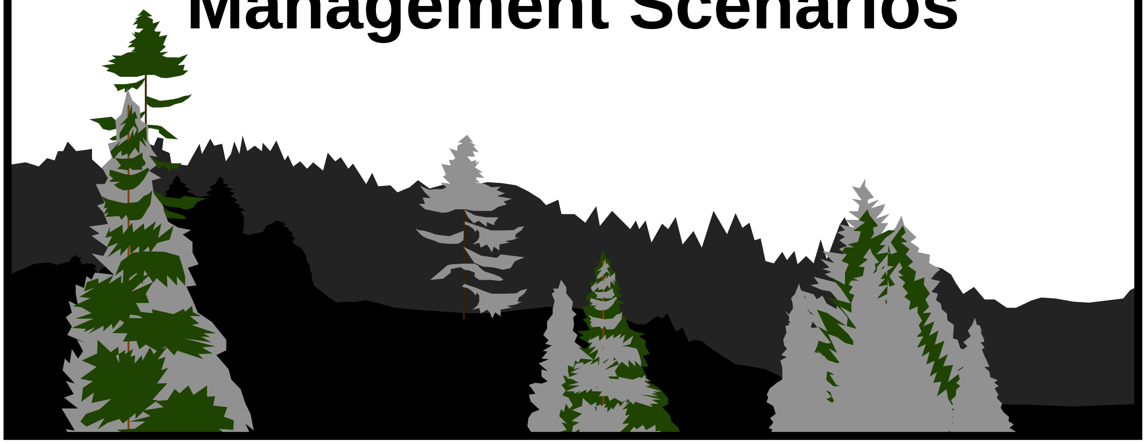
Appendix H

Decadal Analysis of Management Scenarios



Harvest Scheduling Model

The Harvest Scheduling Model was developed by Professor John Sessions of Oregon State University to assist the Oregon Department of Forestry (ODF) in evaluating policy alternatives for the *Elliott State Forest Management Plan* (FMP) and Habitat Conservation Plan (HCP) by providing decadal information on harvest levels, revenue, and vegetation conditions for a planning horizon of 150 years.

The model combines a spatial timber (inventory) layer, ODF inventory data, tree growth and yield projections, and management goals with a search technique to allocate timber management activities over the planning area and planning horizon.

The spatial timber inventory database maintained by the ODF was stratified into groups of stands of like species, size, and stocking. For each timber strata, a number of treatment alternatives were developed as potential management regimes that could be assigned to timber stands to meet management goals. The USDA Forest Service's Forest Vegetation Simulator Pacific Northwest Coast Variant model was used to project growth and yield for the strata under the potential management regimes for 30 five-year periods.

The ODF has four primary management goals considered in modeling: 1) maximize long-term revenue to the Common School Fund (CSF); 2) produce a sustainable, even-flow harvest of timber; 3) maintain properly functioning aquatic habitat conditions; and 4) provide habitats that contribute to maintaining or enhancing wildlife populations at self-sustaining levels.

A search technique was developed to assign the potential management regimes to timber stands to meet management goals. Feasible assignment of management regimes to timber stands required tracking contiguous areas of mature forest habitat, contiguous areas of young stands, and the coordination of riparian and upslope management regimes. To maintain spatial feasibility, a heuristic search procedure was chosen. The search procedure is guided by an objective function that seeks to maximize present net value while minimizing deviations between goals for timber supply and forest structure.

The search procedure begins with an initial assignment of timber regimes that result in a feasible initial spatial solution. Following the initial assignment of timber regimes, the search procedure tests a trial move by randomly selecting a timber stand, randomly selecting a timber regime eligible for the stand, and evaluating the change in the objective function. If the objective function value improves, the trial move is accepted. If the objective function value does not improve, it still may be accepted if the loss in value does not exceed certain criteria. The theory behind accepting a non-improving trial move is to prevent the search from becoming stalled in a local maximum rather than continuing to search for higher values.

Different solutions can be explored by weighting the coefficients of the objective function to increase or decrease the relative importance of the different goals. Goals could be either one-way or two-way. One-way goals penalize either overachievement or underachievement, thus using the goal as a maximum or minimum respectively. Two-way goals penalize both overachievement and underachievement, thereby seeking the specified goal as a target. Goals can also be weighted such that larger deviations from a goal are penalized proportionately more than small deviations.

The ODF chose the heuristic search procedure because it is better able to solve spatial problems than optimization methods such as linear programming. Although linear programming has been widely used in forest management planning, it cannot solve a spatial problem at the scale of this planning area due to the large number of variables and constraints required to formulate the problem. The Elliott State Forest planning area contains approximately 2,100 stands divided into 62,456 upland and riparian parcels with a planning horizon of 30 five-year periods. Depending on the degree of spatial representation, up to 500,000 variables could be required.

Other alternative approaches could solve the nonspatial problem first, and then either try to fit the nonspatial solution to a map or ignore the spatial requirements. These alternative approaches might be adequate for comparative analysis, but may over-represent the attainment of goals by not considering the spatial constraints. The ODF chose to maintain spatial representation, recognizing that a heuristic search procedure cannot find the “optimal” solution, but instead finds the best of many feasible solutions. Heuristic search procedures have been shown to produce good solutions in a number of industries, including forestry.

Purpose of Modeling for the Elliott State Forest Planning Process

The purposes of modeling for the Elliott State Forest planning process are:

- Establish a baseline of the 1995 FMP and Habitat Conservation Plan (HCP) outputs.
- Explore various management scenarios early in the revision process.
- Display a relative comparison of resource conservation and fiscal tradeoffs for decision-makers and the public.
- Compare modeling outputs to narrow the focus of the revision process.
- Possibly use in the National Environmental Policy Act (NEPA) process as a basis for alternatives.

Modeling Process on the Elliott State Forest

In 2001, the Elliott State Forest core planning team developed the parameters for eight different management scenarios for the forest, including the 1995 FMP. The ODF staff worked with Dr. Sessions to translate these parameters into spatial computer models for each of these scenarios. These eight models represented a wide range of possible management scenarios, ranging from an emphasis on conservation to an emphasis on timber production. The model displays the impacts and outputs of those management strategies throughout 30 five-year periods. Outputs are displayed through various quantitative tables and geographic map displays.

In 2002, the core team and steering committee analyzed the outputs from the spatial models to help narrow the focus of the planning effort and identify strategies that will best accomplish the resource goals for the forest. From this analysis, the steering committee identified three concepts for the core team to include in the planning effort: 1) conservation areas for protection of important habitat; 2) revised aquatic/riparian strategies; 3) use of stand structure concepts in defining habitat.

Using the three concepts, the core team developed a draft Integrated Landscape Strategy. This draft strategy was modeled to help determine how well the strategies achieved the goals for the forest. Initial model runs of the draft landscape strategy were conducted in early 2004. The inventory data used in the model were of good quality, with much of the existing data collected since 2000.

In addition to the eight original management scenarios and the draft Integrated Landscape Strategy (ninth scenario), three other scenarios were identified for analysis. Two of these were modeled using the same inventory data. The third was a variation of the draft Integrated Landscape Strategy and was not modeled. Each of the management scenarios that was modeled was used for comparative purposes in developing the draft landscape strategy.

A new yield table incorporating the latest Stand Level Inventory data for the Elliott State Forest was developed in collaboration with a contractor during 2004, and was incorporated into the model in early 2005. In addition to the draft Integrated Landscape Strategy, several of the original 12 management scenarios were selected for analysis in the revised HCP. They were selected to represent a broad range of possible management alternatives. Outputs from the draft Integrated Landscape Strategy and the alternatives selected for the HCP were analyzed in 2005 to help inform decision-makers.

Summary of Model Run Outputs

Table H-2 summarizes the outputs of the model runs for three management approaches (Combined Reserves and Intensive Forestry; Owl HCP—no change; and Wood Emphasis), and three variations of harvest level for the draft Integrated Landscape Strategy—low, mid, and high. None of the other management scenarios were carried forward for modeling with the improved yield tables developed in 2005.

Table H-1. Conceptual Management Scenarios Summary

General Description	Timber Production	Conservation Areas	Riparian Strategy
Model #1 Current Condition (1995 HCP for owls and murrelets)			
Current condition. HCP for owls and murrelets. Calibration of model.	Non-declining flow 17 management basins Rotation ages vary: 80 to 240 years	Total conservation areas[1] 23 percent	1995 Elliott State Forest riparian strategies
Model #2 Take Avoidance			
No HCP. ODF take avoidance policies for owls, murrelets, and fish.	Non-declining flow 13 management basins Minimum harvest age 45 years	Protect owl/murrelet sites through surveys Total conservation areas[1] 30 to 58 percent	W. Oregon State Forests riparian strategies
Model #3 Revised Riparian Strategies			
Current condition with HCP for owls and murrelets. Revised riparian strategies.	Non-declining flow 17 management basins Rotation ages vary: 80 to 240 years	Total conservation areas[1] 27 to 30 percent	W. Oregon State Forests riparian strategies
Model #4 Structure Condition			
Management used to create array of habitat characteristics across landscape.[2]	Non-declining flow Rotation ages vary depending on forestwide structural mix	Maintain existing owl and murrelet areas until new habitat develops Maintain operationally limited and scenic areas	W. Oregon State Forests riparian strategies
Model #5 Combined Reserves and Intensive Forestry			
HCP for owls, murrelets, and fish. 50 percent of Elliott State Forest allocated to conservation areas; 50 percent intensively managed.	Non-declining flow Minimum harvest age 45 years	Total conservation areas[1] 50 percent	W. Oregon State Forests riparian strategies

Table H-1. Conceptual Management Scenarios Summary (continued)

General Description	Timber Production	Conservation Areas	Riparian Strategy
Model #6 Owl HCP (no change)			
1995 HCP for owls. ODF take avoidance policies for murrelets and fish.	Non-declining flow 17 management basins Rotation ages vary: 80 to 240 years	Total conservation areas[1] 27 to 55 percent	1995 Elliott State Forest riparian strategies
Model #7 25% Conservation Area			
25 percent of Elliott allocated to conservation areas; 75 percent intensively managed.	Non-declining flow Minimum harvest age 45 years	Total conservation areas[1] 25 percent	W. Oregon State Forests riparian strategies
Model #8 Grow Only			
No management activities. 100 percent of Elliott allocated as conservation area.	No timber production	100 percent conservation area	100 percent conservation area
Model #9 Integrated Landscape Strategy			
HCP for owls, murrelets, and fish. Use structure to define habitat.[2]	Non-declining flow 13 management basins basin targets for % advanced habitat	Total conservation areas[1] 20 to 30 percent	W. Oregon State Forests riparian strategies
Model #10 Integrated Landscape Strategy with FPA RMA (#10 not modeled)			
HCP for owls only. Take avoidance strategy for murrelets and fish.	Non-declining flow 17 management basins Rotation ages vary: 80 to 240 years	Total conservation areas[1] 19 to 28 percent	FPA RMA
Model #11 Cost of T&E Protection			
No owl or murrelet constraints. FPA RMA.	Non-declining flow Approximate 60- to 80-year rotation.	Total conservation areas[1] 10 to 15 percent	FPA RMA

Table H-1. Conceptual Management Scenarios Summary (continued)

General Description	Timber Production	Conservation Areas	Riparian Strategy
Model #12 Wood Emphasis			
No HCP. 70 acre core for 15 owl sites. 103 murrelet sites averaging 55 acres each.	Maximize net present value 13 management basins No minimum harvest age	Surveys for owls and murrelets. One owl site vacated every 5 years. 19 percent of harvest settings become murrelet sites per 5-year period, up to 15,000 acres. Owl and murrelet site changes stop after 50 years. Total conservation areas[1] 15 to 25 percent.	FPA RMA

Notes:

[1] Conservation areas include owl and murrelet sites, riparian areas, and operationally limited areas.

[2] 5 to 15% early structure; 35 to 45% intermediate structure; 40 to 60% advanced structure

FPA = Forest Practices Act

RMA = Riparian Management Area

Table H-2. Summary of Elliott State Forest Outputs

Alternative	10 Decade Average Annual MMBF Harvest			10 Decade Average Annual Clearcut Acres	10 Decade Average Annual Thinned Acres	10 Decade Average Annual Net Cash Flow in Millions			15 Decade Net Present Value in Millions	10 Decade Average Advanced Structure Percent	10 Decade Average Early Structure Percent
						Gross		Net			
	CC	Thin	Total			CC	Thin	Total			
Combined Reserves and Intensive Forestry	33.9	9.4	43.2	698	892	15.8	2.5	16.0	424.3	46	11
Owl HCP (no change)	20.1	6.4	26.5	464	640	9.5	1.8	9.0	184.43	59	8
Wood Emphasis	46.9	8.3	55.2	977	787	21.9	2.2	21.8	556.2	35	15
Integrated Landscape Strategy (low)	25.7	9.3	35.0	548	876	12.6	2.8	13.1	308.26	53	9
Integrated Landscape Strategy (mid)	29.4	10.6	40.0	631	1000	14.4	3.2	15.2	359.82	49	10
Integrated Landscape Strategy (high)	32.9	12.7	45.6	709	1192	16.1	3.9	17.6	419.21	46	11

Source Data:
L_20050606.txt (model 5)
L_mod6_20050609.txt (model 6)
L_mod12_20050610jy.txt (model 12)
L_35mmbf_20050608jy.txt (model 9)
L_40mmbf_20050608jy.txt (model 9)
L_45mmbf_20050608jy.txt (model 9)

CC = clearcut
MMBF = million board feet

Key Drivers for the Alternatives

All alternatives assume a net present value at 4.5 percent discount rate.

All alternatives have non-declining even flow.

For the Integrated Landscape Strategy, percentage target by management basin is a key driver.