NATURAL RESOURCES JOURNAL

Volume 42
Issue 2 *Spring 2002*

Spring 2002

An Analysis of Northwest Forest Plan Use Allocations

Michael C. Soules

MICHAEL C. SOULES*

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ABSTRACT

This study uses regression techniques to analyze the allocation of land uses to federal forestland under the 1994 Northwest Forest Plan (the Plan). The federal forests of the Pacific Northwest were allocated to different land uses under the Plan, and this study describes which factors influenced the geographic distribution of those uses. Two primary analyses were conducted to test the effect of ecological, economic, political, and other variables on the Plan's land use allocations. The results indicate that ecological factors had the greatest influence over the Plan's land use allocations and that the presence of marbled murrelet sites had a greater effect over the allocations than did northern spotted owl sites. The results also suggest that counties with the largest amount of timber-related economic activity, rather than those most dependent upon the timber industry, received the greatest surplus of harvestable late-successional and old-growth forest.

On April 2, 1993, President Bill Clinton convened the Forest Conference in Portland, Oregon.[1] The conference was a watershed moment in the long-standing conflict over federal forest management in the Pacific Northwest. It represented the end of a period in which the U.S. Forest Service and Bureau of Land Management (BLM) emphasized timber production in their management of the region's old-growth forests.[2] The planning process that began after the Forest Conference ultimately resulted in the Northwest Forest Plan (the Plan).[3]

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* J.D. candidate, Yale Law School, New Haven, CT 06511. The author holds a Master of City Planning from the University of California, Berkeley. He expresses his deep appreciation to Professor Tim Duane for his extensive help throughout the duration of this study and to Professors John Landis and Jeffrey Romm for their helpful comments and criticisms. He especially thanks Amanda Behe for her invaluable critiques and generous editorial assistance.

1. STEVEN LEWIS YAFFEE, THE WISDOM OF THE SPOTTED OWL: POLICY LESSONS FOR A NEW CENTURY 141 (1994).

2. The agencies began to focus on timber production in the Pacific Northwest's federal forests shortly after World War II. *See id.* at 4. For a discussion of the Forest Service's focus on timber production, see PAUL W. HIRT, A CONSPIRACY OF OPTIMISM: MANAGEMENT OF THE NATIONAL FORESTS SINCE WORLD WAR TWO 48, 50 (1994).

3. *See* E. THOMAS TUCHMANN ET AL., THE NORTHWEST FOREST PLAN: A REPORT TO THE PRESIDENT AND CONGRESS 28-33, 38-39 (1996).

Under the Plan, tracts of federal forestland within the range of the northern spotted owl were allocated to different land uses.[4] In this way, the management of different tracts would vary according to their designated use. This study focuses on determining which factors affected the distribution of those land use allocations across the Pacific Northwest. Statistical techniques were used to test the effects of ecological, economic, political, and other variables on the Plan's land use allocations. By examining which variables influenced these land use decisions, this analysis provides insight into the shifting emphasis of federal forest management and how competing economic and political interests have effected changes in policy.

The study is divided into four sections. Part I reviews prior studies of federal forest policy that are relevant to this analysis. Part II presents the hypotheses, variables, methods, and results of the statistical analysis of Northwest Forest Plan land use allocations. In Part III, the results of the statistical study are discussed. Finally, Part IV highlights several conclusions that can be drawn from the study.

I. PREVIOUS STUDIES

Although there has been extensive examination of both Forest Service policy and the debate surrounding federal forests in the Pacific Northwest,[5] comparatively few studies have attempted to delineate which causal factors affect federal forest policy. This section discusses several studies that did. Like the study presented in this article, the analyses described below estimate the degree to which different variables have affected federal forest policies. Thus, while none of these studies focused on the Northwest Forest Plan, their design and analysis are analogous to the study presented here. Moreover, though focusing on different planning processes and regions, these studies provide insight into the decision-making processes of federal agencies in the Pacific Northwest.

Sabatier, Loomis, and McCarthy authored one of the most comprehensive of these studies. They examined the effect different

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4. U.S.D.A. FOREST SERV. & U.S.D.I. BUREAU OF LAND MGMT., RECORD OF DECISION FOR AMENDMENTS TO FOREST SERVICE AND BUREAU OF LAND MANAGEMENT PLANNING DOCUMENTS WITHIN THE RANGE OF THE NORTHERN SPOTTED OWL 6-7 (1994), *available at* http://www.or.blm.gov/forestplan/nwfptitl.htm [hereinafter ROD].

5. The controversy over management of the Northwest federal forests has been well documented in YAFFEE, *supra* note 1, at 3-151. *See also* BRUCE G. MARCOT & JACK WARD THOMAS, OF SPOTTED OWLS, OLD GROWTH, AND NEW POLICIES: A HISTORY SINCE THE INTERAGENCY SCIENTIFIC COMMITTEE REPORT 1-12 (U.S. DEP'T OF AGRIC., GEN. TECH. REP. NO. PNW-GTR408, 1997); Jeremy Rayner, *Implementing Sustainability in West Coast Forests: CORE and FEMAT as Experiments in Process*, J. CAN. STUD., Spring 1996, at 82.

variables had upon Forest Service planning decisions.[6] By sampling the National Forest Management Act (NFMA) planning processes of 44 national forests, they looked at the relative importance of five factors in how Forest Service policymakers chose between alternative forest plans.[7] These five factors were hierarchical controls, bureaucratic conservatism, professional policy norms, local political pressures, and budget maximization.[8] The authors concluded that the influence of environmental groups and those factors favoring the status quo had the greatest effect on which alternative was chosen.[9] Maximization of agency budgets also appeared to have an effect.[10] The authors also surveyed Forest Service officials and found that their attitudes toward timber harvesting had little effect on the NFMA planning process.[11]

Jones and Calloway focused on a different influence on Forest Service policy, examining the extent to which Congress affects the agency's decisions.[12] While their research methods could not provide definitive conclusions of how much substantive change Congress has instigated in the agency, they did note a trend, beginning in the late 1960s, toward increasing congressional involvement in Forest Service activities.[13] The authors concluded that this increased oversight suggested that Congress is a likely source of change within the agency.[14]

Jones and Calloway's findings conflict with the results of Stegner and Fort's study, which analyzed how congressional preferences affect Forest Service policies. Stegner and Fort designed their study to test the "congressional dominance" model of the policy process, which posits that elected officials channel politically controlled benefits through administrative agencies.[15] Examining the exercise of influence through both

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6. Paul A. Sabatier et al., *Hierarchical Controls, Professional Norms, Local Constituencies, and Budget Maximization: An Analysis of U.S. Forest Service Planning Decisions*, 39 AM. J. POL. SCI. 204 (1995).

7. Each national forest, upon concluding the forest planning process, recommends a preferred alternative from the options that were considered. The NFMA plan is then approved by the Regional Forester within whose jurisdiction the forest is located. *Id.* at 211.

8. *Id.* at 205.

9. *Id.* at 220, 226, 234-35. The environmental groups' influence was an example of local political pressures, while the status quo pressures reflect bureaucratic conservatism.

10. *Id.* at 221, 227, 235.

11. *Id.* at 227.

12. Elise S. Jones & Will Calloway, *Neutral Bystander, Intrusive Micromanager, or Useful Catalyst?: The Role of Congress in Effecting Change Within the Forest Service*, 23 POL'Y STUD. J. 337 (1995).

13. *Id.* at 344-46.

14. *Id.* at 346.

15. Tesa Stegner & Rodney Fort, *A Test of Congressional Dominance over Administrative Agencies: The Case of the U.S. Forest Service*, 76 SOC. SCI. Q. 839, 839 (1995). Proponents of this model argue that the distribution of benefits has been standardized through the adoption of

the appropriations and agency oversight processes, they concluded that, based on Forest Service road and trail maintenance and timber sales activities from 1978 to 1988, the congressional dominance model accounted for less than two percent of the variance in these activity levels.[16] These results suggest that congressional preferences might not strongly influence Forest Service policy. Because of the contradictory conclusions of these two studies, it remains unclear how the legislative branch has influenced Forest Service and BLM policies.

Crone and Tschirhart also examined the effect of different variables on Forest Service policies. They studied proposed wilderness designations resulting from the second Roadless Area and Review Evaluation (RARE II) in order to test whether the "sophisticated public interest theory" or the "interest group theory" better predicts the agency's policy decisions.[17] A four-step statistical procedure was used to separate the direct influence of the "public interest" on Forest Service decisions from the indirect influence of interest groups.[18] The authors defined "public interest" as the maximization of economic efficiency.[19] Their results were mixed, with some interest group activity promoting economic efficiency and some detracting from it.[20] But they found greater overall support for the interest group theory.[21]

These studies provide insight into the decision-making processes of the Forest Service and help explain which causal factors play a role in influencing the agency's policies. However, little work has been done on BLM forest policy, and only Crone and Tschirhart considered how highly localized characteristics, such as local economies or natural resources, affect Forest Service policy decisions.[22] This article examines a more recent forest planning process, one that symbolizes a fundamental shift in the

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a system of subcommittees with narrow foci, which minimizes political conflict among legislators. *Id.* at 839-41.

16. *Id.* at 849.

17. Lisa Crone & John Tschirhart, *Separating Economic from Political Influences on Governmental Decisions*, 35 J. ECON. BEHAV. & ORG. 405 (1998). The interest group theory "holds that government supplies regulation in response to demand for it by interest groups...." *Id.* at 406. The sophisticated public interest theory suggests that interest groups sometimes work in the public interest. *Id.* at 406, 423-24.

18. *Id.* at 409-13.

19. *Id.* at 406. They recognized that their criterion for public interest was limited, given that they only measured efficiency on given prices, and did not consider the broader question of whether these prices were efficient. *Id.* at 408 n.5.

20. *Id.* at 423.

21. *Id.*

22. *See id.* at 408-09.

management of federal forests.[23] By measuring the relationship between a series of geographically specific variables and the allocation of land uses under the Northwest Forest Plan, this study sheds additional light on the region's federal forest policymaking processes.

II. ANALYSIS OF LAND USE ALLOCATIONS

The debate over federal forest policy in the Pacific Northwest represents a conflict between competing interests over the management of a scarce natural resource.[24] The relative success different economic and political interests have had in achieving favorable policy outcomes is reflected in the uses to which the forests are put. By looking at one of the region's most significant policy directives, this study attempts to understand which factors influenced the allocation of land uses across the federal forests of the Northwest. The results of this study in turn provide evidence of how the conflict over these forests has been resolved.

Two primary analyses were conducted to discern the factors that most likely affected the distribution of land uses. The first analysis examines the effect of different variables on how uses were allocated to specific tracts of land under the Northwest Forest Plan.[25] It seeks to better understand which factors influenced whether a given tract of federal forestland was allocated to a "reserved" land use in which commercial timber harvesting is generally not permitted, or to an "unreserved" use, wherein timber

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23. *See* U.S.D.A. FOREST SERV. & U.S.D.I. BUREAU OF LAND MGMT., 1 FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT ON MANAGEMENT OF HABITAT FOR LATE-SUCCESSIONAL AND OLD-GROWTH FOREST RELATED SPECIES WITHIN THE RANGE OF THE NORTHERN SPOTTED OWL 2-4 to 2-5 (1994):

> Since World War II, timber management has been a major part of the Forest Service and [BLM's] role of actively managing federal lands for a variety of sustainable benefits for the Nation. The timber management program on federal forests within the range of the northern spotted owl has focused on harvesting older forest areas for timber and replacing them with faster-growing young stands....Managing federal lands to provide habitat for northern spotted owls and other old-growth related species will result in a change in the extent and rate of harvest of older forest areas, as well as changes in how other forest areas are managed.

24. *See* Rayner, *supra* note 5, at 84-87 (characterizing the federal forest policy debate as a dispute between adherents of the "multiple-use sustained-yield paradigm" and the "ecosystem management paradigm"); YAFFEE, *supra* note 1, at 83-151 (detailing the struggle over federal forest management in the Pacific Northwest).

25. The Northwest Forest Plan's cartographic representations divided the federal forests up into individual tracts of land of varying sizes. Specific land uses were then designated for each tract of federal forestland. This article refers to these geographic units as "tracts" or "land use tracts."

harvesting is allowed.[26] The second analysis, which is divided into three sub-analyses, examines these land use allocations at the county level. The county-level analyses confirm the results of the tract-level analysis while highlighting a trend in the regional distribution of unreserved late-successional and old-growth (LS/OG) forest, a valuable economic commodity. These analyses are discussed below.

II.A. TRACT-LEVEL ANALYSIS

A series of logistic regressions were performed to examine the relationship between different factors and the land uses to which individual tracts were assigned. Multiple variables were tested for their predictive power in affecting the land use allocations, and the best fitting model is presented *infra* in Part II.A.3 ("Results"). The entire tract-level analysis is presented in three sections, which describe its hypotheses, methods, and results.

II.A.1. Tract-level Hypotheses

This section presents the hypotheses that guided the tract-level analysis. The hypotheses advanced relate to the effect of ecological, economic, and political factors on the allocations. These hypotheses not only directed the tract-level analysis, but also played a role in the county-level analyses described in Part II.B *infra* ("County-Level Analyses").

The first hypothesis was that the ecological characteristics of the tracts affected the land uses to which they were allocated under the Northwest Forest Plan. The presence of particular ecological features, such as northern spotted owl nesting sites or LS/OG forest, was expected to be positively associated with reserved land uses. Several reasons supported this hypothesis, the most important being the requirements of federal law. The Plan had to provide a certain degree of protection to species associated with LS/OG forest in order to meet the statutory requirements of the Endangered Species Act (ESA) and the National Forest Management Act (NFMA).[27] If it failed to do so, the pre-existing injunctions on federal timber

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26. The terms "reserved" and "unreserved" are used throughout this article. For an explanation of which officially designated land uses are considered reserved or unreserved, see *infra* notes 57-58 and accompanying text.

27. Under section 7 of the ESA, federal agencies must ensure that their actions are "not likely to jeopardize the continued existence of any endangered species or threatened species," nor "result in the destruction or adverse modification of [those species' critical] habitat...." 16 U.S.C. § 1536(a)(2) (1994). The Record of Decision noted the Plan's compliance with this requirement. ROD, *supra* note 4, at 50-51. One of NFMA's implementing regulations required that "[f]ish and wildlife habitat...be managed to maintain viable populations of existing native

sales within northern spotted owl habitat were unlikely to be lifted.[28] More generally, the Plan's stated goals emphasized the central importance of protecting LS/OG forest and its related species.[29]

The economic characteristics of the region's counties were also expected to affect the allocation of land uses. The Forest Ecosystem Management Assessment Team (FEMAT) and the Supplemental Environmental Impact Statement (SEIS) planning groups set up after the 1993 Forest Conference both included economic factors in their analyses.[30] Though the Northwest Forest Plan projected a decline in timber-related employment,[31] it also sought to minimize these job losses.[32] Thus, it was expected that, to protect timber industry employment, federal forest tracts located in areas more dependent on federal timber harvests were more likely to be allocated to an "unreserved" use. The siting of Adaptive Management Areas (AMAs) provided support for this hypothesis.[33] The Northwest Forest Plan placed the AMAs adjacent to communities that were

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and desired non-native vertebrate species in the planning area." 36 C.F.R. § 219.19 (repealed in 65 Fed. Reg. 67,514 (Nov. 9, 2000)). The Record of Decision asserted that this legal requirement had also been met. ROD, *supra* note 4, at 43-47.

28. In 1991, U.S. District Judge Dwyer enjoined Forest Service timber sales in suitable spotted owl habitat until the agency had adopted standards and guidelines sufficient to meet the NFMA regulation's viability requirement. Seattle Audubon Soc'y v. Evans, 771 F. Supp. 1081, 1096 (W.D. Wash. 1991), *aff'd sub nom.*, 952 F.2d 297 (9th Cir. 1991). *See also* Seattle Audubon Soc'y v. Mosely, 798 F. Supp. 1484, 1493-94 (W.D. Wash. 1992), *aff'd sub nom.*, Seattle Audubon Soc'y v. Espy, 998 F.2d 699 (9th Cir. 1993). A year later, U.S. District Judge Frye enjoined the BLM from conducting timber sales within suitable owl habitat until it complied with the National Environmental Policy Act. Portland Audubon Soc'y v. Lujan, 795 F. Supp. 1489, 1510-11 (D. Or. 1992), *aff'd sub nom.*, Portland Audubon Soc'y v. Babbitt, 998 F.2d 705 (9th Cir. 1993). The injunction on the Forest Service was lifted in June 1994. Seattle Audubon Soc'y v. Lyons, 871 F. Supp. 1291, 1302 (W.D. Wash. 1994), *aff'd sub nom.*, Seattle Audubon Soc'y v. Moseley, 80 F.3d 1401 (9th Cir. 1996). The threat of continued timber sale injunctions in the absence of statutory compliance was underscored by Judge Dwyer's observation that "any more logging sales than the [Northwest Forest] [P]lan contemplates would probably violate the laws." 871 F. Supp. at 1300.

29. The Plan had to provide "a healthy forest ecosystem with habitat that will support populations of native species (particularly those associated with late-successional and old-growth forests)." SEIS, *supra* note 23, at 1-4; ROD, *supra* note 4, at 28.

30. FOREST ECOSYSTEM MGMT. ASSESSMENT TEAM, FOREST ECOSYSTEM MANAGEMENT: AN ECOLOGICAL, ECONOMIC, AND SOCIAL ASSESSMENT VI-1 to VI-43 (1993) [hereinafter FEMAT]; SEIS, *supra* note 23, at 3&4-260 to 3&4-319.

31. SEIS, *supra* note 23, at 3&4-297 tbl.3&4-51.

32. ROD, *supra* note 4, at 27 (noting that "Alternatives 1 through 6 would provide a reduced timber supply when compared to Alternative 9").

33. AMAs, in which timber harvesting is allowed, were "designed to develop and test new management approaches to integrate and achieve ecological, economic, and other social and community objectives." *Id.* at 6.

likely to suffer adverse effects from reduced federal timber harvests.[34] The considerable attention paid to timber-dependent communities during the planning processes suggested that other harvestable lands might also have been located near them.[35]

Political variables related to congressional representation and local views about federal forest management were also tested for their relationship to the land use allocations. Because the Northwest Forest Plan was developed administratively without direct congressional involvement,[36] this hypothesis is necessarily weaker than those related to the ecological and economic variables. Nevertheless, it was hypothesized that the FEMAT and SEIS planning teams might have tried to accommodate the normative views of local residents and their political representatives in deciding where to locate unreserved uses.[37] Thus, the teams may have allocated comparatively more unreserved forestland to those areas perceived to have greater support for timber-related interests. Doing so would presumptively have both accommodated the normative preferences of stakeholders and dampened the political and legal barrage expected after the Plan's release.[38]

To the extent such political influence existed, it was expected that tracts in congressional districts with Republican representatives or representatives with anti-environmentalist voting records were less likely to be allocated to a reserved use.[39] It was also expected that tracts located in

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34. "Most [AMAs] are associated with subregions that are impacted socially and economically by a reduced federal timber harvest." SEIS, *supra* note 23, at 2-61. *See also* Rayner, *supra* note 5, at 93.

35. For the planning teams' discussion of timber-dependent communities, see FEMAT, *supra* note 30, at VII-34 to VII-83; SEIS, *supra* note 23, at 3&4-298 to 3&4-313.

36. Congressional efforts to resolve the forest policy dispute in the early 1990s were not successful. *See* MARCOT & THOMAS, *supra* note 5, at 7. However, the planners would have been well aware of congressional views. *See* SEIS, *supra* note 23, at 1-5 to 1-6. *See also* YAFFEE, *supra* note 1, at 148-50 (describing political reactions to the release of the Plan). The Clinton Administration was subject to "intense lobbying from all sides." *Id.* at 149.

37. One way this could have occurred was by incorporating the views expressed by "nonfederal elected officials, tribes, and the public" through comments and meetings. TUCHMANN ET AL., *supra* note 3, at 32. *See also* SEIS, *supra* note 23, at 1-5 to 1-6.

38. Any fears of the planning teams about extreme political reactions would have been well-founded. Numerous lawsuits were filed to overturn the Plan. TUCHMANN ET AL., *supra* note 3, at 36-37. *See also* YAFFEE, *supra* note 1, at 148-50.

39. The party-based expectation stems from the fact that Republican congressional representatives from the Pacific Northwest have generally endorsed policies beneficial to timber-related interests, while Democrats have generally supported policies more friendly to environmental interests. There are exceptions to this, of course, which are accounted for through the use of variables measuring representatives' voting records.

counties with higher proportions of Republican voters were less likely to be allocated to a reserved use.[40]

Other variables were also tested for their effect on the land use allocations. The size of the land use tracts, the population of the counties in which the tracts were located, and the counties' population density were thought to have potentially affected the allocations. For instance, due to the commonly-held perception that urban residents are generally more opposed to timber harvesting,[41] those counties with low populations and population densities might have had higher proportions of unreserved land. Or, for tract size, perhaps the Plan's emphasis on creating large habitat reserves could have caused more large tracts to be allocated to reserved uses.[42] However, there was insufficient evidence supporting these suppositions to be able to advance formal hypotheses about these variables' expected effect on land use allocations.

II.A.2. Methods

This section presents the methods that were used in the analysis. It begins with a description of how the dependent variable was created. Next the independent variables used in the analysis are presented and explained. The section concludes with an explanation of why the logistic regression technique was chosen to analyze the data.

Dependent Variable

The unit of analysis was derived from a geographic information system (GIS) layer representing tracts of land that were allocated to different uses under the Northwest Forest Plan. The Plan allocated all 24,455,300 acres of federal land within the range of the northern spotted owl to one of seven different land uses.[43] Lands designated as "Congressionally Reserved"[44] or "Administratively Withdrawn"[45] were excluded from the

40. This variable was used as a rough proxy for views about federal forest management. It is recognized that there are limitations to this parameter. *See infra* notes 70-72 and accompanying text.

41. *See* FEMAT, *supra* note 30, at VII-31 to VII-33.

42. *See id.* at IV-20 to IV-23 (discussing large habitat areas).

43. SEIS, *supra* note 23, at 2-60.

44. Congressionally Reserved areas, totaling 7,320,600 acres, are lands that were previously reserved by an act of Congress, such as Wilderness Areas, National Parks, and National Wildlife Refuges. ROD, *supra* note 4, at 6. Because the Northwest Forest Plan was implemented as an administrative decision, the amount of Congressionally Reserved land did not change.

45. Administratively Withdrawn lands, totaling 1,477,100 acres, are areas "identified in current forest and district plans or draft plan preferred alternatives and include recreational and visual areas, back country, and other areas not scheduled for timber harvest." *Id.* at 7.

analysis because those allocations were the result of policy decisions made prior to the Northwest Forest Plan. Another exclusion concerned lands in the "matrix," the general forest management areas in which the Plan envisioned most timber harvesting would occur. Although part of the matrix includes "Riparian Reserves,"[46] these reserves are largely a function of stream density and represent the use of buffers around streams, wetlands, and other water bodies.[47] Therefore, the land in Riparian Reserves, which was not distinguished from the matrix allocations in data obtained from the Regional Ecosystem Office (REO),[48] was included as part of the matrix for the purposes of this analysis.[49]

The land use tracts included in the study represent only those policy decisions made under the Northwest Forest Plan, thereby restricting the analysis to one planning process. Those land uses, and the total acreage designated to each use, are presented below:

> LATE SUCCESSIONAL RESERVES (LSRs) (7,430,800 ACRES):
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> These reserves are intended to maintain a functional, interactive, late-successional and old-growth forest ecosystem, which provides habitat for late-successional and

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46. Riparian Reserves are located adjacent to water bodies, and are designed primarily to protect the aquatic system and its associated species. *Id.*

47. U.S.D.A. FOREST SERV. & U.S.D.I. BUREAU OF LAND MGMT., STANDARDS AND GUIDELINES FOR MANAGEMENT OF HABITAT FOR LATE-SUCCESSIONAL AND OLD-GROWTH FOREST RELATED SPECIES WITHIN THE RANGE OF THE NORTHERN SPOTTED OWL B-12 to B-13 (1994) [hereinafter STANDARDS & GUIDELINES]. The maintenance of buffers to protect water bodies is generally consistent with responsible forest management, and thus the fact that these buffers have a legal designation does not change the material fact that buffers would be necessary even if they were not so designated. *Id.* at C-30 to C-31. It is true that the Riparian Reserves are larger than the buffers often required under state forest practices laws. For instance, the Northwest Forest Plan's Standards and Guidelines generally prohibited timber harvesting within 300 feet of fish-bearing streams, *id.* at C-30 to C-32, while Oregon's Forest Practices Rules generally only require retaining all trees within 20 feet. OR. ADMIN. R. 629-640-0100(2) (2002) (Note that Oregon's rules prescribe many additional vegetation retention requirements near streams. *See generally* OR. ADMIN. R. 629-640-0000 to 0500). *Cf.* CAL. DEP'T OF FORESTRY & FIRE PROT., CALIFORNIA FOREST PRACTICES RULES 2002, at 65 tbl.1 (2002) (restricting activity allowed within 75 to 150 foot buffers around fish-bearing streams). Nevertheless, though the Plan's Riparian Reserves may have been more generous than necessary to meet aquatic conservation goals, TUCHMANN ET AL., *supra* note 3, at 82, this does not obscure the fact that the proportion of an area included in the reserves varies with stream density. STANDARDS & GUIDELINES, *supra* note 47, at B-12 to B-13. This factor, together with the issue described *infra* at notes 48-49 and accompanying text, made the exclusion of Riparian Reserves from the analysis appropriate.

48. The Regional Ecosystem Office in Portland, Oregon, oversees the implementation of the Northwest Forest Plan.

49. The Riparian Reserves were not fully mapped, so the FEMAT and SEIS planning teams would not have been able to fully delineate and account for them during the planning processes. SEIS, *supra* note 23, at 2-25.

old-growth related species including the northern spotted owl. Timber harvesting is generally prohibited in LSRs.[50]

ADAPTIVE MANAGEMENT AREAS (AMAS) (1,521,800 ACRES):
AMAs are "designed to develop and test new management approaches to integrate and achieve ecological, economic, and other social and community objectives."[51] Timber harvesting is allowed within AMAs.[52]

MANAGED LATE SUCCESSIONAL RESERVES (MANAGED LSRS) (102,000 ACRES):
Managed LSRs, whose function is similar to LSRs, were "identified for certain owl locations in the drier provinces where regular and frequent fire is a natural part of the ecosystem."[53] Timber harvesting and salvage logging is allowed "to help prevent complete stand destruction from large catastrophic events such as high intensity, high severity fires; or disease or insect epidemics."[54]

MATRIX (3,975,300 ACRES):
The matrix represents the federal land not included in any of the other allocations. This area is where most timber harvesting and other silvicultural activities occur.[55]

Tracts that sat within more than one county were divided into separate tracts so as to be able to ascribe county-level characteristics to all the land in the study. The land use tracts were then coded as either belonging to a reserved or unreserved land use. This coded variable, described below, was used as the dependent variable for the statistical analysis.

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50. Silvicultural treatments allowed in LSRs, which include thinning in stands less than 80 years old west of the Cascades and treatments to reduce the risk of large-scale disturbances east of the Cascades and in the Klamath province, are to benefit the creation and maintenance of late-successional forest conditions. STANDARDS & GUIDELINES, *supra* note 47, at C-11 to C-13.

51. ROD, *supra* note 4, at 6.

52. *See supra* notes 34-35 and accompanying text.

53. STANDARDS AND GUIDELINES, *supra* note 47, at A-4.

54. *Id.* at A-4, C-26.

55. ROD, *supra* note 4, at 7.

RESERVED[56]
A binary variable representing whether a land use tract was allocated to a reserved or unreserved use:
1 = reserved use: LSRs and Managed LSRs were considered to be reserved uses.[57]
0 = unreserved use: AMAs and the matrix were defined as unreserved land uses.[58]

This variable was regressed on the twenty-seven independent variables listed below to test the hypotheses about how different factors affected land use designations. The independent variables represent the ecological, economic, political, and other characteristics associated with specific tracts of federal forestland.

Ecological Variables

These variables test the relationship between the tracts' ecological characteristics and their designated land use. Most of the data for these variables was obtained from the REO. Five primary characteristics were measured.[59] Since there are hundreds of other species present in the federal forests, these variables are somewhat limited in their ability to measure how ecological considerations affected land use. But they do represent some of the most important factors considered during the FEMAT and SEIS planning processes.[60] Furthermore, because LS/OG forest is the habitat of many of the species considered in the Northwest Forest Plan, the variables

56. It would have been possible to classify the dependent variable using the original land use designations, thereby allowing four possible outcomes (LSR, Managed LSR, AMA, or matrix). A binary dependent variable was chosen since the key question was whether or not a tract would be used for commercial timber harvesting. Because harvesting was an intended purpose of AMA and matrix lands, and not of LSR lands, a binary dependent variable was appropriate.

57. Although more silvicultural activities are allowed in Managed LSRs than in LSRs, the Managed LSRs were appropriately classified as a reserved land use since these activities were to be undertaken for the stated purpose of maintaining an optimum amount of LS/OG forest by preventing large-scale disturbances.

58. While AMAs were designed to be managed for a broad range of objectives, they do allow timber harvesting. The importance of AMAs as a source of timber is demonstrated by the role they played in the development of FEMAT Option 9, the only alternative that both met biological criteria and projected an annual timber supply of more than one billion board-feet (bbf).

59. Though there are six ecological variables, two of them measure characteristics related to LS/OG forest.

60. FEMAT, *supra* note 30, at Chap. IV, V; SEIS, *supra* note 23, at 3&4-11 to 3&4-260.

related to LS/OG forest partially account for these other species.[61] The chosen variables thus represent a proxy for those species closely associated with late-successional and old-growth forest habitat. Though some of these data were collected prior to 1993, they were the most up-to-date available at that time and represent the actual data used in the planning processes. The ecological variables are presented below:

LS/OG	A dummy variable measuring the presence of late-successional/old-growth forest within a tract. It was coded 1 if LS/OG forest was present and 0 if it was not.
Spotted Owl	A dummy variable indicating the presence of northern spotted owl centers within a tract.[62]
Murrelet	A dummy variable indicating the presence of occupied marbled murrelet centers within a tract.
% LS/OG	The percentage of a land use tract's total area that is composed of LS/OG forest. This variable provides a more refined measure than the "LS/OG" variable to test if differing proportions of LS/OG forest within a tract affected the probability of the tract being reserved.
Watershed	A dummy variable measuring whether a portion of the tract was located within one of the Key Watersheds identified by FEMAT.[63]
Roadless	A dummy variable indicating whether a portion of the tract was located within an inventoried roadless area.

61. FEMAT identified 1098 terrestrial species as being "closely associated with late-successional forests on federal lands." FEMAT, *supra* note 30, at IV-20. *See generally* SEIS, *supra* note 23, at 3&4-206 to 3&4-258.

62. Northern spotted owl centers include both single owls and owl pairs.

63. Forest Service and BLM fish biologists defined a Key Watershed as containing either (1) "habitat for potentially threatened species or stocks of anadromous salmonids or other potentially threatened fish" or (2) "greater than 6 square miles with high-quality water and fish habitat." SEIS, *supra* note 23, at Glossary-9. The planning teams identified 164 Key Watersheds on federal lands within the region. ROD, *supra* note 4, at 10.

Economic Variables

These variables, which are based on county-level economic data, were used to measure how economic factors influenced land use allocations. They represent the economic conditions of the county in which a tract was located.

The economic variables included in the analysis represent two different time points, 1992 and 1987. Economic data from 1992 was used because this year immediately preceded the Forest Conference and resultant planning processes. It represents the last year in which the Forest Service and BLM managed the region's forests before the implementation of the Northwest Forest Plan. Federal judges enjoined much of the region's timber harvesting in 1991 and 1992, and when the injunctions were finally lifted in 1994, the region's forests were managed according to the Plan's dictates.[64]

The other time period chosen, 1987, was selected for two reasons. First, it allows a comparison to the economic situation in 1992. The five-year period between 1987 and 1992 saw great changes in the regional economy, and many communities' reliance on federal timber harvests decreased.[65] To better capture this dynamic of economic change, the analysis also included variables representing reductions in timber-related employment over the period. Large reductions in timber employment in a particular county might indicate either an area suffering greater economic hardship or an area experiencing structural changes in its local economy. The second reason for including 1987 economic data is because the planning teams often compared timber harvest projections to the harvest rates of the 1980s, using that decade as a baseline of comparison.[66] Thus, using data from both years in the analysis allowed for the incorporation of a factor, historic timber-related economic activity, considered by the planning teams themselves.

Many of the economic variables were computed using county-level data pertaining to SIC (standard industrial classification) 24 industries. SIC 24 includes most lumber and wood products industries, with the exception of furniture-making and a handful of other wood specialty products. The economic variables are presented below:

Employees: 92	The number of employees working in SIC 24 industries in 1992.

64. *See supra* note 28.

65. FEMAT, *supra* note 30, at VI-5 tbl.VI-2.

66. *See id.* at VI-5 to VI-6 (table and graph comparing projected harvests to the period 1980–1989); SEIS, *supra* note 23, at 3&4-264 to 3&4-270. The planning teams made these comparisons despite the Northwest's rapidly changing economy.

Payroll: 92	The 1992 SIC 24 payroll, measured in thousands of dollars.
% Payroll: 92	The percentage of a county's total 1992 payroll coming from SIC 24 industries.
% Total Jobs: 92	The percentage of total 1992 employment coming from SIC 24 industries.
% Mfg. Jobs: 92	The percentage of total 1992 manufacturing employment coming from SIC 24 industries.
County Payroll: 92	The total annual payroll in 1992.
Employees: 87	The number of employees working in SIC 24 industries in 1987.
Payroll: 87	The 1987 SIC 24 payroll, measured in thousands of dollars.
% Payroll: 87	The percentage of total 1987 payroll coming from SIC 24 industries.
Job Loss	The reduction in SIC 24 employment between 1987 and 1992, measured in jobs.
% Job Loss	The percentage reduction in SIC 24 employment between 1987 and 1992.
County Payments	Payments to counties in 1992 resulting from federal timber receipts, measured in dollars.
Payments per capita	Per capita payments to counties in 1992 resulting from federal timber receipts, measured as dollars per person.[67]

67. The 1990 county populations and timber receipts from 1992 were used to compute this variable, thus making this calculation not entirely precise. However, no changes in the region's overall population distribution in the early 1990s were so drastic that they would seriously skew the results. Also, 1990 Census figures reflect the most recent highly accurate count of the

Political Variables

These variables test the degree to which political factors may have influenced the land use allocations. Political variables were assigned in the same way as the economic variables. Therefore, these variables indicate the characteristics of the political jurisdictions within which a land use tract sits. No tracts are located in multiple political jurisdictions.

These variables were intended to capture two distinct political factors.[68] The first was to measure how the views of congressional representatives might have influenced the allocation of land uses among their districts. The second factor measured by the political variables reflects the views of local residents toward federal forest management. Although the forest management preferences of local residents could not be directly measured, since region-wide surveys were not conducted during the planning processes, the county's vote in the 1992 presidential election was used as a rough proxy. As Yaffee has documented,[69] Bush and Clinton presented very different visions of how they intended to manage federal forests in the Pacific Northwest if they were elected. Bush sided with the timber-related interests, while Clinton's views were more friendly to environmentalists.[70] While many, if not most, of the region's voters may have chosen their candidate based on other issues, voters who were closely aligned with either timber or environmental interests likely voted for the candidate most closely allied with their views.[71] Therefore, it could be expected that those counties with a higher proportion of people aligned with timber-related interests would show higher levels of support for Bush. The political variables are listed below:

Rep: Party	A dummy variable indicating the political party of the Congressional Representative. It was coded 1 for a Republican Representative and 0 for a Democrat.

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counties' populations, and thus are the best source for population data. This variable was used to capture the relative degree of economic dependency on timber-related payments.

68. The rationale for testing these factors can be found at *supra* notes 36–38 and accompanying text.

69. YAFFEE, *supra* note 1, at 141.

70. *Id.*

71. It is a well-known phenomenon that some voters with deeply held beliefs about a particular issue will base their entire vote on that issue. For instance, a Gallup Survey shows that "20% of Americans would only vote for a candidate who shared their views on abortion." *See* LYDIA SAAD, PUBLIC OPINION ABOUT ABORTION—AN IN-DEPTH REVIEW 7 (2001), *at* http://www.gallup.com/poll/specialReports/pollSummaries/sr020122vii.asp.

Rep: LCV	The Congressional Representative's 1993 League of Conservation Voters (LCV) score.[72]
Sen: LCV	The Senators' 1993 LCV score. For each state, the scores of the two Senators were averaged, producing a mean Senate LCV score.
President	A dummy variable representing whether the county gave a plurality of its vote for Bush in the 1992 Presidential election. It was coded 1 if a plurality voted for Bush.
% Bush	The percentage of major party voters who voted for Bush in the 1992 election.[73]

Other Variables

Finally, three other variables were included in the analysis. As previously explained, no hypotheses related to these variables were advanced. Nevertheless, they were tested to see what, if any, effect they had upon the spatial distribution of land use allocations.

Acreage	The size of the land use tract, in acres.[74]
Population	The county's 1990 population.
Pop Density	The county's population density in 1990, measured in persons per square mile.

72. The League of Conservation Voters is a non-partisan political organization that promotes pro-environment elected officials. It publishes an annual scorecard scoring congressional representatives for their votes on environmental issues.

73. The overwhelming majority of the region's counties gave a plurality of their votes for Clinton (only 14 of 52 counties voted for Bush), but since there was a wide variation in levels of support for Bush in the counties Clinton won, this variable attempts to provide a more refined measure of local political preferences. To derive the variable, voters for third party candidates, most notably Ross Perot, were excluded from consideration. The variable was then calculated by adding the votes for Bush and Clinton, dividing the number of Bush votes by this sum, and multiplying by 100.

74. This variable measures the size of the tract to which the analysis tracts originally belonged. Thus, if one of the tracts designated by the Northwest Forest Plan was located in two counties, though the tract was split in two, the original tract size was used for this variable. This variable tests whether size influenced the likelihood of a tract being designated as reserved or unreserved.

The Logistic Regression Technique

Logistic regression (logit) was applied to test which independent variables were most highly correlated with "Reserved," the dependent variable indicating whether a tract was allocated to a reserved or to an unreserved land use. The dichotomous nature of the dependent variable meant that logit was the most appropriate regression technique to use.[75] The ordinary least squares (OLS) or weighted least squares (WLS) regression techniques generally assume that the dependent variable is continuous, thereby producing a range of outcomes.[76] This assumption cannot be met when the dependent variable is dichotomous, taking values of only 0 and 1. Using linear regression techniques in that situation would lead to incorrect estimates.[77] For this reason, a nonlinear model had to be used for this analysis. The logit model is a nonlinear probability model based on the logistic function.[78] Because the values of the logistic function cluster near 0 and 1, it better approximates the outcomes from a model with a binary dependent variable. Therefore, logit was chosen to test the hypotheses of the independent variables' effect on land use allocations.[79]

II.A.3. Results

This section presents the results of the tract-level analysis. The steps taken to generate the best-fitting model are mentioned briefly, and the actual results are presented next. This section concludes with a short summary of the implications of the results.

Of the twenty-seven independent variables used in the analysis, only a handful were highly correlated with a particular land use. Most of the variables had little predictive power over the uses to which tracts were

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75. With a binary dependent variable taking values of 0 and 1, any regression model will attempt to estimate, based on the independent variables, the probability that the dependent variable will have a value of 1. The question is which technique produces the most accurate estimates, and logit is superior to linear regression techniques. JOHN H. ALDRICH & FORREST D. NELSON, LINEAR PROBABILITY, LOGIT, AND PROBIT MODELS 27-30, 52-54 (1984).

76. *Id.* at 12.

77. Estimates derived from linear regression techniques when the linearity assumption is violated "(1) have no known distributional properties, (2) are sensitive to the range of the data, (3) may grossly underestimate the magnitude of the true effects, (4) systematically yield probability predictions outside the range of 0 to 1, and (5) get worse as standard statistical practices for improving the estimates are employed." *Id.* at 30.

78. The logistic function is mathematically defined as $P_i = (e^{Z_i}) / (1 + e^{Z_i})$, where $Z_i = b_0 + b_1X_{1i} + b_2X_{2i} + \ldots + b_kX_{ki}$.

79. The other technique that could have been used for this analysis was the probit model, which is based on the cumulative normal distribution function. Logit and probit yield nearly identical results, and so the choice between the two models was arbitrary. ALDRICH & NELSON, *supra* note 75, at 34, 80.

allocated. Several steps were required to find the best fitting model, in which only the significant variables were included. First, the dependent variable, Reserved, was regressed on all the independent variables using Maximum-Likelihood Estimation, the estimation method typically used for the logit technique.[80] This full model had moderate predictive power, but many of the independent variables had an insignificant influence over the probability that a tract would be allocated to a reserved or unreserved use.[81] Using these results as a starting point, numerous other models were tested in order to eliminate the insignificant independent variables. It was determined that the best model for predicting land uses included only the four variables representing the presence of LS/OG forest, occupied marbled murrelet centers, Key Watersheds, and roadless areas within a tract.

This best fitting model is displayed in Table 1. In addition to showing the effect individual variables had on the dependent variable, two summary statistics for the entire model are presented. The first of these is the pseudo R^2 statistic that was proposed by Aldrich and Nelson.[82] The second is a proportional reduction of error (PRE) measure.[83]

These results suggest that, among the independent variables tested in this analysis, ecological factors were the greatest predictors of whether a tract would be allocated to a reserved or unreserved land use. The ecological variables, particularly those representing the presence of marbled murrelet centers and LS/OG forest within a tract, were much more highly correlated with a particular land use than economic, political, or other variables. The results therefore support the ecological hypothesis, but they also indicate that economic and political factors did not influence the distribution of land uses. Nor did the tract size and county population variables have a detectable effect on the distribution of land uses.

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80. *Id.* at 49.

81. The negligible effect most independent variables had upon the dependent variable was evident from the Exp(B) values. Exp(B) is e^(coefficient), the factor by which the odds (of a tract being allocated to a reserved land use) change when the independent variable increases by one unit. MARIJA J. NORUŠIS, SPSS PROFESSIONAL STATISTICS 7.5, at 43 (1997). It is the logistic regression equivalent of a beta weight.

82. It is calculated as c / (c + n). Like the OLS regression R^2, it ranges between 0 and 1. It also does not have a penalty for increasing the number of independent variables, so it remains unadjusted for degrees of freedom. Other goodness-of-fit statistics, such as testing the significance of the likelihood ratio statistic c or the Homer and Lemeshow statistic, could not be used due to the large sample size. The X^2 statistic is extremely sensitive to sample size, and with very large samples inconsequential changes in the dependent variable are judged statistically significant. ALDRICH & NELSON, *supra* note 75, at 57.

83. The proportional reduction of error formula is: PRE = ((% errors without the model) - (% errors with the model) / (% errors without the model)).

Table 1: Logit Analysis[a]

n = 22,869
c = 6615.992[b]
pseudo Rsq = .224[c]
PRE = 35.6%[d]

Classification Table

		Predicted 0	Predicted 1	
Observed	0	8740	4646	65.29%
	1	1459	8024	84.61%
			Overall =	73.30%

Variable	Estimated Coefficients	Significance Level	R[e]	Exp(B)[f]
LS/OG	2.20	0.000	0.36	9.04
Murrelet	6.41	0.000	0.02	608.74
Watershed	0.56	0.000	0.10	1.76
Roadless	0.47	0.000	0.06	1.59
(Constant)	-1.98	0.000		

[a] These results demonstrate the effects of independent variables on the probability that a land use tract is allocated to a reserved use.
[b] c = -2 log (L0 / L1); the log likelihood ratio statistic; it follows a chi-square distribution and can be used to test the null hypothesis that all the coefficients in the model are 0, similar to the F test used in OLS.
[c] pseudo Rsq = c / (c + n)
[d] PRE = ((% errors without the model) - (% errors with the model) / (% errors without the model))
[e] R = the partial correlation between RESERVED and the dependent variables
[f] Exp(B) = e^(coefficient), the factor by which the odds (of a tract being allocated to a reserved land use) change when the independent variable increases by one unit.

The results suggest that the Northwest Forest Plan largely incorporated the environmental goals it advocated, but that local economic and political characteristics had comparatively little effect on the allocations. However, as explained in Part II.B.4 *infra* ("Model 3"), this does not mean that the timber-related variables had no influence over the spatial distribution of land uses across the region's federal forests. The meaning of the tract-level results is considered at greater length *infra* in Part III ("Discussion").

II.B. County-Level Analyses

Unlike the first analysis, which was disaggregated to the level of individual land use tracts, these analyses were conducted at the county level. Three separate county-level analyses are presented in this section. The section begins with a brief introduction of the models. Next, methods applicable to all of the county-level models are presented, and several new variables introduced. Finally, the three individual models, their hypotheses, and the results are presented in separate subsections.

The first model measures the correlation between the percentage of unreserved federal forestland in a county and the independent variables. Its primary purpose was to confirm the tract-level results. Like the tract-level analysis, this model tests which variables were the strongest predictors of the allocation of land uses. Its results, which similarly indicate the primacy of ecological variables, provide additional support for the conclusions drawn from that analysis. The second model measures the association between the percentage of unreserved LS/OG forest and the independent variables. Its focus is narrower than the first model. By seeking to understand which factors influenced the proportion of LS/OG forest left unreserved in different counties, the second model highlights those factors that influenced the allocation of this highly contested resource. The third model explores the relationship between the independent variables and those counties that were allocated higher proportions of unreserved LS/OG forest. Because the Northwest Forest Plan considered the needs of timber-dependent communities,[84] this model tests whether timber-dependent counties received a greater share of this valuable commodity.

II.B.1. Methods

The county-level analyses used the OLS regression method to examine the correlation between the independent and dependent variables and delineate which variables best predicted the outcomes. Because the county rather than the land use tract served as the level of analysis, the ecological variables were aggregated to the county level. Although these variables are not direct parallels of the tract-specific ecological variables used in the logit model, they are very similar and represent the closest county-level analogue. The revised variables are described below:

Owl: County	The number of northern spotted owl centers located in a county.

84. SEIS, *supra* note 23, at 3&4-300 to 3&4-305.

Murrelet: County	The number of marbled murrelet centers located in a county.
Watershed: County	A dummy variable indicating whether the geographic center of a Key Watershed is located in a county. This serves as a proxy for those counties with a sizable proportion of a Key Watershed within their respective boundaries.
Roadless: County	A dummy variable indicating whether the geographic center of a roadless area is located in a county. This serves as a proxy for those counties with a sizable proportion of a roadless area within their respective boundaries.
LS/OG: Ha	Hectares (ha) of LS/OG forest contained within all the land use tracts of a county.[85]

The same economic, political, and other variables used in the tract-level analysis were used here.[86] The county-level analyses also employed three new dependent variables, two of which are presented in this section. Because the results of the second model contributed to the design of the third model, the final dependent variable is formally introduced with the third model in section II.B.4 ("Model 3"). All three variables were derived using the same land use tracts applied to the tract-level analysis, with previously reserved forestland continuing to be excluded from the analysis. The first two dependent variables are presented below:

% Unreserved	Percentage of unreserved federal forestland in the county.[87] It represents the most direct parallel to the dependent variable used in the tract-level analysis.

85. This does not include LS/OG forest located in previously reserved areas, such as Congressional Reserves.

86. *See supra* notes 65–76 and accompanying text (describing economic, political, and other variables).

87. This variable was calculated by adding the unreserved acreage in the tracts, dividing this by the total acreage, and multiplying by 100.

% LS/OG Unres. Percentage of unreserved federally-owned LS/OG forest in the county.[88]

The variable measuring the percentage of total unreserved forestland was used for Model 1, section II.B.2 *infra*. The variable measuring the proportion of unreserved LS/OG forest was employed for Model 2 in section II.B.3 *infra*.

II.B.2. Model 1

This model tests the correlation between unreserved federal forestland and the independent variables. Several hypotheses guided the analysis. Because it was closely analogous to the tract-level study, the hypotheses mirror those advanced in section II.A.1 ("Tract-Level Hypotheses"). The presence of greater ecological resources in a county was expected to be negatively correlated with higher proportions of unreserved forestland. Counties with higher proportions of their economy based on the timber industry were expected to be positively correlated with unreserved forests. Like the tract-level analysis, it was expected that counties with Republican or anti-environmentalist congressional representatives would have a higher proportion of unreserved forest. And, as in the tract-level analysis, no formal hypotheses were advanced with respect to the other variables.

The dependent variable, measuring the percentage of unreserved federal forests in a county, was regressed on all the independent variables. Though this model had a relatively high R^2 of .67, which explains much of the variation in the dependent variable, many of the independent variables were not significant. After testing groups of independent variables, it was determined that the best fitting model included only three variables: those representing marbled murrelets, northern spotted owls, and Key Watersheds. The results of this model are presented in Table 2.

The results generally mirror those of the logit analysis. Here again ecological variables were the strongest predictors of the dependent variable, with counties containing Key Watersheds and more marbled murrelets having, as expected, lower proportions of unreserved federal forestland. As with the logit model, the economic, political, and other variables were not significantly correlated with the land use allocations. Thus, these results largely comport with those seen in Table 1.

88. This was calculated similar to "% Unreserved," except using only LS/OG instead of all forests. *See supra* note 87 and accompanying text. This variable was used to determine which factors affected the proportion of unreserved LS/OG forest allocated to a county.

Table 2: Regression Analysis of Unreserved Forestland[a]

Dependent Variable: % Unreserved
n = 52
Rsq = .356
Adjusted Rsq = .316
F = 8.86, significance level = .000

Variable	Estimated Coefficients	Standardized Coefficients	Significance Level
Owl: County	0.44	0.13	0.001
Murrelet: County	-0.36	0.11	0.002
Watershed: County	-27.31	7.94	0.001
(Constant)	68.97	6.84	0.000

[a] These results demonstrate the effects of independent variables on the percentage of unreserved forestland.

This model highlights an anomalous result concerning the relationship between northern spotted owls and the land use allocations. Counties with more northern spotted owls had higher proportions of unreserved federal forest. A similar result was seen with some of the logit regressions tested in this study, where the coefficient for the owl-related variable[89] indicated that a tract with a spotted owl center was less likely to be reserved. Yet because this county-level analysis does not measure the land uses of individual tracts, these results do not demonstrate that tracts containing spotted owls were less likely to be reserved. This analysis does not make clear whether or not the specific tracts with spotted owl centers were reserved. Moreover, the odds ratio for the spotted owl variable used in the logistic regressions[90] was negligible, meaning that this variable could not predict to which land use a tract was allocated. One possible reason for this relationship seen at the county level is that counties with higher numbers of spotted owls also had more forests, and thus more timber-related industry. Therefore, it is possible that since areas with more spotted owls often have greater forest resources, they could have been allocated more unreserved forestland without severely threatening the owl's local viability.

89. This was the "Spotted Owl" variable, representing the presence of a spotted owl center within a land use tract.

90. *See id.*

II.B.3. Model 2

This model tests the association between the independent variables and the proportion of federally-owned LS/OG forestland left unreserved in a county.[91] The same relationships hypothesized for Model 1 were hypothesized for this analysis as well. Ecological variables were again expected to be negatively correlated with the percentage of unreserved LS/OG forest, and the economic and political variables were anticipated to produce the same correlations that had been expected for the logit model.

Before any regressions were performed, those counties with fewer than 1000 ha of LS/OG forest were excluded from the analysis. This was done so that those four counties, whose LS/OG forest was substantially less than the rest, would not skew the analysis.[92] Then the dependent variable, representing the percentage of unreserved LS/OG forest, was regressed on the independent variables. As was the case with the prior analyses, the full model had many insignificant independent variables. After numerous models were tested, the insignificant variables were removed. The best fitting model is presented in Table 3.

Table 3: Regression Analysis of Unreserved LSOG Forest[a]

Dependent Variable: % LS/OG Unres
n = 48
Rsq = .380
Adjusted Rsq = .322
F = 6.577, significance level = .000

Variable	Estimated Coefficients	Standardized Coefficients	Significance Level
Sen: LCV	-0.33	-0.33	0.014
Owl: County	0.33	0.39	0.007
Murrelet: County	-0.26	-0.36	0.014
Watershed: County	-37.02	-0.53	0.000
(Constant)	65.00		0.000

[a] These results demonstrate the effects of independent variables on the percentage of unreserved LSOG forest.

91. Due to the areas excluded from the analysis, as explained *supra* at notes 44-49, this variable only measures the proportion of unreserved LS/OG forest that had not been previously reserved.

92. The amount of LS/OG forest located in those counties was comparatively so insubstantial that including it in the analysis would have misrepresented the hypothesized relationships concerning the overwhelming majority of federally-owned LS/OG forest.

These results suggest that the factors important in the first county-level model likewise affected the proportion of LS/OG forest left unreserved. Based on the standardized regression coefficients, it appears that the greatest single predictor for the proportion of unreserved LS/OG forest was whether the center of a Key Watershed was located in a county. Similar to the results of Model 1, this model shows counties with more spotted owl centers having greater amounts of unreserved LS/OG forest. The same possible reasons for this seemingly contradictory result could apply here as well.

An interesting result of this analysis was the inclusion of a statistically significant political variable. The variable measuring the mean League of Conservation Voters score for each state's senators, "Sen: LCV," was a significant predictor in the model. This could indicate possible support for the hypothesis concerning the political variables, particularly since the direction of the coefficient comports with expectations.[93] Nonetheless, the numerical values of the this variable, in which each state had a different score, suggest that the result could simply be a proxy for the three states in the region.[94] Without further evidence, and none has been found in the previous models, the hypothesis that senatorial preferences influenced land use allocations cannot be supported.

II.B.4. Model 3

The tract-level analysis and the two prior county-level analyses indicate that land use allocations were most strongly affected by ecological factors. Yet, as this final analysis demonstrates, economic factors do appear to have played a role in the distribution of unreserved LS/OG forest under the Northwest Forest Plan. This analysis examines the effect of the independent variables on the distribution of surplus proportions of unreserved LS/OG forest. The idea behind the analysis was to identify which factors might have resulted in some counties receiving a larger share of unreserved LS/OG forest than their proportionate share of the region's total LS/OG forests would have predicted. If the premise is accepted that ecological factors had an overall greater influence over the allocations than

93. The political hypotheses are discussed *supra* notes 36-40 and accompanying text.

94. The results show the Oregon counties getting a higher proportion of unreserved LS/OG than California counties. Oregon has a lower LCV score than California, with Washington's score in between the other two states. If an ordinal variable with Oregon = 1, Washington = 2, and California = 3 had been constructed, based on a factor like the total amount of forest resources, this would have produced an almost identical result. Given the weight of the evidence, the significant influence of "Sen: LCV" is more likely the result of the same phenomenon causing the "Owl: County" to be negatively correlated to the proportion of reserved forest rather than an indication of congressional influence over land use allocations.

economic or political factors, then an analysis exploring this question is in order. For this test a new dependent variable was required:

Surplus LS/OG	The proportional surplus or deficit of unreserved LS/OG forest allocated to a county.[95]

Using the same set of independent variables applied to the other county-level analyses, an OLS regression was performed.

Initial tests of the model revealed a high degree of covariance between the economic variables. To correct for this multicollinearity, a factor analysis was performed on the timber-related economic variables to derive two factors.[96] These factors represented two different elements of a county's timber-related economy.

Factor 1, which had high factor loadings for number of employees in SIC 24, SIC 24 payroll, reduction in SIC 24 employment between 1987 and 1992, and total federal payments from timber sales, represented the raw size of the county's timber-related economy. Factor 2, with high loadings on the proportion of jobs in SIC 24, the proportion of total annual payroll in SIC 24, and per capita federal payments from timber sales, represented the degree of timber dependency in a county. A county with large numbers of workers in SIC 24 industries would have had high scores for Factor 1, while a county with a large share of its total economic activity included in SIC 24 industries would have had high scores for Factor 2.

The individual economic variables included in these factors were taken out and the regression was run again using the factor scores.[97] After testing several models, the insignificant variables were excluded and the best fitting model found. It is presented in Table 4.

These results suggest that two primary variables affected how unreserved LS/OG forest was distributed across the region. The most

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95. The variable was derived by first calculating the percentage of the whole region's LS/OG forest located in a particular county. Then the percentage of all unreserved LS/OG forest located in that county was calculated. Finally, the percentage of total LS/OG forest was subtracted from the percentage of unreserved LS/OG forest to determine whether a county had a relative surplus or deficit of unreserved LS/OG forest.

For example, Clackamas County had 3.09% of the region's total LS/OG forest contained in the studied land use tracts, while it had 4.95% of all unreserved LS/OG forest. Thus, its surplus of unreserved LS/OG forest was 4.95 – 3.09 = 1.86.

96. The factors were derived using Principal Components extraction with Varimax orthogonal rotation.

97. After extracting these two economic factors, all the earlier tract- and county-level analyses were repeated using the factor scores, but this substitution did not produce a significant change in any of the models. As a result, the regression results including these factors were only presented for the purposes of this final analysis.

powerful explanatory variable was the raw size of a county's timber economy. Those counties with the largest amount of timber-related economic activity, rather than those most dependent upon the timber industry, received the greatest surplus of harvestable LS/OG forest. While it is true that some of the more timber-dependent counties also had high scores for Factor 1, timber-dependency itself was not a causal factor in receiving a surplus. Even though the FEMAT planning team went to great lengths to identify "at risk" timber-dependent communities,[98] the model presented here suggests that this consideration did not play a primary role in the distribution of this economically valuable resource.

Table 4: Regression Analysis of the Surplus of Unreserved LSOG Forest[a]

Dependent Variable: Surplus LS/OG
n = 52
Rsq = .437
Adjusted Rsq = .451
F = 21.978, significance level = .000

Variable	Estimated Coefficients	Standardized Coefficients	Significance Level
Factor 1	1.21	0.74	0.000
Murrelet: County	-0.02	-0.34	0.004
(Constant)	0.26		0.169

[a] These results demonstrate the effects of independent variables on the surplus of unreserved LSOG forest.

III. DISCUSSION

Taken together, these analyses of land use allocations highlight a number of key relationships. Most importantly, when the first comprehensive management plan was crafted for all the federal forests in the Pacific Northwest, it was the environmentalists' goals of old-growth forest preservation, roadless area protection, and biodiversity maintenance that were most effectively translated into public policy.[99] Though the timber industry greatly influenced the region's federal forest policy for most of the postwar period, in the Northwest Forest Plan timber-related considerations were overshadowed by ecological factors.[100] This represents a major triumph for the environmental groups involved.

98. FEMAT, *supra* note 30, at VII-48 to VII-75.
99. *See supra* Tables 1-3 and accompanying discussions.
100. *See* Rayner, *supra* note 5, at 88, 90-91. *See generally* YAFFEE, *supra* note 1.

Another important relationship was the degree to which the marbled murrelet influenced land use allocations. Although the northern spotted owl is the species most commonly associated with conflict over federal forest management in the Pacific Northwest, the marbled murrelet had a much greater effect on the allocations. This result is consistent with ecological considerations. While the northern spotted owl and the marbled murrelet are both threatened species, the murrelet's nesting habitat is more restricted.[101] The expanded degree of protection afforded the murrelet suggests that the Plan accounted for its greater fragility.[102]

Throughout the history of federal forest management in the Northwest, political considerations have often affected the formulation of forest policy.[103] For example, the adoption of FEMAT's Option 9, which accepted a higher level of risk to species associated with LS/OG forest in order to allow a larger timber harvest,[104] was likely partially motivated by President Clinton's political goal of presenting a balanced solution.[105] Providing an annual timber supply of more than 1 billion board-feet (bbf) while meeting statutory requirements for species protection was a powerful way of meeting that goal.[106] Despite this, the models presented in this article suggest that localized political factors, like congressional representation, did not affect land use allocations. For those political variables tested, the results indicate a lack of partisan political influence. None of these factors were convincingly shown to have affected land use allocations.

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101. Every known marbled murrelet nest in the region was found in forests with old-growth characteristics. FEMAT, *supra* note 30, at IV-15. Moreover, they only nest in forests close to the ocean. The SEIS team tentatively identified suitable murrelet nesting habitat as "old-growth forests, and mature forests with an old-growth component...." SEIS, *supra* note 23, at 3&4-246. Compare this to the suitable habitat for the northern spotted owl, which is "strongly associated with late-successional forests....[but] is also fairly common in some types of relatively young forest...." *Id.* at 3&4-211. Moreover, the spotted owl is not restricted to forests near the ocean.

102. It was noted that "[t]he marbled murrelet was a focal point of the development of alternatives for this SEIS, and therefore is generally well accommodated in the alternatives." *Id.* at 3&4-248.

103. *See, e.g.*, YAFFEE, *supra* note 1, at 65-66, 118-23, 127-28, 136-40.

104. "Alternatives 1 through 6 would provide a reduced timber supply when compared to Alternative 9 as it appeared in the Draft EIS. Based on the habitat assessments...Alternatives 1 through 6 would in many cases provide higher levels of assurance of the continuation of the diversity of plant and animal communities in the planning area than Alternative 9." ROD, *supra* note 4, at 27. The Record of Decision went on to note that the Final SEIS classified 775,000 more acres as LSR, but this does not obscure the fact that Alternative 1 was the environmentally preferred alternative. *Id.* at 25.

105. *See* YAFFEE, *supra* note 1, at 147-49.

106. The Plan projected annual timber sales of 1.1 bbf for the first decade. SEIS, *supra* note 23, at 3&4-266 tbl.3&4-16.

The final regression exposed the only non-ecological factor to significantly affect forest policy. The unreserved LS/OG forestland was correlated with the presence of local economies with a large amount of timber-related activity. Yet this distribution was not associated with those counties most dependent on the timber industry. This suggests that the most timber-dependent communities, which were much of the focus of the planning process and, more generally, symbolic of the plight of loggers, received comparatively little unreserved LS/OG forest.[107] It is possible that a large number of what FEMAT defined as "communities at risk" were located within counties with large timber economies, but this cannot be verified because those communities were never publicly identified.[108] Regardless, the results at least call into question the assumption that timber-dependent communities would be well accounted for in the Plan. The key factor appears to have been the size of a county's timber economy, not the degree of timber-dependency.

The models produced another outcome inconsistent with the expected results. With the northern spotted owl at the locus of the forest management debate, it was expected that areas with more spotted owls would have higher proportions of reserved forest. Instead, counties with greater numbers of northern spotted owls actually had less federal forest allocated to reserved uses than those with fewer owls. In addition, the logit results showed that the presence of spotted owl centers did not affect the likelihood of a tract being allocated to a reserved use. One possible reason spotted owl centers were not a significant variable was that "LS/OG," the variable representing the presence of LS/OG forest within a tract, was serving as a proxy for other LS/OG-related species as well as the spotted owl. However, given the strong predictive power of the marbled murrelet, whose habitat is also LS/OG forest, it makes intuitive sense that spotted owl sites should have had some effect on the probability that a tract was allocated to a reserved use. And even the possibility of LS/OG forest acting as a substitute for spotted owl habitat does not explain the county-level results.

In addition to the possibility discussed *supra* in Part II.B.2 ("Model 1") concerning more forest resources in those counties with higher numbers of spotted owl centers,[109] there is another possible explanation based on the planning process itself. After the FEMAT science team crafted the original set of eight new options, two additional options, including Option 9, were added.[110] To accomplish the biological goals, the science team combined the

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107. *See supra* Table 4 and accompanying discussion.
108. FEMAT, *supra* note 30, at VII-49 to VII-56.
109. *See* text following Table 2, *supra*.
110. YAFFEE, *supra* note 1, at 146.

needs of the terrestrial and aquatic species by merging the large forest reserve areas with the Key Watershed areas.[111] This was a major departure from the previous plans.[112] By having the same areas serve multiple functions as both terrestrial and aquatic habitat, more forests could be left unreserved. In all of the county-level models, there is a negative correlation between the presence of Key Watersheds and the proportion of unreserved forests. It is possible that, just as the LS/OG variable likely served as a proxy for spotted owl habitat in the logit analysis, the Key Watershed variable did the same in the county-level analyses.

IV. CONCLUSION

This study examines one planning decision, the Northwest Forest Plan, that attempted to resolve the region's long-standing debate over federal forest management. By focusing on which variables affected the Plan's land use allocations, the study provides evidence about the extent to which different interests saw their goals translated into policy. The land use allocations suggest that many of the environmentalists' goals were incorporated into the Plan. Their relative success can be seen both in the aggregate land use allocations, where the majority of federal forests were reserved, and in the tract-level analysis, where ecological features were strongly correlated with reserved uses. Given the substantive requirements of federal laws like the ESA and the Clinton Administration's greater sympathy for environmental interests, it is not surprising that the Plan reflected ecological concerns. Yet the tract-level results are notable for the degree to which ecological considerations permeated the planning process.

But while in the aggregate the Plan emphasized environmental goals, the distribution of unreserved LS/OG forest suggests that the interests of the timber industry may also have been incorporated to some degree. This distribution also highlights a potential divergence of interests between proponents of large timber concerns and rural timber-dependent communities, with the former benefiting to the detriment of the latter.

The analysis of the allocation of land uses under the Northwest Forest Plan will hopefully inform future inquiries into the factors that influence the decision-making processes of the Forest Service and the BLM. And, as policymakers continue to grapple with how best to manage the Northwest's federal forests, hopefully they can learn from the lessons of the Northwest Forest Plan and other management experiments to craft plans that better meet both ecological and economic goals.

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111. Telephone interview with Cay Ogden, Regional Wildlife Ecologist, U.S. Forest Service Region 6 (Mar. 20, 2000). *See also* SEIS, *supra* note 23, at 2-30.

112. Telephone interview with Cay Ogden, *supra* note 111.