LMS & Companions, Technical Tools

Begun in 1989, boost in 1994.

Dr. Jim McCarter & Chris Nelson, primary developers

Landscape Management System 2002 Proposed

- Emphasis on Sustainability (Economic, Social and Ecological)
- Strong Public Involvement
- Use of Science
- Monitoring Program
- Dynamic Planning Process

Six Questions

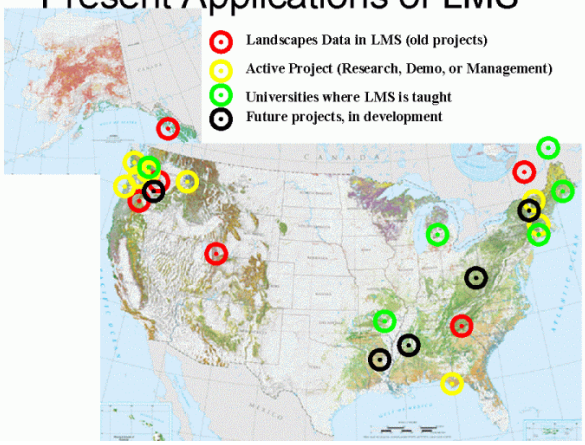
- What elements of biological diversity? Landscape and species
- Over what geographic area and timeframe should diversity be evaluated?
- What is an appropriate management standard? Range of biological diversity of native ecosystems in the surrounding landscape
- Difference in surrounding Landscapes?
- Diversity of plants and animals in context to multiple use objectives?
- What is the capability of the Forest Service to implement?

Computer needs for LMS2.0+

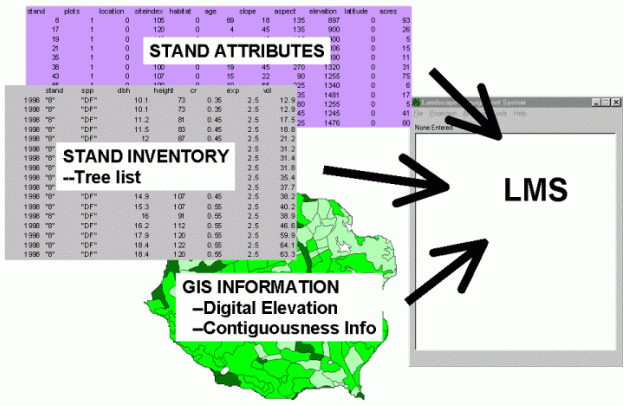
- Runs well on Windows 98, NT, & above
- (Will tolerate Windows 95)
- Runs well on 64MG's memory
- (Will tolerate 32 MG's minimum)
- Speed of CPU: Anything in Pentium class & above

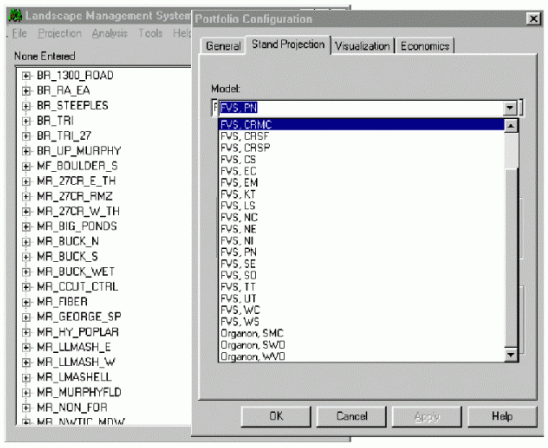
http://lms.cfr.washington.edu

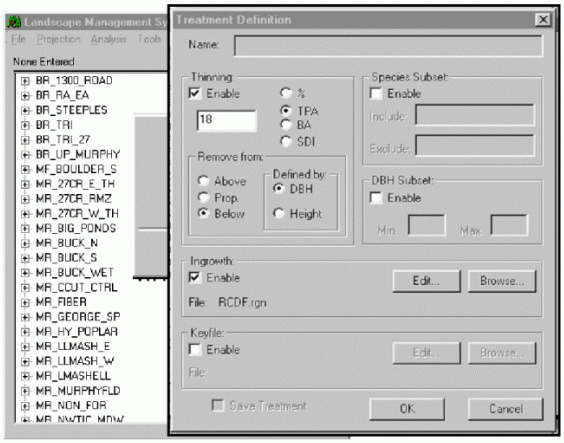
Present Applications of LMS

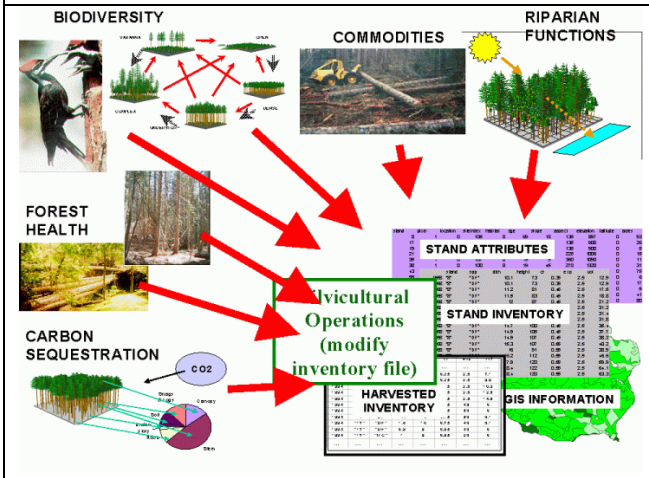


INPUT DATA

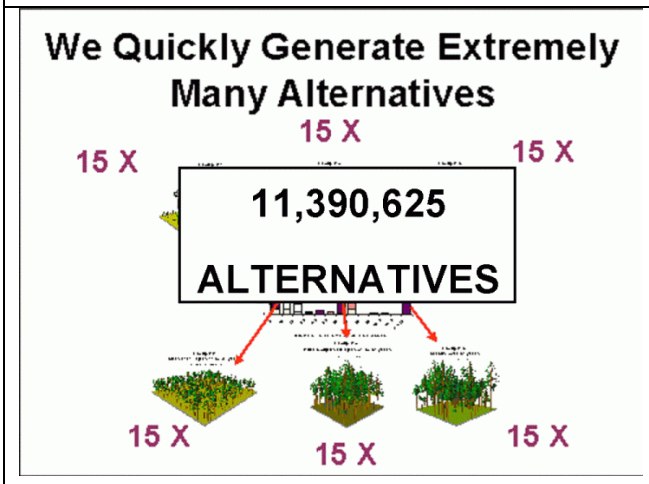


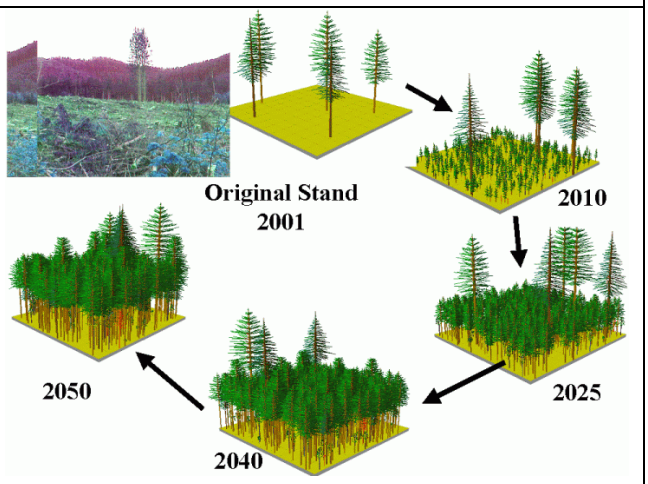

Landscape Management System
Portfolio Configuration
General
Stand Projection
Visualization
Economics
Model
OK
Cancel
Apply
Help

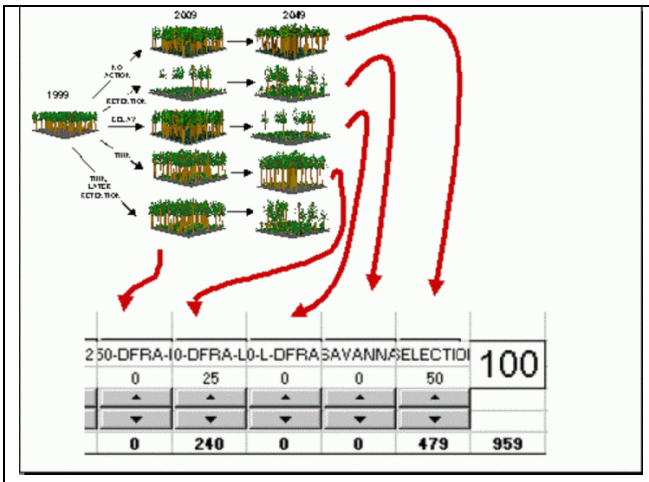

Treatment Definition
Name:
Thinning
Enable
Remove from:
Above
Prop.
Below
Defined by:
DBH
Height
Species Subset:
DBH Subset:
Ingrowth
Edit...
Browse...
Keyfile:
Save Treatment
OK
Cancel

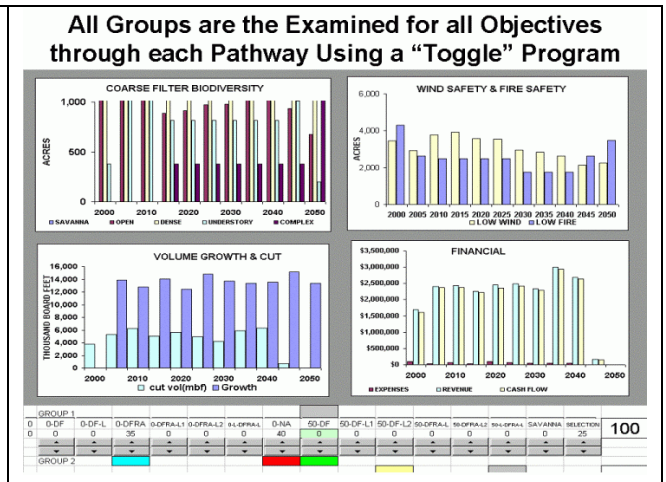

BIODIVERSITY
COMMODITIES
RIPARIAN FUNCTIONS
FOREST HEALTH
CARBON SEQUESTRATION
CO2
STAND ATTRIBUTES
STAND INVENTORY
HARVESTED INVENTORY
GIS INFORMATION
Silvicultural Operations (modify inventory file)

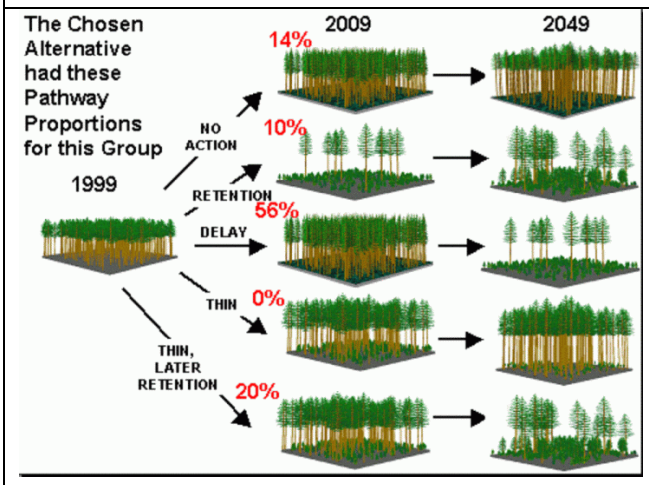
WaDNR OESF Local Advisory Group
"Trust Us…"
"…and then a miracle occurs…"
Forest Managers
Other Interest Groups


We Quickly Generate Extremely Many Alternatives
15 X
15 X
15 X
11,390,625
ALTERNATIVES
15 X
15 X
15 X


Original Stand
2001
2010
2025
2040
2050

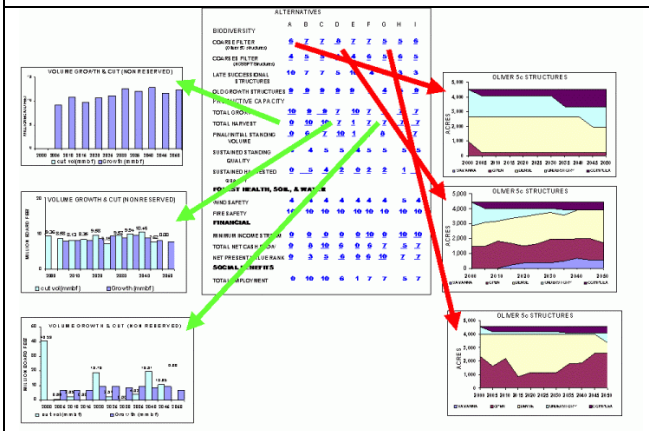






Summary Values

	ALT A	ALT B	ALT C	ALT D	ALT E	ALT F	ALT H	ALT I	ALT J	ALT O
		Existing	Intensive	Mixed	Industrial					
WILDLIFE HABITAT (AAHU's)										
COOPER'S HAWK	308	307	430	302	302	280	256	256	**513**	337
SOUTHERN RED-BACKED VOLE	570	562	547	543	519	544	617	665	455	546
SPOTTED TOWHEE	123	123	64	111	95	85	91	77	117	**155**
PILEATED WOODPECKER	456	452	386	352	198	309	368	509	334	431
STRUCTURAL DIVERSITY										
STRUCTURES										
COARSE FILTER (Oliver5C structures)	59%	59%	63%	64%	64%	63%	**67%**	62%	64%	60%
LATE SUCCESSIONAL STRUCTURES	89%	89%	**100%**	89%	72%	78%	89%	89%	**100%**	89%
OLD GROWTH STRUCTURES	**100%**	**100%**	78%	**100%**	78%	78%	89%	**100%**	78%	89%
RESERVES										
TOTAL RESERVES (acres)	**793**	669	177	464	160	160	253	280	160	253
OLD RESERVES (acres)	**156**	**156**	53	**156**	36	36	36	**156**	36	36
PRODUCTIVE CAPACITY										
TOTAL GROWTH	138	140	119	112	104	127	144	153	96	111
SUSTAINED VOLUME GROWTH	90%	92%	78%	73%	68%	82%	94%	**100%**	63%	73%
TOTAL HARVEST	0.0	5.7	43.5	43.1	80.3	**110.3**	39.7	16.5	25.7	26.9
FAIR SHARE	0%	4%	37%	39%	77%	**87%**	27%	11%	0.3	24%
SUSTAINED STANDING VOLUME	592%	589%	418%	351%	285%	263%	805%	605%	436%	618%
SUSTAINED STANDING QUALITY	70%	75%	**88%**	78%	68%	65%	77%	80%	87%	72%
SUSTAINED HARVESTED QUALITY	NA	0%	50%	0%	0%	66%	0%	26%	64%	16%
FOREST HEALTH										
WIND SAFETY	48%	48%	68%	72%	**87%**	77%	73%	58%	48%	83%
SOCIAL BENEFITS										
FINANCIAL										
GROSS TOTAL REVENUE (THOUSAND $)	$0	$2,542	$18,571	$19,030	$34,983	**$45,738**	$17,135	$7,212	$11,094	$11,599
SOCIAL CONTIRBUTION										
TOTAL EMPLOYMENT (person-yrs)	38	92	686	690	1284	**1764**	635	264	411	431
CARBON SEQUESTRATION (tonnes)										
STANDING	213,220	207,489	117,557	107,395	57,842	40,249	179,277	200,551	116,759	154,372
HARVESTED	0	10,538	72,605	85,898	155,083	**156,637**	77,352	30,520	45,573	51,042
TOTAL	213,220	218,028	190,162	193,181	212,925	196,885	**256,629**	231,171	162,332	205,415
PERCENT OF MAXIMUM	83%	85%	74%	75%	83%	77%	**100%**	90%	63%	80%



Normalized Values

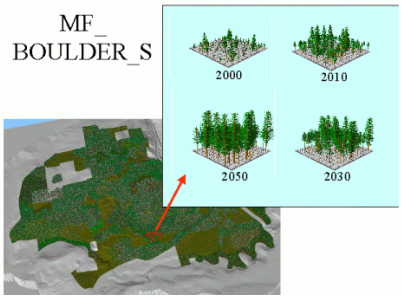
	ALT A	ALT B	ALT C	ALT D	ALT E	ALT F	ALT G	ALT H	ALT I	ALT O
		Existing	Intensive	Mixed	Industrial					
WILDLIFE HABITAT										
COOPER'S HAWK	**10**	**10**	**10**	**10**	**10**	9	9	8	8	**10**
SOUTHERN RED-BACKED VOLE	**10**	**10**	**10**	**10**	9	**10**	**10**	**10**	**10**	**10**
SPOTTED TOWHEE	**10**	**10**	5	9	8	7	8	7	6	**10**
PILEATED WOODPECKER	**10**	**10**	9	8	4	7	**10**	8	**10**	**10**
STRUCTURAL DIVERSITY										
STRUCTURES										
COARSE FILTER (Oliver5C structures)	6	6	6	6	6	6	6	**7**	6	6
LATE SUCCESSIONAL STRUCTURES	9	9	**10**	9	7	8	9	9	9	9
OLD GROWTH STRUCTURES	**10**	**10**	8	**10**	8	8	**10**	9	**10**	9
RESERVES										
TOTAL RESERVES	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**
OLD RESERVES	**10**	**10**	7	**10**	5	5	5	5	**10**	5
PRODUCTIEV CAPACITY										
TOTAL GROWTH	9	9	8	7	7	8	**10**	9	**10**	7
TOTAL HARVEST	NA	1	4	4	7	**10**	1	4	1	2
FAIR SHARE	0	1	4	5	**10**	**10**	1	3	1	3
SUSTAINED STANDING VOLUME	0	1	4	5	**10**	**10**	1	3	1	3
SUSTAINED STANDING QUALITY	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**
SUSTAINED HARVESTED QUALITY	**10**	0	**10**	0	0	**10**	5	0	5	3
FOREST HEALTH										
WIND SAFETY	5	5	7	7	**9**	8	7	7	6	8
SOCIAL BENEFITS										
FINANCIAL										
GROSS TOTAL REVENUE	0	1	4	4	8	**10**	0	4	2	3
SOCIAL CONTRIBUTION										
TOTAL EMPLOYMENT	0	1	4	4	7	**10**	1	4	1	2
CARBON SEQUESTRATION	8	8	7	8	8	8	9	**10**	9	8

The Expected Treatment/Output of each Stand for each Management Cycle is Known

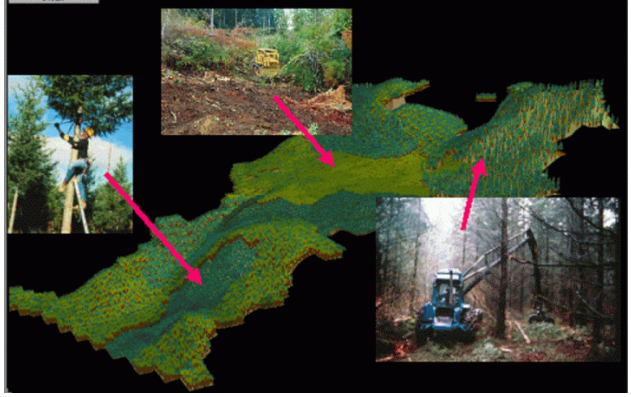
Stand Name	Beginning of 5-Year Management Cycle	Operation	Stand Acres	Oliver5c Structure Classes	CutVolume/Acre, Bd.Ft.Scribner	Dominant Species	Harvested "pole" (under 12 inches DBH) volume for stand, Thousand Bd.Ft.Scribner	Harvested "sawtimber" (12 - 24 inches DBH) volume for stand, Thousand Bd.Ft.Scribner
BR_1300_ROAD	2000	Clearcut, leaving 5 largest Trees/Acre and regenerating 300 Douglas-firs/Acre	15	2_SE	0	DF	0	0
BR_EBETH_RID	2000	Weed control, removing hardwoods	165	1_SI	0	DF	0	0
BR_HIGH_PNT	2000	Weed control, removing hardwoods	30	1_SI	0	DF	0	0
BR_MIDWAY	2000	Weed control, removing hardwoods	20	1_SI	0	MIXED	0	0
BR_NF_CCUT	2000	Weed control, removing hardwoods	19	2_SE	0	DF	0	0
BR_NF_CLUMP	2000	Weed control, removing hardwoods	25	2_SE	0	DF	0	0
BR_NF_DISP	2000	Weed control, removing hardwoods	15	4_SV	0	DF	0	0
BR_SILV_WEST	2000	Thin from below, leaving 40 largest	17	3_UR	21,479	DF	0	368

Expected Treatments & Conditions of Individual Stands Can Be Projected

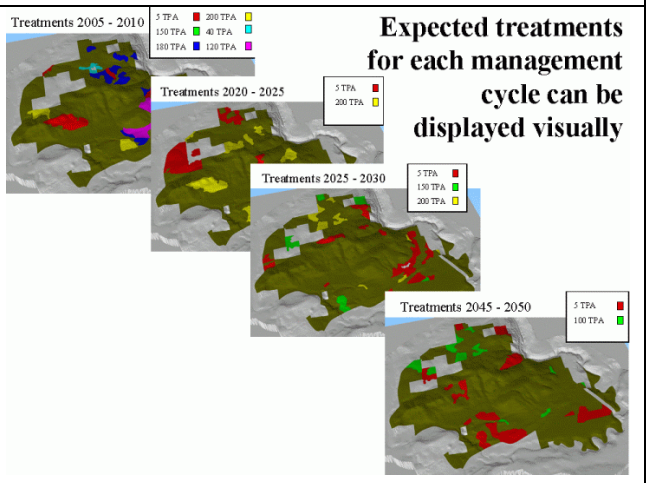
2000 Weed control, removing hardwoods
2005 Thin from below, leaving 180 largest Trees/Acre
2030 Thin from below, leaving 75 largest Trees/Acre



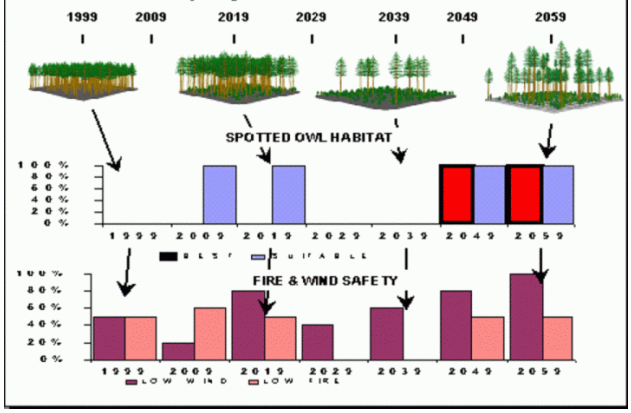
The Manager Knows What Stand-Specific Operation to Do When & Where to Achieve the Objectives



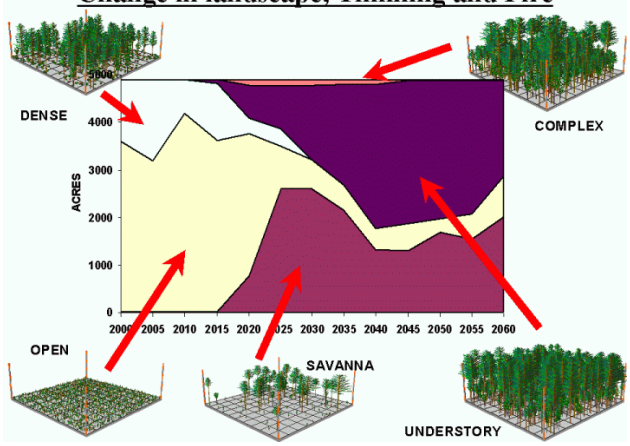
Expected treatments for each management cycle can be displayed visually

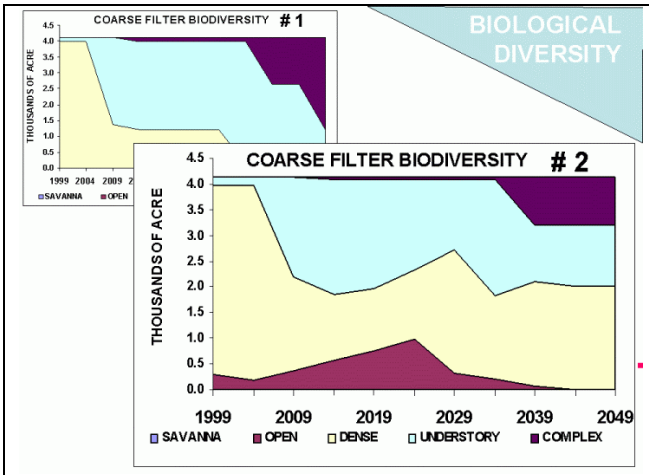


The Changing Structures & Values can be projected over time



Change in landscape, Thinning and Fire





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BR_EBETH_RID	2000	Weed control, removing hardwoods	165	1_SI	0	DF	0	0
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BR_MIDWAY	2000	Weed control, removing hardwoods	20	1_SI	0	MIXED	0	0
BR_NF_CCUT	2000	Weed control, removing hardwoods	19	2_SE	0	DF	0	0
BR_NF_CLUMP	2000	Weed control, removing hardwoods	25	2_SE	0	DF	0	0
BR_NF_DISP	2000	Weed control, removing hardwoods	15	4_SV	0	DF	0	0
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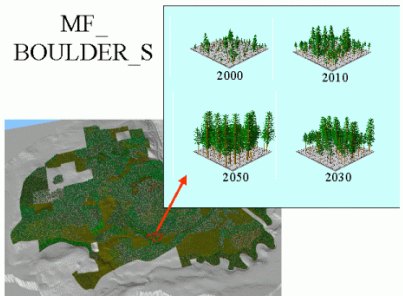
Expected Treatments & Conditions of Individual Stands Can Be Projected

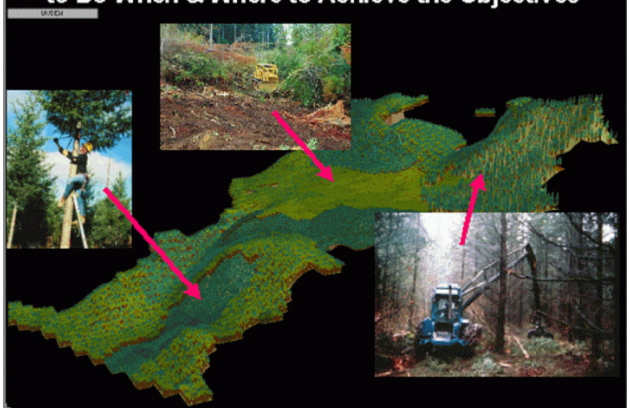
2000 Weed control, removing hardwoods

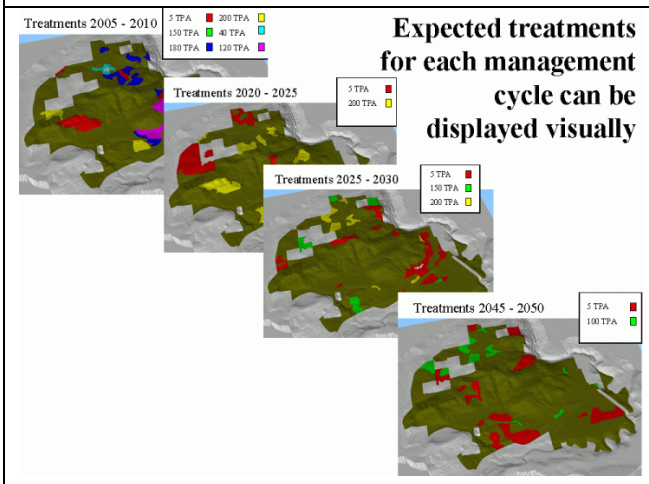
2005 Thin from below, leaving 180 largest Trees/Acre

2030 Thin from below, leaving 75 largest Trees/Acre



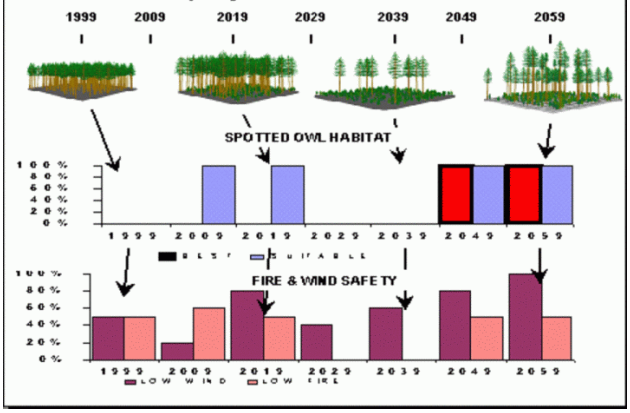
The Manager Knows What Stand-Specific Operation to Do When & Where to Achieve the Objectives

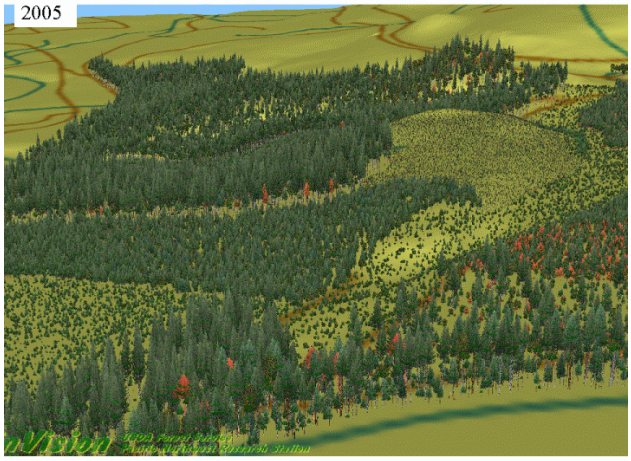


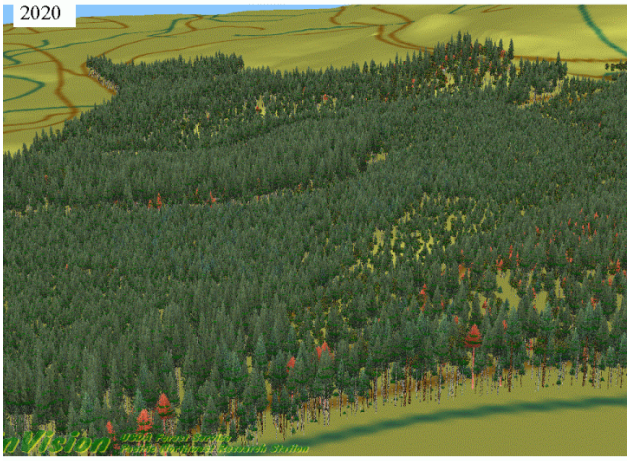


Expected treatments for each management cycle can be displayed visually

The Changing Structures & Values can be projected over time







Tongass National Forest, Sitka, Alaska

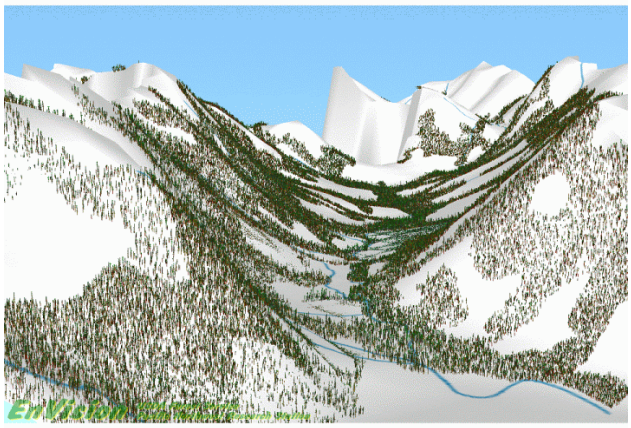
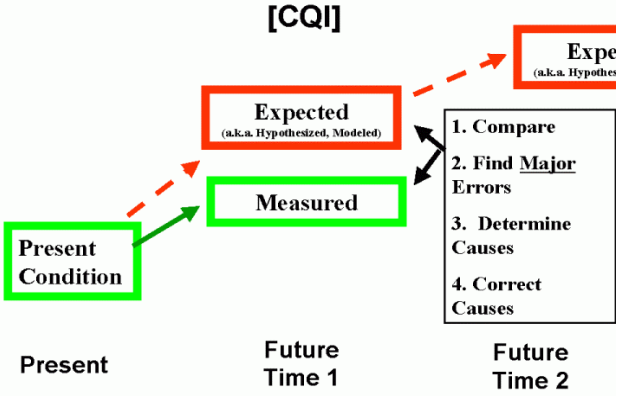


Photo >>

<< Visualization

Statistical Process Control
a.k.a. Continuous Quality Improvement
[CQI]



Proposed Monitoring Process:

Step 1. Stratify stands by how well projection met actual result:

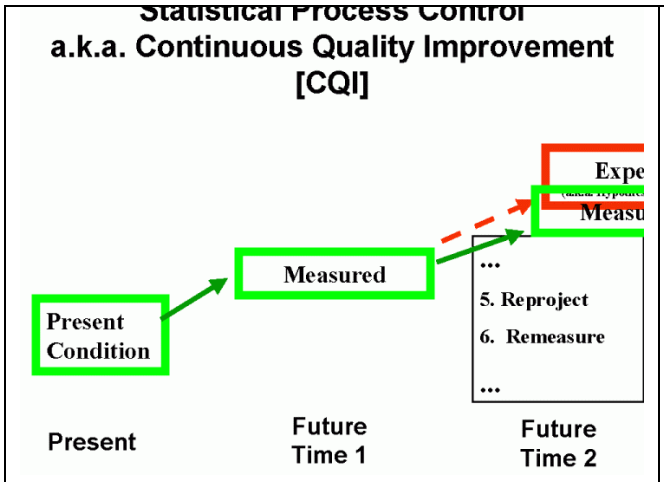
A. Stratify by visualizations

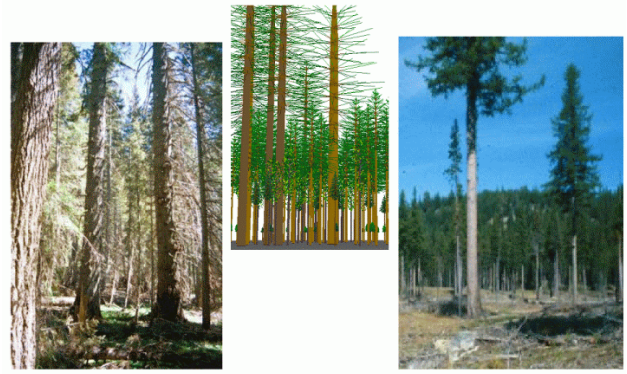
B. Stratify by comparing projected lists

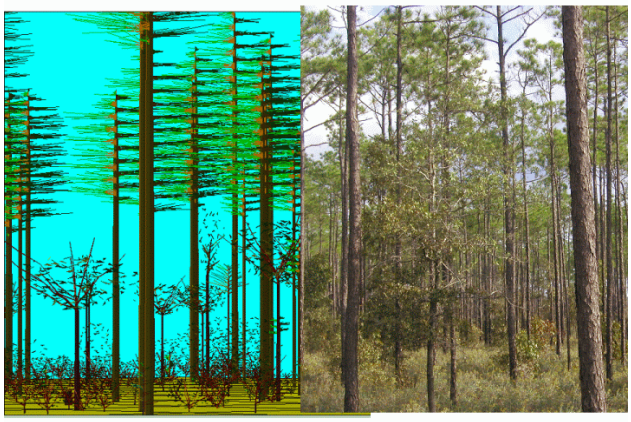
Step 2. Compare 1A with 1B to find consistencies and major errors

Step 3. Do more detailed analyses to determine causes of errors

Step 5. Correct causes of errors, and incorporate into next planning cycle (5- or 10-years)







Models Implemented

- Structure
  - Wildlife Habitat Relationship Structures (Johnson & O'Neil 2001)
  - DNR Spotted Owl Habitats (WAC 222-16-085)
- Presence/Absence (WeyWild, Doug Runde, Weyeco)
  - Guilds: Aquatic salamander & conifer nester
  - Individual species: Beaver, northern goshawk, and hermit warbler
- HSI (Satsop Forest HEP)
  - Pileated woodpecker, southern-red-backed vole, Cooper's hawk, spotted towhee
- Population Response
  - 17 bird species relationships from Hansen, *et al.* (1995)
  - Roosevelt elk (Unpublished model from Ken Raedeke)

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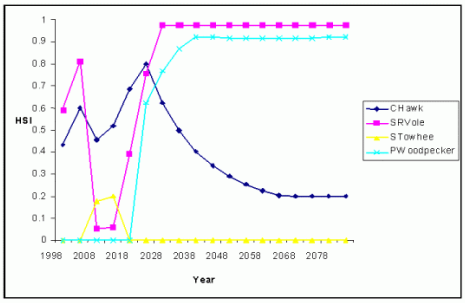
  - Roosevelt elk (Unpublished model from Ken Raedeke)

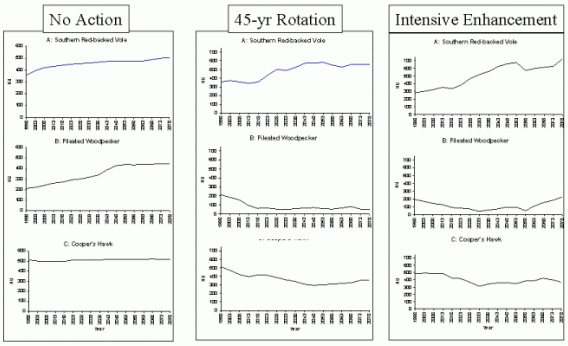
Developing New Wildlife Habitat Models: Family Forest HCP

- 8 species of stream- or pond-associated amphibians:
  - Columbia torrent salamander
  - Cascade torrent salamander
  - Dunn's salamander
  - Van Dyke's salamander
  - Tailed frog
  - Western toad
  - Cascades frog
  - Oregon spotted frog
- Will develop riparian vegetation models for each species using peer-reviewed and "gray" literature

Barbour 15-150 Wildlife Species

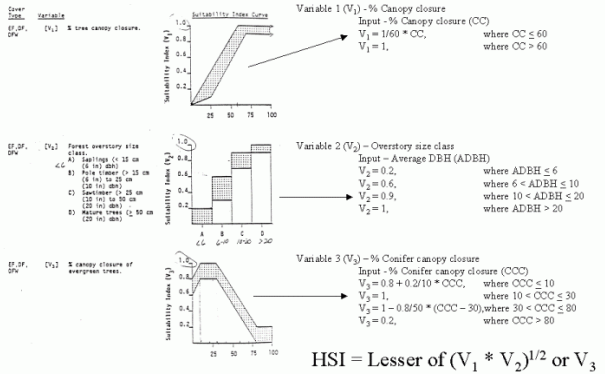


Habitat Quantity Tracked Through Time



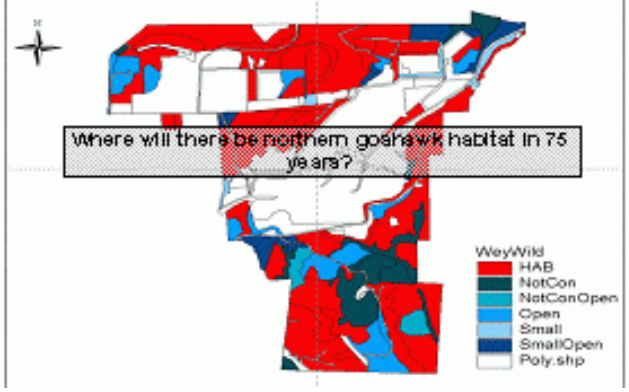
Example 1: Cooper's hawk HSI model

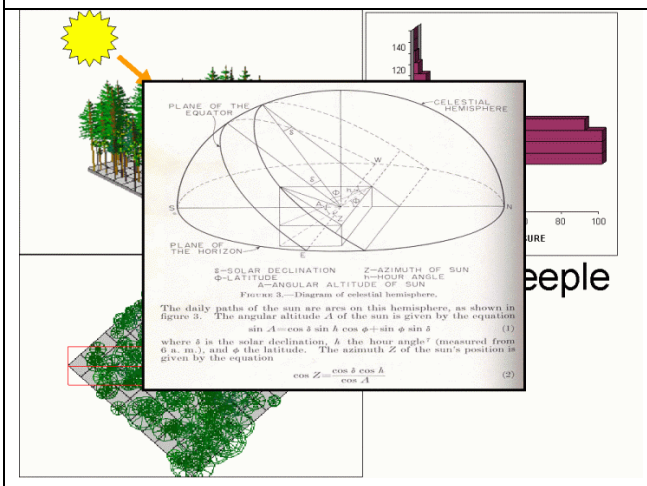
1994 2000



HSI = Lesser of $(V_1 * V_2)^{1/2}$ or V_3

Goshawk Habitat – 2078

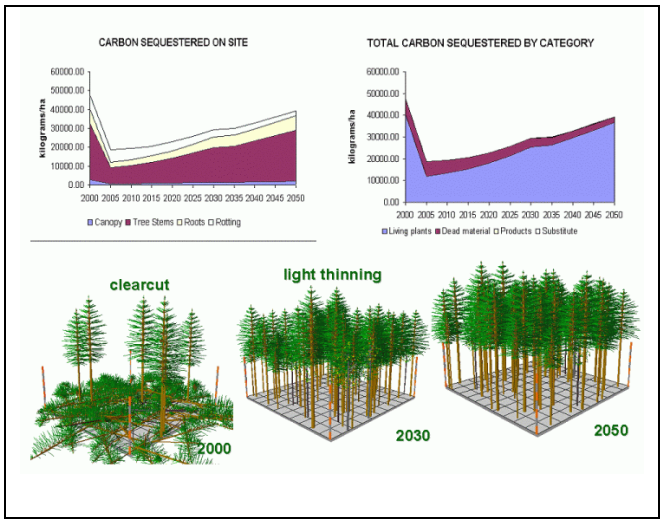




GENERALIZED, GLOBAL VALUES

MONTREAL PROCESS: Criteria for Sustainable Forestry

1. **Biological diversity**
2. **Productive capacity**
3. **Forest health and vitality**
4. **Soil and water conservation**
5. **Global carbon sequestration**
6. **Socio-economic benefits**
7. **Legal, institutional, economic framework**


CARBON SEQUESTERED ON SITE
kilograms/ha
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050
Canopy Tree Stems Roots Rotting
TOTAL CARBON SEQUESTERED BY CATEGORY
kilograms/ha
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050
Living plants Dead material Products Substitute
clearcut
light thinning
2000
2030
2050