authors, but results from the fact that in spite of all the valuable information that exists, the systemic knowledge is still quite limited.

For instance, a discussion of the ecological basis of forest ecosystem management includes the following underwhelming conclusions:

The long-term consequences of these changes in diversity [in stands managed primarily for timber production] to ecosystem outputs are not well understood; consequently, forest management in the Coast Range should be viewed as a large experiment

. . .

[N]atural processes of vegetation development must be better understood if managers can hope to reach a goal of retaining native species and communities . . .

.

. . .

[W]e lack knowledge of many of the details of ecological processes and habitat relationships that are essential to modern forest planning and the ability to predict the consequences of specific actions.⁹⁶

94. See generally, Spies, *supra* note 86; see also NORTHWEST FOREST MANAGEMENT PLAN, *supra* note 15, at 2-32 and 2-62 (listing species of concern).

95. FOREST AND STREAM MANAGEMENT, *supra* note 84.

96. Spies, *supra* note 86, at 36, 60-61.

Similar admissions of lack of information appear in chapters on fish and aquatic ecosystems⁹⁷ and the ecology of wildlife.⁹⁸ In an area as intensively studied as the Oregon Coast Range, the encyclopedic material that does exist hardly seems to make a dent in understanding the big picture. But what if the same teams of interdisciplinary scientists were asked to consider what they already know from a somewhat different perspective? What if they were asked directly to identify the variety of ecosystem services provided by coast range forested watersheds, specifically the Tillamook? I venture to say that--even without any additional research--a very complex picture could be developed. In fact, many of the Tillamook's ecosystem services have already been mentioned earlier, just by describing the various constituencies interested in the forest.⁹⁹ Combining those interest group demands with what the Oregon scientists know and incorporating the considerable work done by others in the ecosystem services area would produce something like the following list, though with much more detail and sophistication:

- A wide range of valuable wood products, including everything from high quality Douglas fir lumber, to lower quality woods for paper pulp and veneer, and medicinal products such as taxol from Pacific yew trees;
- Other forest products including such things as moss, mushrooms, shrubbery, boughs, greens, cones, and ferns;
- Water-related goods and services, including, among others, important Pacific salmonid fisheries habitat, freshwater supplies, estuary nutrients, floodwater storage and flood control, water filtration, and erosion control;
- Soil creation and renewal and waste decomposition;
- Carbon sequestration, climate stabilization, radiation protection, and temperature modulation;

97. Gordon H. Reeves, Kelly M. Barnett, & Stanley V. Gregory, *Fish and Aquatic Ecosystems of the Oregon Coast Range*, in FOREST AND STREAM MANAGEMENT, *supra* note 84, at 83, 85 (noting an emerging, but not yet implemented, recognition that a comprehensive ecosystem approach is necessary for recovery of imperiled fish and that "understanding of the broad-scale behavior of aquatic ecosystems over extended time periods is limited.").

98. John P. Hayes & Joan C. Hagar, *Ecology and Management of Wildlife and Their Habitats in the Oregon Coast Range*, in FOREST AND STREAM MANAGEMENT, *supra* note 84, at 126-128 (describing the challenges of managing for wildlife habitat at large spatial scales for several reasons, including patchwork ownership, species' unique responses to management activities, and the need to deal with very long time horizons, even centuries).

99. See Part II.

- Pollination, seed dispersal, and nutrient transport;
- Maintenance of biodiversity;
- Scientific study; and
- Recreation and esthetics.¹⁰⁰

This “simple” list demonstrates that the Tillamook State Forest ecosystem is much greater than the sum of its parts. Until a true ecosystem approach is adopted, the forest managers, the interest groups, and the public will all fail to see the forest for the trees . . . or the fish . . . or the off-road-vehicle trails . . . or any other single interest.

2. Managing the Tillamook State Forest for the “Greatest Permanent Value”

The Tillamook State Forest is publicly owned.¹⁰¹ The forest’s boundaries happen to coincide, albeit roughly, with two significant watersheds. The area is recognized as the largest contiguous parcel of temperate rain forest in the lower forty-eight states. What is more, the law governing the Tillamook’s management directs the State Forester and the Board of Forestry to manage these lands for the “greatest permanent value” of the lands to the state.¹⁰² This phrase echoes the vocabulary of long-term financial trust management and provides the mandate for treating the Tillamook State Forest as an endowment that must be nurtured to protect its long-term productivity. This law positively begs for an ecosystem services approach.

Although the legislature chose not to define the management directive explicitly in the statute, the lawmakers did include a menu of authorized activities that can be pursued to “secure” the lands’ greatest permanent value. “[T]o that end,” the State Forester may: sell forest products; reforest the lands, and protect them from fire, disease, and pests; sell rock, sand, gravel, and pumice, and execute mining leases; permit use of the lands for livestock

100. See Daily, *supra* note 79 (summarizing ecosystem services), and NORTHWEST FOREST MANAGEMENT PLAN, *supra* note 15, Chapter 2 (detailing the resources of the Tillamook State Forest).

101. The Tillamook State Forest’s public ownership status makes incorporation of an ecosystem services approach to management much easier than for private lands. See J.B. Ruhl, *The “Background Principles” of Natural Capital and Ecosystem Services—Did Lucas Open Pandora’s Box?*, 22 J. LAND USE & ENVTL. L. 527 (2007) (discussing challenge of using common law to address ecosystem services on private lands).

102. OR. REV. STAT. § 530.050 (2005). The “greatest permanent value” language became a part of the state statute in 1941. 1941 Or. Laws, Ch. 236, § 5. No legislative history survives to illuminate the original meaning of the phrase, but since these are three ordinary English words, their plain meaning is not hard to derive. The terms by their nature are flexible and forward-looking and a contemporary determination of what constitutes the greatest permanent value must certainly incorporate expanding understandings of ecology and ecosystems.

grazing, fish and wildlife habitat, protection of water supplies, flood and erosion protection, and recreation; and even use the forestlands to establish a marketable carbon offset program.¹⁰³ Without the introductory mandate of managing for greatest permanent value, this list is in many ways just a typical “multiple use” prescription, similar to that for many other public lands. The statute gives no guidance on how to choose or balance among these interests, such as when to favor selling forest products over protecting fish and wildlife habitat, or how to reconcile recreation with protecting water supplies. Without such guidance on priorities or further definition of what is meant by greatest permanent value, the law invites interest groups to lobby for their favorite items from the statutory menu. So far, that is exactly what has happened.

The state forestry managers, unlike bank trust officers, do not work in quiet back offices, communicating periodically with their beneficiaries through routine paper reports. The state forestry department employees work in full public view at all times. The legislature approves the budget that pays their salaries. The governor appoints and the State Senate confirms the volunteer citizen Board members, who in turn appoint the State Forester.¹⁰⁴ The Board represents designated geographic regions throughout the state.¹⁰⁵ Three of the seven board members—but no more than that—may have ties to the timber industry.¹⁰⁶ The Board makes its decisions in public meetings, and the doors of the Department are open at all times to all of the state forests’ bosses, beneficiaries, and shareholders. The managers are under the direct and constant scrutiny of politicians, loggers, environmentalists, all-terrain vehicle users, downstream farmers, fishermen, hunters, boaters, and on and on. The only constituencies who cannot put direct personal pressure on the state employees are the fish and the furred and feathered creatures, but they have plenty of human spokespeople to do the job for them.

Therefore, these state land managers often understandably make decisions that are more about appeasing interest groups seeking short-term gains than about long-term permanent value maximization. Adding together a bunch of interest group demands and calling it “the public interest” and even the “greatest value” is sometimes the best agencies can do when their mandates include

103. OR. REV. STAT. § 530.050(1)-(11) (2005).

104. OR. REV. STAT. §§ 526.009(1), 526.031(1) (2005). The Board members are private citizens who are compensated only for expenses and a small per-diem when attending meetings. OR. REV. STAT. § 526.016(2) (2005); OR. REV. STAT. § 292.495 (2005).

105. OR. REV. STAT. § 526.009(3) (2005).

106. OR. REV. STAT. § 526.009(4) (2005).

something for everyone without any direction on how to make hard choices. The decisions thus reflect rational self preservation, or sometimes just plain weariness, in dealing with conflicting demands from competing constituencies, all of whom have essentially equal claims under the law and who operate on short time horizons.

When the Board of Forestry promulgated administrative rules to further explain the thrust of the greatest permanent value statute in 1998,¹⁰⁷ this was the context in which they operated. The rulemaking process generated tremendous controversy.¹⁰⁸ In the end, the greatest permanent value rules were the product of political compromise.¹⁰⁹ The Board was able to broaden the notion of the public interest in state forestlands somewhat beyond timber to reflect new constituencies and new understandings, and thus the rules reflect an updated view of the "public interest" in publicly owned forests.¹¹⁰ But insofar as the rules try to be all things to all people by maximizing timber harvest and environmental values at the same time, the rules perpetuate multiple use management and thus stop short of fulfilling the statute's broader fiduciary duty to manage the forest for the greatest permanent value, a duty which does not necessarily allow something for everyone in the short term.

Building on the compromised rule, the Department and Board again attempted to interpret their mandate somewhat creatively when they adopted a management plan for the Tillamook State forest in 2001.¹¹¹ The Plan adopted by the Board looks many years into the future, again attempting to maximize multiple returns from the Tillamook's resources. However, it does so by foregoing some immediate benefits, such as near-term timber harvest, and focusing on creating a diverse and healthy forest ecosystem over

107. OR. ADMIN. R. 629-035-0000 (2007) to 629-035-0110 (2007). The author's term on the Board of Forestry began after the greatest permanent value rules were adopted. See NORTHWEST FOREST MANAGEMENT PLAN *supra* note 15.

108. See, e.g., Joan Laatz Jewett, *Subcommittee Delays Position on State Forests' Prime Use*, OREGONIAN, Nov. 5, 1997, at E3. (describing "outpouring of opposition from the public and the governor" to the proposed rules provision that would have formalized timber production as state forests' primary purpose, which led to appointment of a subcommittee of the Board of Forestry to try to reach a compromise).

109. Draft rules published on July 15, 1997, stated timber harvest and producing revenue as primary goals. The final rules as adopted defined greatest permanent value to be "healthy, productive, and sustainable forest ecosystems that over time and across the landscape provide a full range of social, economic, and environmental benefits to the people of Oregon" and placed timber harvest as a goal that needed to be "pursued within a broader management context" but still expressed a goal of actively managing the lands for sustainable timber harvest and revenues). Compare Department of Forestry Notice of Proposed Rulemaking Hearing, July 15, 1997, with OR. ADMIN. R. 629-035-0000 *et seq.* (adopted Jan. 7, 1998).

110. *Id.*

111. See Part II(I).

several decades using structure-based management, with the hope that a more complex ecosystem will be better able to support timber harvest, fisheries, and numerous other benefits than the closed canopy, even-age, second growth forest that is the Tillamook today.

However, as noted earlier, the new thinking was not greeted with open arms: far from it. The timber industry responded by lobbying the state legislature to directly override the plan and mandate more timber cutting.¹¹² Their proposed legislation would have required a 40-year harvest schedule.¹¹³ The environmental groups and fisheries advocates also tried to legislate their own preferred plan through the citizen initiative process.¹¹⁴ The Wild Salmon Center and others sponsored a ballot measure that would have placed half of the acreage in the Tillamook completely off-limits to logging or other active management in order to grow old forest reserves.¹¹⁵

This swift reaction to the new management plan demonstrates just how difficult it can be to change an existing management model to incorporate ecosystem services. In spite of a broad and forward-looking statutory mandate and the initial willingness of state forest managers to use this authority creatively, the Tillamook State Forest is still the victim of see-saw management policies. As long as the competing interest groups can keep the focus on short time horizons and single outputs, the state will continue to spend down the principal in order to have enough outputs to keep the various constituents happy in the near term.

However, in spite of the pressures that have kept the state forest managers embattled, the law is on the side of fighting back. The state forest land management law is *qualitatively* different from the usual multi-purpose natural resource management directive because of those three operative words: *greatest . . . permanent . . . value*. Use of the word *permanent* clearly demands taking a very, very long view. Determining the *greatest value* requires comparative valuation analysis among various competing possible returns, which is different than simply adding up a tally of several desired outputs. The statute does not constrain value to dollars and cents, but contemplates a much more open-ended assessment

112. See, e.g. SENATE BILL 699 (2003). The legislature also tried to force more logging by including budget notes in the Department of Forestry's budget, directing the Department to log at least 250 million board feet a year as a condition of keeping more than 20 full time agency positions. See Michelle Cole, *Senate Democrats Pressured to Vote Against Forestry Budget*, OREGONIAN, July 13, 2005, at C1; and Michael Milstein, *Governor Defies Forest Directive*, OREGONIAN, Sept. 9, 2005, at B1. (both discussing legislative budget notes in the 2003-2005 and 2005-2007 biennial sessions and Governor Ted Kulongoski's direction to the Department not to follow the budget notes).

113. *Id.*

114. See 2004 BALLOT MEASURE 34, *supra* note 35.

115. *Id.*

of everything from timber to flood control to carbon sequestration.¹¹⁶ The statute thus gives state officials significant latitude, indeed requires them, to act like trustees of an endowment, managing state forest lands for the long haul, carefully considering the entire list of authorized uses and their relative values in order to determine what management prescriptions would best maximize the long-term gains for the state of Oregon.¹¹⁷

But how should state officials compare the value of 10,000 board feet of lumber cut from 60-year-old trees today with 100,000 board feet of lumber cut from 100-year-old trees in 2047? Even assessing just today's cut, how should they factor in and compare the loggers' wages, the counties' trust payments from the state, the foregone wages of the ocean fishermen if the salmon hot spots are damaged by logging, the loss of spotted owl and murrelet habitat, and the indirect impacts on recreation? As soon as forest managers start projecting years into the future, the calculations become even more daunting and less solid, subject to debate about proper discount rates and other predictions.

I know that if I take my checkbook to the lumberyard, I can write a check for fifty dollars and take home a certain number of two-by-fours. But how many murrelet nests would that fifty dollars buy, and who would take my money?¹¹⁸ If I lived in Wheeler, Oregon, and wanted to assure that the Tillamook watershed would provide clean drinking water for my grandchildren, how much would that cost, and who could I pay for it even if I wanted to? Will there be jobs for my grandchildren to keep them in Wheeler? Will they be loggers, fishing guides, owners of a saltwater taffy shop for tourists, or carbon traders?

Traditional, conventional economic theory does not provide an easy way to value these non-commodity outputs of the forest, what ecological economists have termed "natural capital."¹¹⁹ Mainstream economists treat land and related natural resources simply as one of many inputs into human economic systems of production and consumption, thus subordinating ecosystems and the natural environment to the human economy.¹²⁰ In contrast, the relatively

116. See *supra* notes 102-103. (the statute lists forest products, flood control, and carbon offsets as three among many authorized purposes for the lands, including both commodity and non-commodity uses).

117. This fiduciary duty is directly supported by the plain statutory language and does not require any creative theories such as an expansive reading of the public trust doctrine. Cf. J.B. Ruhl, *Toward a Common Law of Ecosystem Services*, 18 ST. THOMAS L. REV. 1, 6-9 (2005) (noting the public trust doctrine's failure to provide a basis for incorporating ecosystem services into the common law).

118. Cf. Salzman, *supra* note 77 (discussing lack of markets for ecosystem services).

119. See generally PRUGH, *supra* note 75.

120. *Id.* at 9-21; see also Lawrence H. Goulder & Donald Kennedy, *Valuing Ecosystem Services: Philosophical Bases and Empirical Methods*, in NATURE'S SERVICES, *supra* note 79, at 24-27 (describing

new field of ecological economics recognizes that all human economic activity is enabled by (and thus essentially subordinate to) the natural environment.¹²¹ Nature provides goods, such as food, water, and other materials (like metals or fossil fuels) that humans use directly or modify to produce other goods.¹²² The environment also provides services, including generating oxygen, purifying water, creating soil, and absorbing waste.¹²³ Looked at this way, it becomes clear that all human economic activity is made possible by the natural environment, and the human economy “nests within the ecosphere,” and is thus subordinate to nature, rather than the other way around.¹²⁴

Applying an ecological economics approach to a forested watershed like the Tillamook State Forest requires valuing more than the number of board feet of lumber that can be cut and sold, or even how many dollars fishing visitors might spend in the local communities. Traditional economics assigns all factors of production to one of three categories — land, labor or capital.¹²⁵ The ecological approach instead uses a very wide angle economic lens that broadens the traditional “economic trinity”¹²⁶ of land, labor, and capital (wealth) to include a more realistic appreciation and valuation of “natural capital.”¹²⁷ This view specifically recognizes several important insights in addition to the basic truth that the human economy exists within the natural environment rather than the other way around.

First, the category of land and natural resources includes much more than just raw materials for human use. The phrase “raw materials” brings to mind lumber, coal, oil, diamonds—and many other tangible substances that humans take from nature and use for many purposes. A person would not normally think of air or water in the same category of “raw materials”, yet humans are completely dependent on nature for these crucial substances as well.¹²⁸ Furthermore, manmade capital is not endlessly substitut-

anthropocentric utilitarian approach to valuing the natural environment only to the extent it confers satisfaction to humans).

121. *Id.*

122. *Id.*

123. Daily, NATURE’S SERVICES, *supra* note 79, at 3-4; PRUGH, *supra* note 75, at 55.

124. PRUGH, *supra* note 75, at 21; Harold A. Mooney & Paul R. Ehrlich, *Ecosystem Services: A Fragmentary History*, in NATURE’S SERVICES, *supra* note 79, at 11-17 (arguing that the human economy is a “wholly-owned subsidiary” of natural ecosystems rather than the other way around).

125. See PRUGH, *supra* note 75, at 7.

126. *Id.*

127. *Id.* at 51-53 (describing natural capital).

128. Think of an astronaut leaving earth; she needs to take air and water along for the journey since the spatial “ecosystem” does not provide them. Cf. Daily, *supra* note 79, at 3 (discussing John Holdren’s exercise of deciding what species to take along to live on the moon, assuming that the moon had a human-friendly atmosphere and climate). See also Salzman, *supra* note 77, at 887 (discussing the “Biosphere I” experiment).

able for natural capital, nor are all forms of natural capital renewable, such as minerals and fossil fuels.¹²⁹ Although we may be able to substitute synthetics for wood, ethanol for oil and coal, and cubic zirconia for diamonds, we have not yet found a substitute for oxygen or water. Additionally, natural capital consists of both stocks and flows; for instance, the Tillamook or any other forest contains a stock of trees, but it also produces a flow of services, such as carbon sequestration, oxygen generation, erosion control, water capture and filtration, and wildlife habitat maintenance.¹³⁰

If the atmosphere did not protect us from the rays of the sun, we would be hard-pressed to protect ourselves. If plants stopped converting carbon dioxide into oxygen, we would be astronauts without a spaceship. And if microbes and fungi stopped decomposing, we would soon be buried in our own waste. The bottom line is that natural capital is the basis for “life-support” on the planet, and “[a]ll the rest is secondary.”¹³¹ Thinking narrowly about how much timber to harvest in a particular state forest seems to be missing the point a bit when placed in the context of these larger concepts.

Land managers, like those who are responsible for determining the greatest permanent value of the resources of the Tillamook State Forest, therefore must incorporate principles of natural capital and ecological economics in two important ways. First, they can use traditional utilitarian and anthropocentric economic analysis to quantify the near-term value of the Tillamook’s natural systems and ecosystem services to people, including the downstream communities, the Portland recreationists, and all those who breathe the air in the region. Then, they can expand the analysis beyond the short term and the strictly utilitarian to encompass a longer time horizon and a more biocentric perspective.

Traditional neoclassical economics values resources based on their utility to human beings.¹³² However, even the utilitarian economic equation needs considerable expansion to accommodate the value of nature’s services in a way that people can relate to. For instance, economists need to join with the coast range scientists discussed earlier to place dollar values on the benefits of the Tillamook for flood control, water purification, soil creation, and fisheries. The benefits to area farmers of the pollination services of bees and butterflies can also be measured in dollars, as can the value of fertile soil. To some degree, all that’s required is simply

129. PRUGH, *supra* note 75, at 49-51.

130. *Id.* at 49.

131. *Id.* at 52.

132. Goulder & Kennedy, *supra* note 120, at 26.

opening our eyes to all that nature provides to us without any conscious realization on our part and without the need for any overt market transaction. Once we acknowledge those goods and services, we can “account” for them in dollars and cents.

Accounting for natural capital and assigning economic values to identified ecosystem services also involves doing a better job of measuring both positive and negative externalities.¹³³ The timber company who wants to harvest in the Tillamook puts on its balance sheet the cost of the timber price bid, labor, equipment, fuel, supplies, and transportation; the company tallies benefits based on the net profits from selling the raw logs. The company does not need to include in its calculations any negative externalities to downstream fisherman or the down-gradient communities such as erosion, increased runoff, or pollution.¹³⁴ Nor do the company employees need to think about the positive externality they themselves may have obtained from the forest’s capture and filtration of the water they drink. Recognizing and valuing positive and negative externalities associated with our use of nature and assigning economic value to the services nature provides to us are relatively straightforward components of a new economics that broadly accounts for nature’s value to humans. In this way, we simply expand utilitarian cost-benefit analyses to better calculate the full costs and benefits of human activities.¹³⁵

But that’s only scratching the surface of ecological economics. Besides properly valuing nature’s provision of “production inputs,” economic analysis must also acknowledge nonconsumptive use values and even “non-use values.”¹³⁶ Why is it necessary for economic analysis to stretch this way? Because these values are real, even if they are less tangible than measurable production inputs. As just one example, the Tillamook State Forest and other similar natural areas provide wildlife habitat. Habitat supports birds and many people enjoy bird watching. Although birdwatchers do not have to pay directly for bird watching in the market, their enjoyment of the birds creates both tangible and intangible benefits. Birdwatchers buy gas, food, lodging, birdseed, binoculars, bird books, cameras, film, hats, and clothing in support of their hobby. They do not consume any birds or habitat, but they gain satisfaction from their non-consumptive use of the resource. Ecological

133. *Id.* at 28-29.

134. See Michael Milstein, *Future Uses of State Forests Ride on Fate of Measure 34*, OREGONIAN, Oct. 16th, 2004, A1. (comparing economic values from logging and forest protection: “Wild salmon are grown on state forests, just like trees,” said Bob Rees, a Tillamook fishing guide..... “My job depends on wild salmon. It sustains my income.”)

135. Goulder & Kennedy, *supra* note 120, at 27-28.

136. *Id.* at 29.

economists also recognize non-use values, including “existence value” and “option value.”¹³⁷ A bird lover might never come to the Pacific Northwest to see spotted owls, eagles, falcons, and marbled murrelets, but could still place considerable value on knowing that they exist. Option values also recognize a somewhat abstract worth—the value someone says he or she is willing to pay to preserve some aspect of nature.¹³⁸ Existence and option values are difficult to measure, because they essentially reflect opinions without any corresponding expenditures, even indirect ones like the birdwatchers’ purchases.¹³⁹ But that difficulty does not mean they can be ignored.

At a minimum, determining the greatest permanent value for a forested watershed requires doing the challenging work of broadening traditional economic analysis to include all of these values. Natural capital and ecosystem services need to be included in order to measure the full worth of these lands to the state, the northwest, and beyond. Indeed, at a time when global climate change is our most critical environmental problem, the value of such lands in carbon sequestration may be the greatest value of all.

3. *A Sustainable View of the Tillamook State Forest*

Assigning economic value to ecosystem goods and services, as described above, can recognize and capture immediate and relatively concrete benefits to humans that we otherwise take for granted and fail to include in economic equations. But these strictly utilitarian and short-term valuation methods will still undervalue natural capital unless they also adequately consider whether current human uses of natural resources and impacts on natural ecosystems can be sustained over time.¹⁴⁰

The current level of depletion of natural capital and perturbation of ecosystems is not sustainable if projected forward; this is true generally as well as locally in places like the Tillamook State Forest.¹⁴¹ Because the biosphere is our very life support system, to destroy its integrity, stability, and functionality will ultimately destroy the earth’s capacity to support the lives of our grandchildren.¹⁴² Some scholars believe that we may already be close to a

137. *Id.* at 34.

138. *Id.* at 34-35.

139. *Id.*

140. PRUGH, *supra* note 75, at 102. Even though the birdwatchers do not consume the birds, they do, of course, consume other resources in support of their hobby.

141. *Id.* at 52, 102.

142. *Id.* at 52.

“critical threshold . . . at which indispensable life-support functions might degrade or even collapse.”¹⁴³ To avert collapse and pass on to our descendants a world where they can breathe the air, drink the water, and tolerate the sun’s rays thus requires more than just broadening anthropocentric, utilitarian cost-benefit analysis to include more costs and more benefits. A much longer time horizon is critical: what level of use of natural capital can be sustained over generations to come?¹⁴⁴ A more biocentric perspective is also crucial: since humans are just part of—and completely dependent on—the biosphere, what level of biotic integrity is required to allow us to continue our existence?¹⁴⁵ These somewhat abstract questions need to be addressed in the specific context of the Tillamook State Forest, and in every other place around the world where resource management decisions are being made.

Answering these questions depends on understanding natural capital as consisting of both stocks and flows. Considering the Tillamook fisheries as an example, a “stock” of habitat creates a flow of fish. Indeed the fish population can also be viewed as a stock at any point in time. With sufficient habitat and a critical mass of minimum population size, a fishery can produce a steady stream of harvestable fish into the future. But if the habitat disappears, or the population drops below the minimum level needed for viable reproduction, the fishery will be depleted beyond repair, to the point of extinction.

The Tillamook as a watershed providing a freshwater drinking water supply to several downstream communities presents another example of natural capital stocks and flows. A healthy, functioning watershed consists of healthy vegetation, soil, and well-developed stream channels and processes. The vegetation and soil capture precipitation, keeping it from running off the surface too quickly, thus preventing flooding. Vegetation also protects the soil from erosion, thus limiting sedimentation and pollution. Adequate ground cover and rich, fertile soil horizons help water percolate slowly into the ground, providing perennial base flows for surface streams and recharging aquifers. Meanwhile, the percolation process also filters the water, helping to remove impurities. The surface water and groundwater can then be accessed for drinking water supplies, often with minimal treatment. In this way, the watershed itself serves a stock of natural capital, producing a flow (pun intended) of freshwater. But if the watershed’s health and

143. *Id.* at 52 (discussing critical threshold) and 102 (noting that “many observers” think that threshold is already upon us).

144. *Id.* at 102-105.

145. *Id.*

natural functions are impaired, thus depleting the stock of natural capital, the flow of valuable drinking water is reduced, and perhaps even eliminated. An overdrawn aquifer may subside and compact to the point that it can never be recharged. A polluted river may be reclaimable at significant cost and effort, but a contaminated aquifer may be a lost cause. A devegetated watershed may also be a lost cause, if it has degraded to the point where the stream channels can no longer carry runoff and the soil can no longer absorb water. Floods, pollution, and water shortages are the result.

Comprehensive analysis and appreciation of the relationship of existing natural capital stocks to future flows of critical ecosystem goods and services are required to insure sustainable flows that will support future generations. Failing to do this means we are "eating the seed corn," imperiling not only the flows but also the stocks of natural capital on which those flows depend for our descendants, indeed imperiling the species' future survival. Although the Tillamook State Forest is certainly not on the verge of collapse as an ecosystem, it is critical that all of the interest groups vying for control of and influence over the forest's outputs begin to appreciate that every single thing they want depends on the continued functioning of that ecosystem. Whether someone wants timber or salmon, water or mushrooms, the prerequisite is the same: a healthy forest, a healthy watershed, and a diverse ecosystem.

IV. CONCLUSION: THE TILLAMOOK STATE FOREST'S RE- REFORESTATION

"Thinking *inside* the box" goes against the grain of the current mantra for creative thinking. But in the case of an ecosystem, thinking inside the box can actually be a good thing. This case study of Oregon's Tillamook State Forest illustrates the value of thinking inside the box when it comes to ecosystem services. Looking at an ecosystem within a watershed boundary helps to focus attention on a system of interrelated parts and processes too often taken for granted. The Tillamook's experience can serve as a model for other land managers seeking a sustainable future for the resources they oversee.

What has your ecosystem done for you lately? Quite a lot, it turns out, but law and policy are only beginning to reflect this reality. The current natural resources management model treats natural resources as spoils for the victor in the political arena. An ecosystem services model would instead view natural resources as

critical goods and services produced by interconnected, working parts of a healthy, functioning ecosystem that needs to be managed like a precious endowment fund. Applying these concepts to the Tillamook State Forest reveals both the difficulty and the importance of shifting natural resource management from a multiple-use, public choice model to an ecosystem services model. Where there are victors, there are also the vanquished. All the interest groups currently vying to impose their vision of the Tillamook on the ground have to continually fight to maintain their position. All victories are temporary, and can be undone by the next legislature, a change in membership on the Board of Forestry, a lawsuit, or a shift in public opinion.

Even though the Tillamook State Forest occupies a relatively small area on the map of the United States, it is an area that produces benefits, such as wood, fish, and even climate modulation, out of proportion to its size and location. If ecosystem services can be incorporated into the management of this state forest, the impacts would be considerable, both as a practical matter and as a matter of showing how it could be done. If ecosystem services cannot be effectively incorporated into the management of the Tillamook, that would not bode well for the future of this field, because the Tillamook's governing law, territory, and resources seem ready made for this approach.

The contests among the interest groups vying for the resources of the Tillamook State Forest threaten to bring down the Tillamook's big tent. To the extent that the constituencies can turn away from the old and begin to embrace the new—new understandings of the ecosystem, new economics, new time horizons and new duties, the focus may begin to change. Even siblings fighting over their inheritance sometimes can be convinced that it is in their long-term interest to work together to protect the assets of the estate. Perhaps the same could be true for the Tillamook State Forest. In the 1950s, a new vision for the Tillamook galvanized and unified thousands of people to participate in the reforestation effort. The Tillamook State Forest needs to be reforested again, and perhaps the citizens will once again answer the call.

