Option forestry: an example application to the recovery of late-successional reserves burned in the 200,000-ha Biscuit Fire
Fall 2002

Learning Design

Questions for the management study:

- Can late-successional habitat be restored and protected from high-severity fire by managing in more than one way in the Reserves (not designated as roadless) burned in the Biscuit Fire?

- How fast will various management pathways, and their interactions with natural disturbances, achieve late-succession conditions?

Pathway debate:

- Group 1 --- Need to intensively salvage and regenerate conifers.

- Group 2 --- No need for salvage.

- Group 3 --- Need to re-institute indian burning patterns.

Pathway decisions:

Pathway A. Group-1 like: maximum salvage; no fuels-management zones around the perimeters

Pathway B. Group-2 like: promote natural recovery processes & add 200-ft fuels-management zones

Pathway C. Group-3 like: reestablish landscape-scale, low-intensity fire & 400-ft fuels-management zones

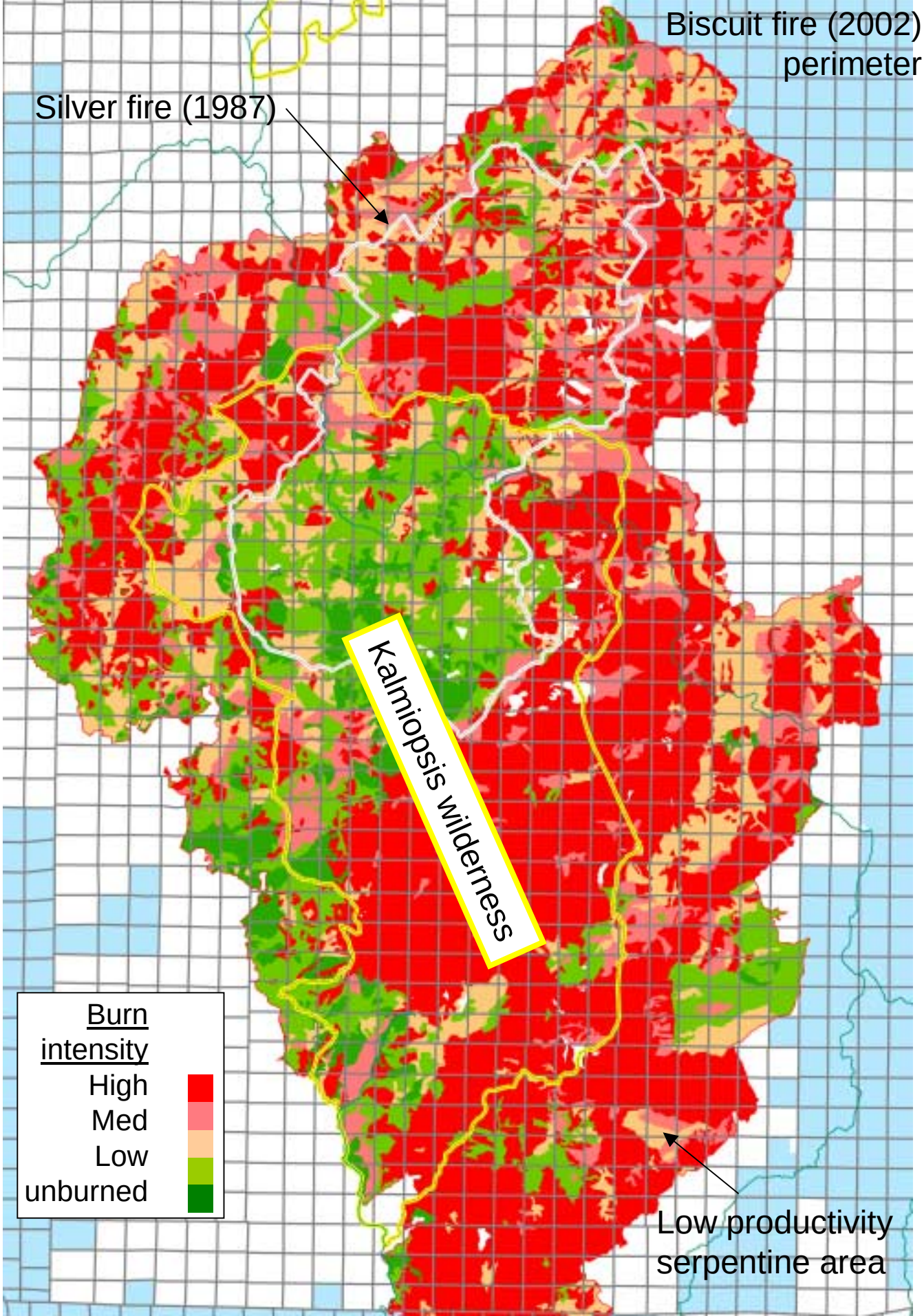
Selecting experimental units

Size of areas applying 1 pathway (experimental unit) were based on:

- **A minimal area for operations**
- **Access logistics (road layout)**
- **Encompassing the patterns of the fire**

Conclusions:

- **Need 3 to 4 townships to have reasonable chance of encompassing full range of fire intensities (3000 to 4000 ha);**
- **Could mainly use watershed boundaries because most roads are on ridgetops;**

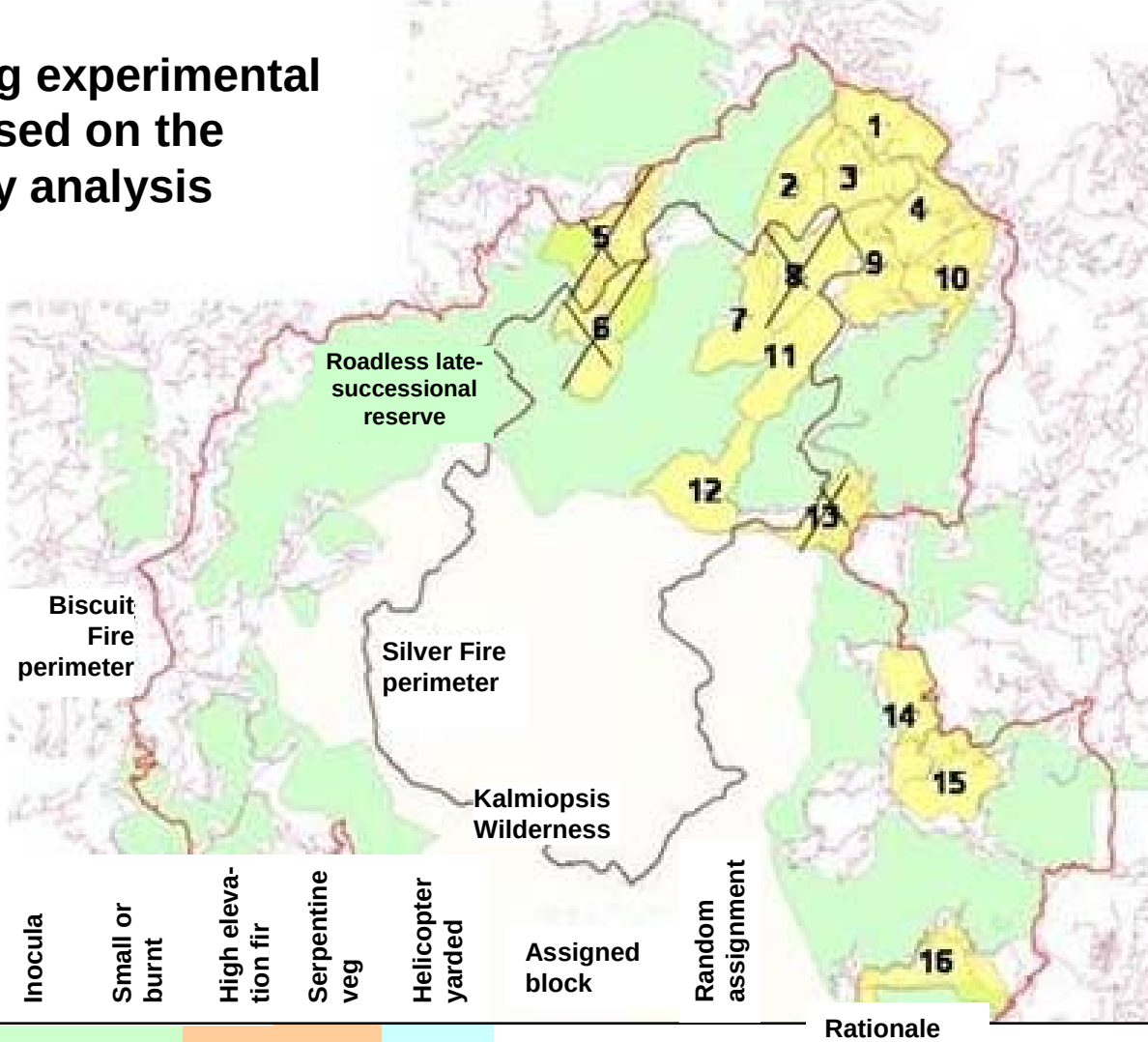

Biscuit fire (2002) perimeter
Silver fire (1987)
Kalmiopsis wilderness
Burn intensity
High
Med
Low
unburned
Low productivity serpentine area

Similarity analysis

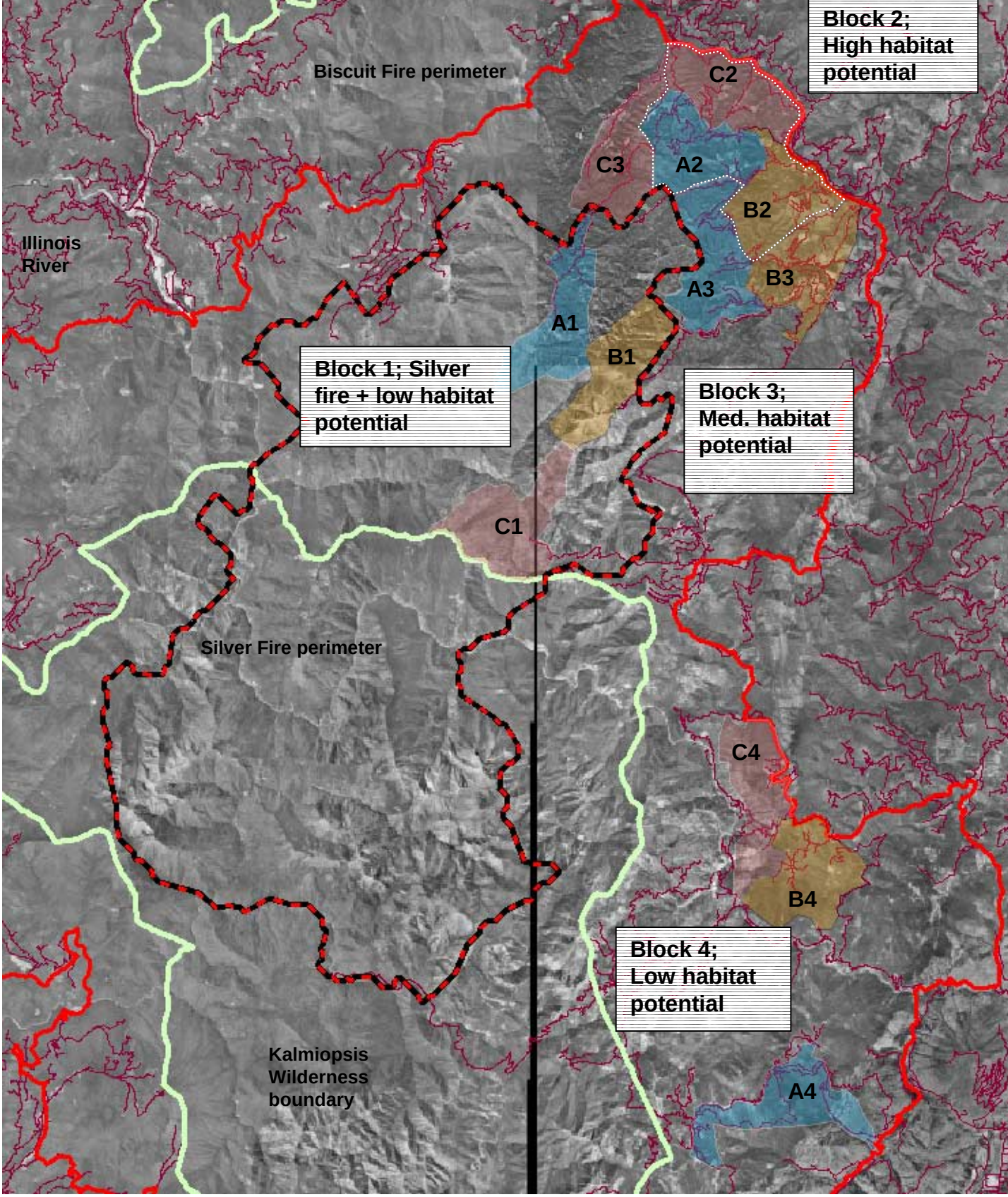
Put similarity variables (in priority order)

- **What is the potential for rapidly achieving late-successional conditions?**
  - **Habitat that survived the fire**
  - **Areas with some remaining habitat elements**
  - **Extensively burned areas or surviving small trees**
- **Will helicopter yarding be needed?**
- **Will matrix-designated areas be included?**
- **What proportion is in serpentine and high-elevation plant associations?**
- **Are the areas managed by the BLM or the Forest Service?**

Grouping experimental units based on the similarity analysis



Number (above)	Living habitat	Inocula	Small or burnt	High elevation fir	Serpentine veg	Helicopter yarded	Assigned block	Random assignment	Rationale
7	8%	14%	78%	0%	0%	54%	Fishhook	A	**Silver Fire; low habitat potential; few roads;** non-matrix; low elevation veg.; non-BLM.
11	8%	21%	71%	0%	0%	82%	Fishhook	B	
12	2%	9%	89%	0%	1%	79%	Fishhook	C	
1	43%	22%	34%	2%	0%	0%	Sourgrass	C	Non-Silver; **highest habitat potential; many roads;** non-matrix; non-serpentine; 1 BLM experimental unit
3	37%	21%	42%	1%	0%	7%	Sourgrass	A	
4	20%	39%	39%	6%	0%	8%	Sourgrass	B	
2	24%	30%	46%	4%	0%	7%	Hobson	C	Non-Silver; moderate habitat potential; many roads; non-matrix; minor high elev. serpentine veg.; 1 BLM experimental unit.
9	9%	19%	71%	2%	5%	10%	Hobson	A	
10	13%	33%	54%	1%	1%	0%	Hobson	B	
14	7%	30%	63%	0%	2%	17%	Briggs	C	Non-Silver; moderate to low habitat potential; many roads; non-matrix; minor serpentine.
15	16%	35%	49%	0%	1%	13%	Briggs	B	
16	13%	29%	57%	3%	2%	3%	Briggs	A	
5	14%	26%	60%	0%	12%	0%	Rejected		Matrix
6	17%	23%	60%	2%	2%	52%	Rejected		Poor fit: in Silver
8	15%	27%	57%	0%	0%	74%	Rejected		Poor fit: in Silver
13	4%	26%	70%	1%	22%	0%	Rejected		Poor fit: low live habitat, matrix



Final experimental layout with 3 treatments randomly assigned within 4 initially similar blocks, with different habitat potential and fire history.

Table 2. Primary variables to compare pathway outcomes

Goal	Primary variables	Units	Approach
Restore habitat in late-successional stands	Conifer stocking	Trees acre-1	Permanent stand-exam plots extrapolated to units with remote sensing (photo interp.)
	Conifer 100-yr growth	Site index, G&Y models	
	Snags and logs	#s & vol. acre-1	Brown transect lines
	Understory diversity	Species cover	Ecology-plot methods
Protect late-successional stands from high-severity fire	Dead fuel amounts and distribution	Volume acre-1 layer-1	Permanent Brown transects extrapolated to units with remote sensing (photo interp.)
	Live fuels amounts and distribution	Biomass acre-1 layer-1 by species	Permanent stand-exam plots extrapolated to units with remote sensing (photo interp.)
	Undesired ignitions controlled	#s	Fire response records
	Wildfire behavior entering units	Acres day-1	Infra-red, satellite, images
Manage land-scapes to approach historical late-succession pattern and extent	Pattern-generating management and natural disturbances	Patterns, patch sizes and distributions	Mapping changes in tree mortality from fire, insects, diseases, wind, landslides, etc..
	Distribution of various late-successional habitat inocula	Acres, distances, frequencies	Spatial statistics
Implement pathways according to study plan	Salvage volumes by closure class, planting, and fuels treatments	Acres, volumes	Standard implementation monitoring

Table 3. Additional interpretive and contextual variables.

Goal	Secondary variables	Units	Approach
Restore habitat in late-successional stands	Fire effects on soil fertility	C, N kg ha-1	LTEP methods on small plots
	Snags effects on regeneration		Permanent stand-exam plots and Brown transects
	Hardwoods: competition and soil effects	Biomass acre-1 C, N kg ha-1	LTEP methods on small plots
Protect late-successional habitat from high-severity fire	Fuel reduction by prescribed burning	Tons ha-1 and distribution	Compare different prescribed-fire approaches in small-scale experiments on timing, fuel conditions, weather, escapes
	Conifer mortality from prescribed fire	Trees acre-1	Permanent stand-exam plots extrapolated to units with remote sensing (photo interp.)
	Hardwoods as fuel ladder or suppressant	Cover ha-1 by species	
Describe historical late-succession pattern and extent	Describe patterns from Government Land Office records for the late 1880s and 1930s photos	Acres of late-successional habitat	Remote sensing and GIS
Provide commercial wood products	Wood volume harvested, jobs, xxxxx	Board feet unit-1	Cruise, harvest, and mill records
Protect firefighters and communities	Changes in fuel distributions and access	Fuel distribution, burnout corridors	Remote sensing and GIS
Restore and plant and animal habitat	Plant biodiversity	Species presence & abundance	Ecology-plot methods
Restore water quality and fish habitat	Erosion from stands	Tons ha-1 x	Small-plot erosion traps
	Sedimentation and landslides	Tons ha-1 x	Permanent cross-stream transects extrapolated to units with remote sensing
Learn	Quality of monitoring and scientist-manager interactions	Options forestry criteria	(Bormann and Kiester 2004)

Monitoring plan (1 of 3)

Focus	1. Commitment of the Siskiyou National Forest[a]	2. Potential Forest commitment, given additional funding
Understanding the Biscuit Fire's behavior and effects	**Make all historical and current data available to researchers and others. This includes georectified post-fire photos, management records, and plot data.**	**Digitize all historical air photos and Government Land Office records and make into GIS layers.**
Restoring habitat—trees and stand structure	**Monitor species, growth trajectory of dominant trees, and stand structure with standard exams. Use permanent plots[c] monitored at years 0, 1, and 3 years after the pathways are established and remote sensing to draw inferences on unit responses.**	**Extend the sampling to years 5 and 10, and every 10 years thereafter; expand the sample size of permanent plots to speed the detection of differences between pathways.**
Restoring habitat—snags and woody debris	**Monitor size and numbers per acre of burned and insect-created snags and logs with standard exams and remote sensing.**	**Monitor effect of shade from snags on planted and natural tree seedlings.**
Restoring habitat—landscape patterns	**Track changes in amount and distribution of "patches," including seral stages, interior habitat, structure, canopy density, and layering from air-photo interpretations (LSRA 1995).**	

[a] Includes the Medford BLM as well.

[b] Includes synthesis of ongoing federally sponsored research on the Forest ecology and inventory plots and the long-term ecosystem productivity experiment, with new analyses of available data.

[c] See text for description of permanent plots.

Monitoring plan (2 of 3)

Focus	1. Commitment of the Siskiyou National Forest[a]	2. Potential Forest commitment, given additional funding
Restoring habitat—plants	Monitor plant biodiversity and exotic weeds on permanent plots and use sampling and remote sensing to infer experimental unit responses.	Expand the sample size to evaluate effects on rare species.
Restoring habitat—animals	Monitor animals directly to meet sale-layout requirements.	Track changes in behavior and reproductive success of known spotted owl pairs, prey bases, and owl predators after major losses of habitat, repeat every 10 yrs.
Restoring LS habitat—soil productivity	Monitor soils directly only to meet sale-layout requirements, and track changes in site index with a database of all previous georeferenced site-index measures.	Monitor erosion and establish a soil-sampling grid (following long-term ecosystem productivity protocols—www.fsl.orst.edu/ltep) on burned and unburned stands with and without brush-control.
Protecting habitat through time—dead fuels	Monitor dead fuels on permanent Brown line transects with traditional size-classes in treated areas.	Monitor dead fuels on permanent Brown line transects with traditional size-classes in untreated areas.
Protecting habitat through time—live fuels	Monitor vertical distribution of live fuels on permanent plots in treated areas and use sampling and remote sensing to infer experimental unit responses.	Monitor vertical distribution of live fuels by species on permanent plots in treated areas.
Protecting habitat through time—risks	Run fire models (fuels, resistance to control, and potential fire behavior) to predict fire risks.	

Monitoring plan (3 of 3)

Focus	Commitment of the Siskiyou National Forest[a]	Forest commitment, pending additional funding
Protecting habitat through time—future fires	Evaluate how future wild and prescribed fires actually behave through different pathways and experimental units.	Study intensity, duration, and containment of prescribed fires in pathway C to modify techniques for subsequent trials.
Forest management costs and benefits	Record costs and benefits associated with management and monitoring.	
Other important effects—aquatic conservation	Monitor riparian habitat and organisms to meet sale-layout requirements.	Monitor landslides and new sediment deposits along streams draining different pathways with satellite images, checked with low-elevation photographs.
Other important effects—landslides	Analyze available aerial photos (every 5 years or less) for large landslides, document them on the ground, and compare them to predicted danger-class and proximity to stand and road management.	
Other important effects—social perceptions	Maintain a database with public comments relating to the experiment.	Build interpretive trails into representative parts of each management pathway (would require changes to the final EIS or a new NEPA document).

[a] Includes the Medford BLM as well.
[b] Includes synthesis of ongoing federally sponsored research on the Forest ecology and inventory plots and the long-term ecosystem productivity experiment, with new analyses of available data.
[c] See text for description of permanent plots.

Table 6. Timeline for Forest commitments (federal agencies cannot budget beyond current year)

Activity	2004	2005	2006	2007	2008	2009	2010
Conduct surveys as required for timber sales	XX						
Layout sales to meet study design	XX						
Publish the hypothesis database on a web page, detailing various assumptions in table 3 and model projections, and invite alternative hypotheses.	XX						
Establish permanent stand exams and transects	XX						
Redo late-successional reserve assessment on units	XX						
Take pre-treatment ground measures	XX						
Take post-treatment measures (10 yr thereafter)		XX		XX			
Monitor activities and costs specific to pathways	XX	XX	XX	XX	XX	XX	XX
Develop and test remote-sensing techniques	XX	XX	XX	XX			
Track all ignitions and fire spread in and near units	XX	XX	XX	XX	XX	XX	XX
Monitor fire intensity in prescribed fires		XX	XX	XX	XX	XX	XX

Table 7. Timeline for other Forest and research commitments—these will only happen with specified additional funding ($ thousands)

Activity	2004	2005	2006	2007	2008	2009	2010
Assemble and georectify key historical data including GLO, post-fire air photos, management records, …..	50	50					
Coordinate retrospective and other research	25	25	25	25	25	25	25
Retrospectively analyze fire behavior across stands with different pre-fire conditions in study area	120	120	120				
Retrospectively analyze pre-fire vegetation and fire intensity effects on soil fertility and sedimentation	120	120	120				
Assess fire effects on spotted owl pairs	???	???					
Publish retrospective study synthesis.		50			50		
Monitor landslides and sediment deposits	30					30	
Establish soil and erosion plots	100						
Monitor soil changes on productivity plots[a]	100						100
Synthesize monitoring data (proximity,…)				50	50	50	50
Evaluate adaptive management (Five Rivers, Biscuit, others) with options forestry criteria.			10				
Small-scale silviculture experiments focused on veg control and snag removal (idealized pathways)[a]	200	50					50
Track neotropical birds and animals	100	100	100				100
Monitor stream reach habitat by pathway							
Build interpretive trails (1 per pathway)		50	50				
Evaluate public reactions				75			
Sum of estimated costs	845	565	565	150	125	105	325

[a] Productivity and silviculture research might be combined