Effect of Input Assumptions on Potential Sustainable Harvest Levels

B. Bruce Bare

College of Forest Resources

University of Washington, Seattle

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Outline

- Definition of key terms
- Input parameters to consider
- Sample sustainable harvest calculations for western Washington

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Definitions

- Sustained yield: Management of the forest to provide harvesting on a continuing basis without major prolonged curtailment or cessation of harvest. (RCW 79.68.030)

Definitions

- Sustainable harvest: The volume of timber scheduled for sale from state-owned lands during a planning decade as calculated by the department of natural resources and approved by the board of natural resources.
- Planning decade: The ten-year period covered in the forest land management plan adopted by the board of natural resources. (RCW 79.68.035)

Definitions

- Even flow: A sustainable harvest wherein the planned sale volume remains constant from one decade to the next over the planning horizon.
- Note: This interpretation of sustained yield is more rigorous than required by the RCW definition but was adopted by the board of natural resources.

Comment

- Usually, an even flow interpretation is more constraining and, hence, more costly to the trusts than a more flexible interpretation permissible under RCW 79.68.030.

Definitions

- Nondeclining even flow: A sustainable harvest wherein the planned sale volume either remains constant or increases from one decade to the next over the planning horizon.
- Used by the U.S. Forest Service and the Bureau of Land Management.

Definitions

- Multiple use: The management and administration of state-owned lands under the jurisdiction of the department of natural resources to provide for several uses simultaneously (on a single tract and/or planned rotation) of one or more uses on and between specific portions of the total ownership (RCW 79.68.020).

Definitions

- Public lands: Lands belonging to, or held in trust by the state, which are not devoted to or reserved for a particular use by law and include --
- State lands:
  - School lands held in trust for the support of the common schools;

Definitions

- University lands held in trust for university purposes;
- Agricultural college lands held in trust for the use and support of agricultural colleges;
- Scientific school lands held in trust for the establishment and maintenance of a scientific school;

Definitions

- Normal school lands held in trust for state normal schools;
- Capitol building lands held in trust for the purpose of erecting public buildings at the state capital for legislative, executive and judicial purposes;
- Institutional lands held in trust for state charitable, educational, penal and reformatory institutions; and

Definitions

  - All public lands of the state, except tidelands, shore lands, harbor areas and the beds of navigable waters.

- Lastly, forest board transfer trust (including forest board purchase lands), and community and technical college forest reserve.

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Key Parameters

- Legal
- Policy
- Managerial
- Technical
- Economic

Legal Parameters

- The board of natural resources shall establish policies to ensure that the management of lands and resources within the Department's jurisdiction are based on sound principles designed to achieve "the maximum effective development and use of such lands" (RCW 43.30.150).

Legal Parameters

- The department of natural resources shall manage the state-owned lands … on a sustained yield basis insofar as compatible with other statutory directives (RCW 79.68.040).

Legal Parameters

- Washington statutes regarding the administration of the federal grant lands also reflect the primary objective of maximizing the economic returns due the benefiting institutions (AGO No. 11, 1996).

Comment

- Case law throughout the West has generally upheld the notion that income generation is a paramount obligation of trustees of Federal grant land.
- Short-term income generation must be balanced against preservation of the trust in the long-term.

Legal Parameters

- Duties of trustee run separately to each trust (AGO No. 11, 1996).
- Consolidation of trusts for management is permissible where it serves the economic interests of each trust (AGO No. 11, 1996).

Observation

- No legal requirement to practice sustainable forestry.

What Is Sustainable Forestry?

- Managing a forest to meet all existing regulations such that environmental, social and economic factors are balanced to meet the needs of the present without compromising the ability of future generations to meet their needs.

What Is Sustainable Forestry?

- A land stewardship ethic that integrates reforestation, growing, and harvesting trees for useful products while conserving soil, air, and water quality, wildlife and fish habitat and aesthetics, and protecting the resource from fire, pests, and diseases.
- Protection of lands of special significance.

What Is Sustainable Forestry?

- Definition conveys notion that sustainability applies to many resources in addition to timber; considers the needs of future generations as well as those of the present; is concerned with ecological functions and conditions; and is as much a social as a bio-physical process.

Legal Parameters

- Legislature directs that a multiple use concept be utilized by the department of natural resources in the management and administration of state-owned lands where such a concept is in the best interests of the state and the general welfare of the citizens thereof, and is consistent with the applicable trust provisions of the various lands involved (RCW 79.68.010).

Legal Parameters

- If multiple uses are not compatible with the financial obligations of management of trust land, they may be permitted only if there is compensation satisfying the financial obligations (RCW 79.68.050).

Key Parameters

- Legal
- Policy
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Policy Parameters

- The Department will manage state forest lands to produce a sustainable even flow harvest of timber subject to economic, environmental and regulatory considerations. (Forest Resource Plan, 1992)

Policy Parameters

- Use even flow volume regulation model (Forest Resource Plan, 1992) .
- Calculate sustainable harvest for each ownership group.
- Use of "off base" acres to meet policy goals.
- Manage all trusts under a consolidated management plan.

Key Parameters

- Legal
- Policy
- Managerial
- Technical
- Economic

Managerial Parameters

- Ownership groups (W Washington):
  - Forest board transfer (16 counties)
  - Federal grant and forest board purchase lands (5 administrative regions)
  - Capitol State Forest
  - OESF
- A total of 23 separate even flow volume harvests in western Washington.

Managerial Parameters

- Ownership groups (E Washington):
  - All State lands (5 administrative regions)
- A total of 5 separate even flow volume harvests in eastern Washington.
- No sustainable harvests determined for any individual trust.

Managerial Parameters

- Off base acres do not contribute to the sustainable harvest. They include lands:
  - too small, isolated, or costly to harvest
  - which can not produce another crop of timber within 80 years
  - of risk to public resources
  - deferred from harvest (owl habitat, old growth, gene pool, and mature natural stands)

Managerial Parameters

- Off base acres do contribute to the generation of habitat and enhance non-timber forest values.

Key Parameters

- Legal
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- Economic

Technical Parameters

- Current timber inventory must be accurately estimated using defined merchantability standards and units.
- Growth and yield estimates for future timber stands must be accurate.
- Must evaluate a wide-range of silvicultural treatments to satisfy habitat requirements as well as meet timber objectives.

Technical Parameters

- Historically, use an age-class model to determine the sustainable harvest.
- Simulation and linear programming models can be used to calculate the sustainable harvest.

Key Parameters

- Legal
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Economic Parameters

- Should utilize an economic model when determining the sustainable harvest.
- Current and future timber prices, costs of management, interest rates, etc. must be selected and tested for sensitivity.
- Rotation ages and all silvicultural alternatives must pass an economic test prior to use in the sustainable harvest calculation.

Economic Parameters

- Interest rate (real): 5%/year
- Timber price increase (real): 1%/year
- Cost increase (real): 1%/year
- Initial costs: a) reforestation ($250/ac); b) pre-commercial thin ($100/ac); c) annual administration ($5/ac).

Economic Parameters

- Objective of analysis: maximize net present value subject to a variety of constraints.

Outline

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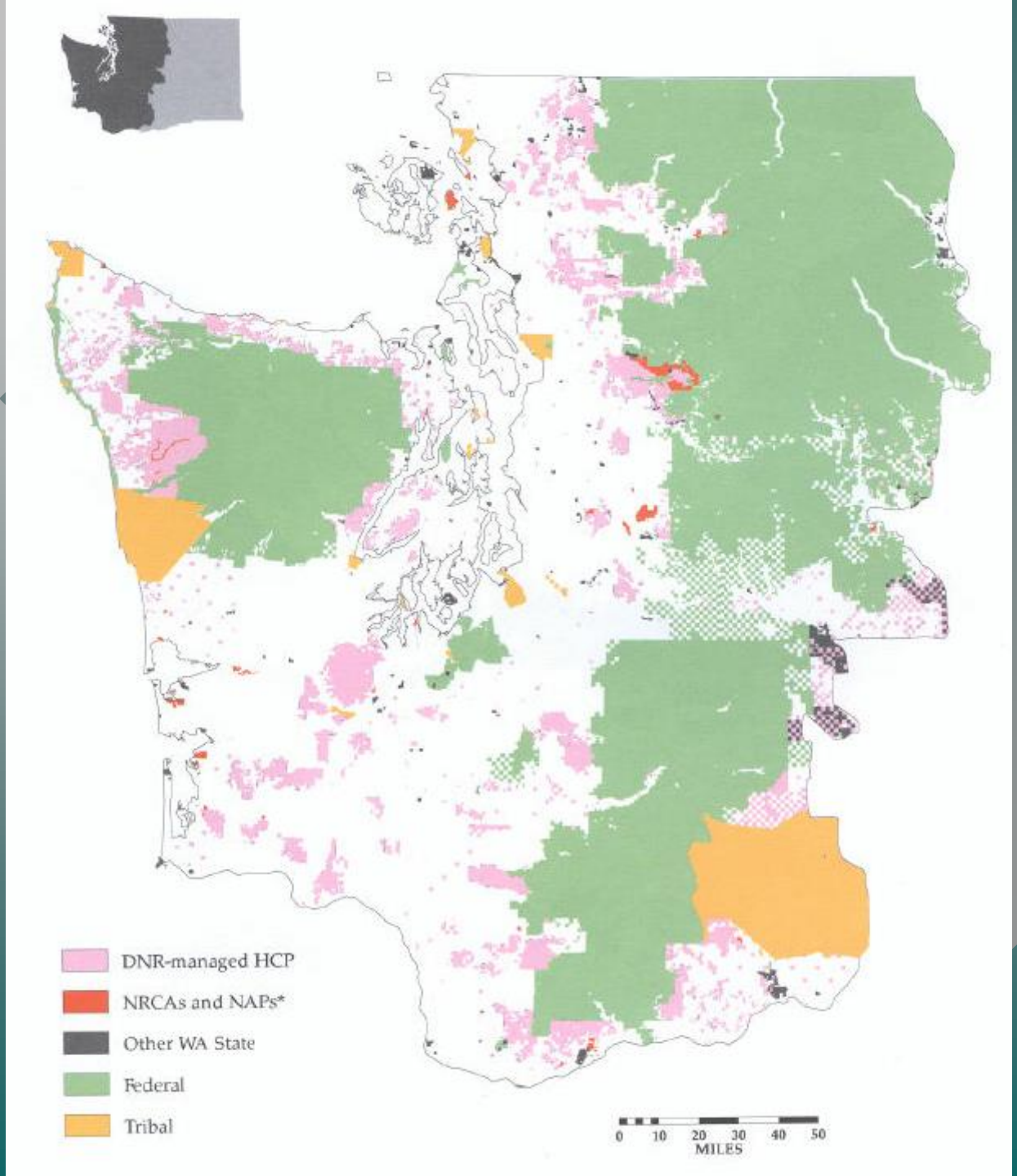
Input Assumptions

- Western Washington DNR forest land base map.
- Six planning areas consisting of between 113,000 - 381,400 acres.
- Multiple trusts are consolidated for management purposes.


DNR-managed HCP
NRCAs and NAPs*
Other WA State
Federal
Tribal
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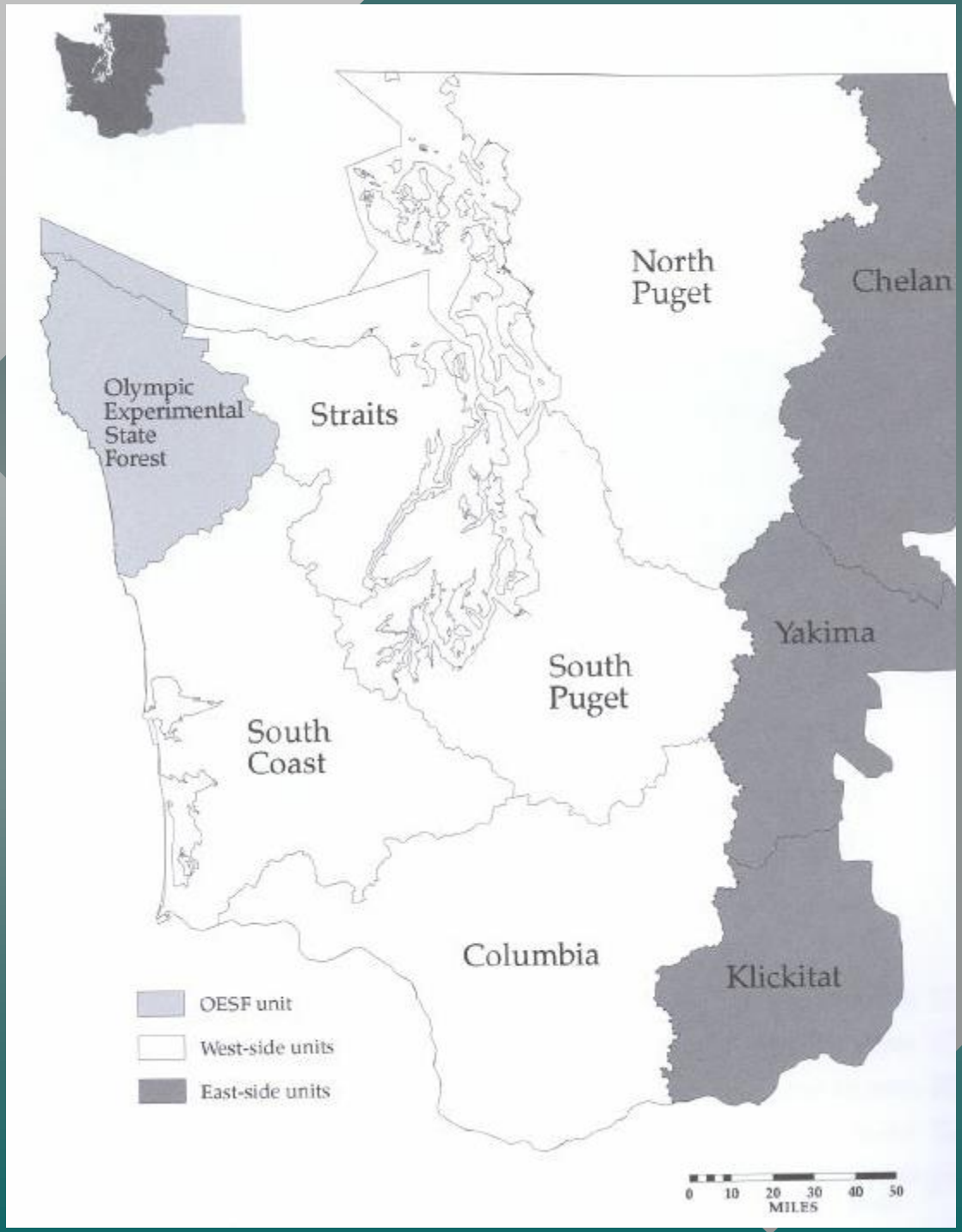
MILES


North Puget
Chelan
Olympic Experimental State Forest
Straits
Yakima
South Puget
South Coast
Columbia
Klickitat
OESF unit
West-side units
East-side units
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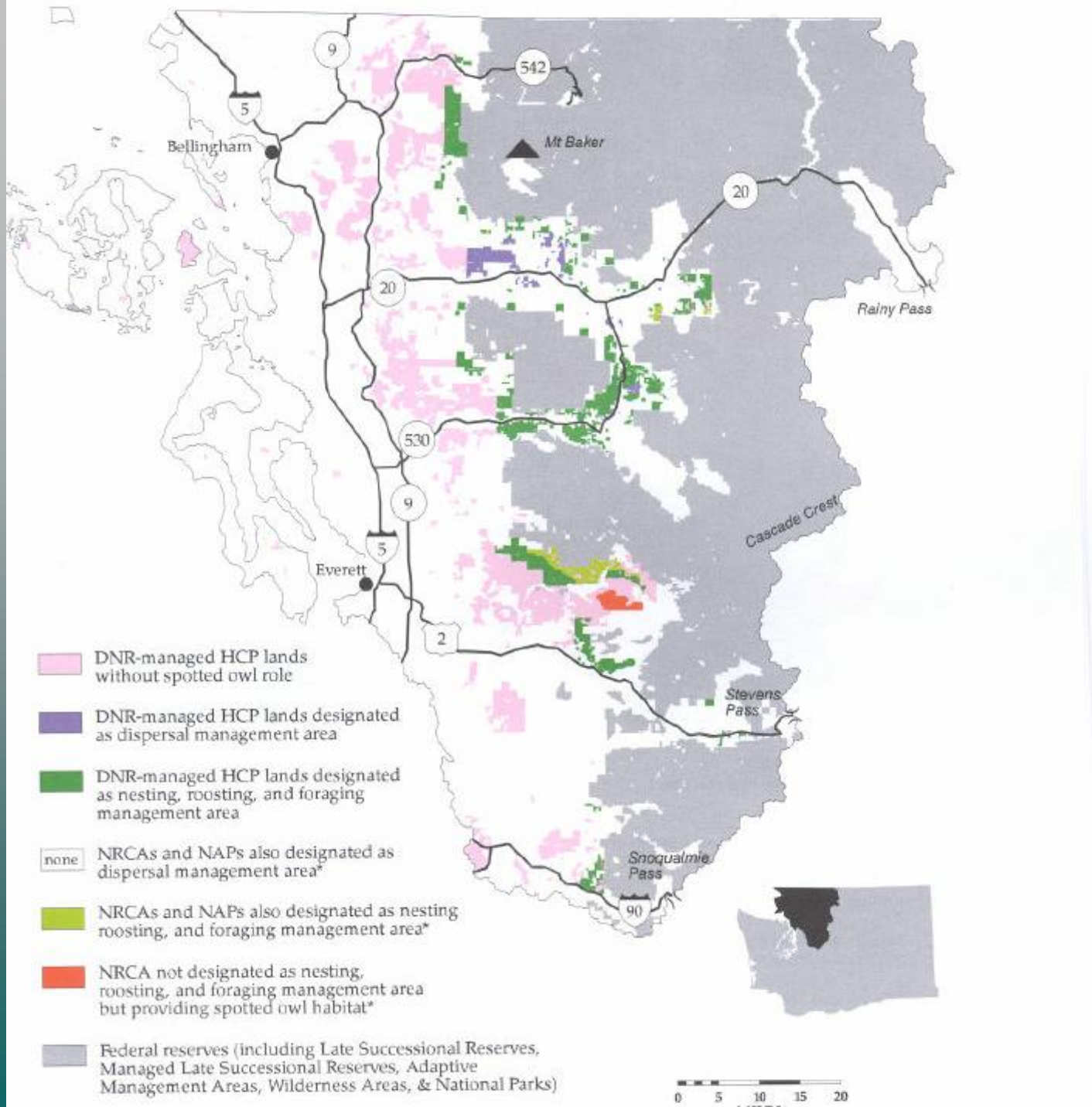
MILES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NRCAs and NAPs also designated as dispersal management area*
NRCAs and NAPs also designated as nesting roosting, and foraging management area*
NRCA not designated as nesting, roosting, and foraging management area but providing spotted owl habitat*
Federal reserves (including Late Successional Reserves, Managed Late Successional Reserves, Adaptive Management Areas, Wilderness Areas, & National Parks)
0 5 10 15 20

Planning Scenarios

- DNR: Simulation of the 1997 DNR HCP.
- ALTS: An alternative model.

Planning Scenarios

- Two scenarios differ by:
  - acres treated as off base and unavailable for timber production
  - range of possible silvicultural alternatives
  - minimum permissible rotation age
  - harvest (sale) volume flow constraints

Planning Scenarios

- DNR: Uses 60+ year rotations; on/off base acre allocations as shown; no wildlife thins; no partial cuts in the 60-70 year old age classes; even flow harvest volume constraints; no harvests in riparian or wetland areas; nondeclining late seral conditions.

Planning Scenarios

- ALTS: Uses 50+ year rotations; on/off base acre allocations as shown; wildlife thins; partial cuts in the 60-70 year old age classes; ± 25% change in harvest from one decade to the next; partial harvests in riparian or wetland areas if on-base; nondeclining late seral conditions.

Planning Area	Riparian On Base	Wetland On Base	Riparian Off Base	Wetland Off Base	Unstable Off Base
No. Puget	17,429	3,800	7,160	1,295	40,769
So. Puget	7,319	3,489	1,720	333	12,370
Columbia	17,391	2,542	6,968	509	30,078
Straits	4,886	1,631	1,502	366	9,952
So. Coast	16,822	2,229	2,809	505	15,518
OESF	67,771	3,080	28,363	905	33,688
Total All West-Side	131,618	16,771	48,522	3,913	142,375
% West-side Ac	9%	1%	3%	0.3%	10%

Planning Area	NEST Off	NRF On	NRF Off	DSP On	DSP Off
No. Puget	13,192	67,072	27,475	19,594	2,658
So. Puget	644	1,667	332	56,675	9,927
Columbia	6,370	35,583	11,048	20,067	6,968
Straits	No Owl Habitat Designated				
So. Coast	No Owl Habitat Designated				
OESF	No Owl Habitat Designated				
Total All West-Side	20,206	104,322	38,855	96,336	19,553
% West-side Ac	1%	7%	3%	7%	1%

Planning Area	Murrelet Off Base	Total Acres
No. Puget	2,761	381,403
So. Puget	493	141,815
Columbia	806	283,021
Straits	92	113,143
So. Coast	1,009	240,835
OESF	15,148	265,877
Total All West-Side	20,309	1,426,094
% West-side Acres	1%	

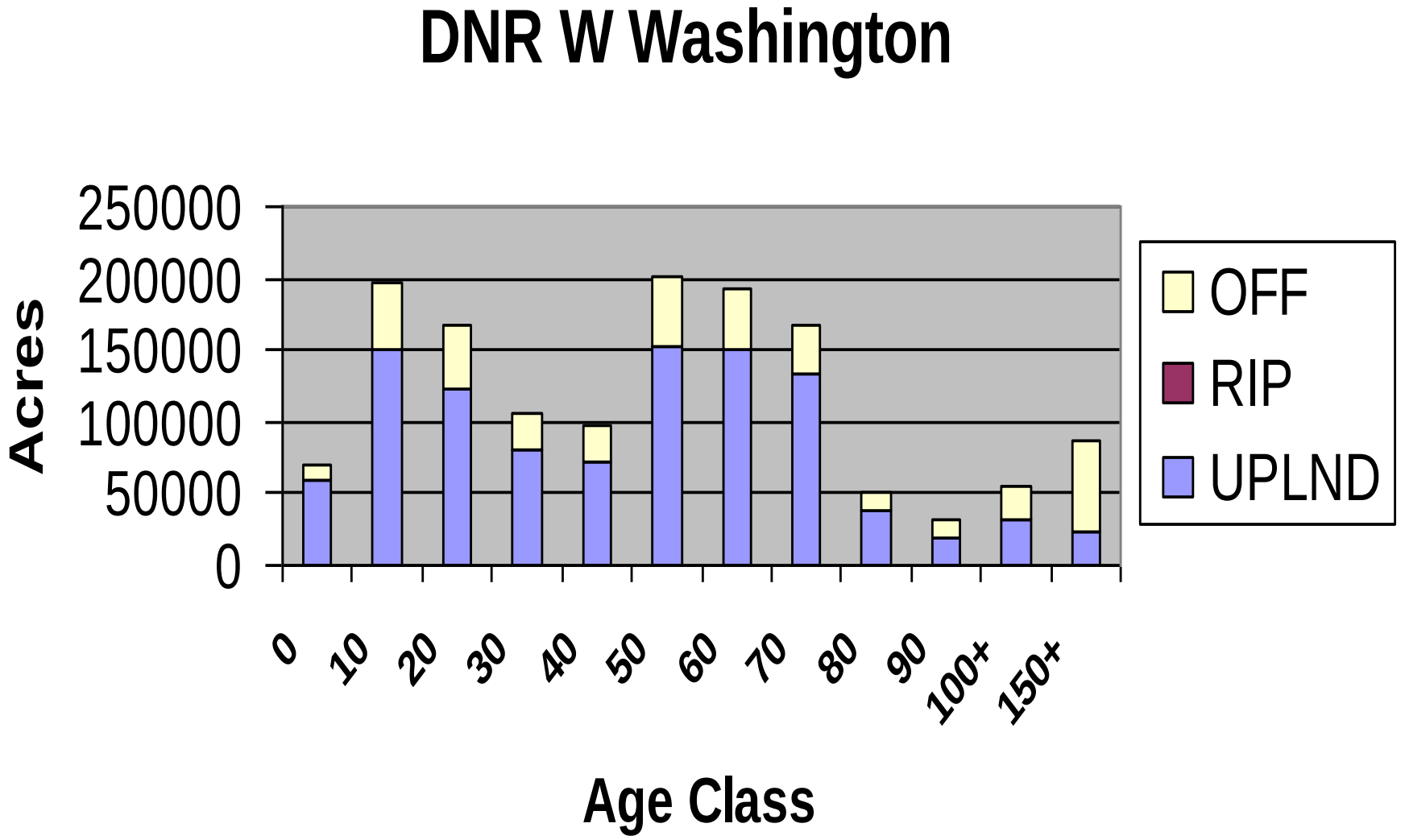
W Washington Acreage Summary

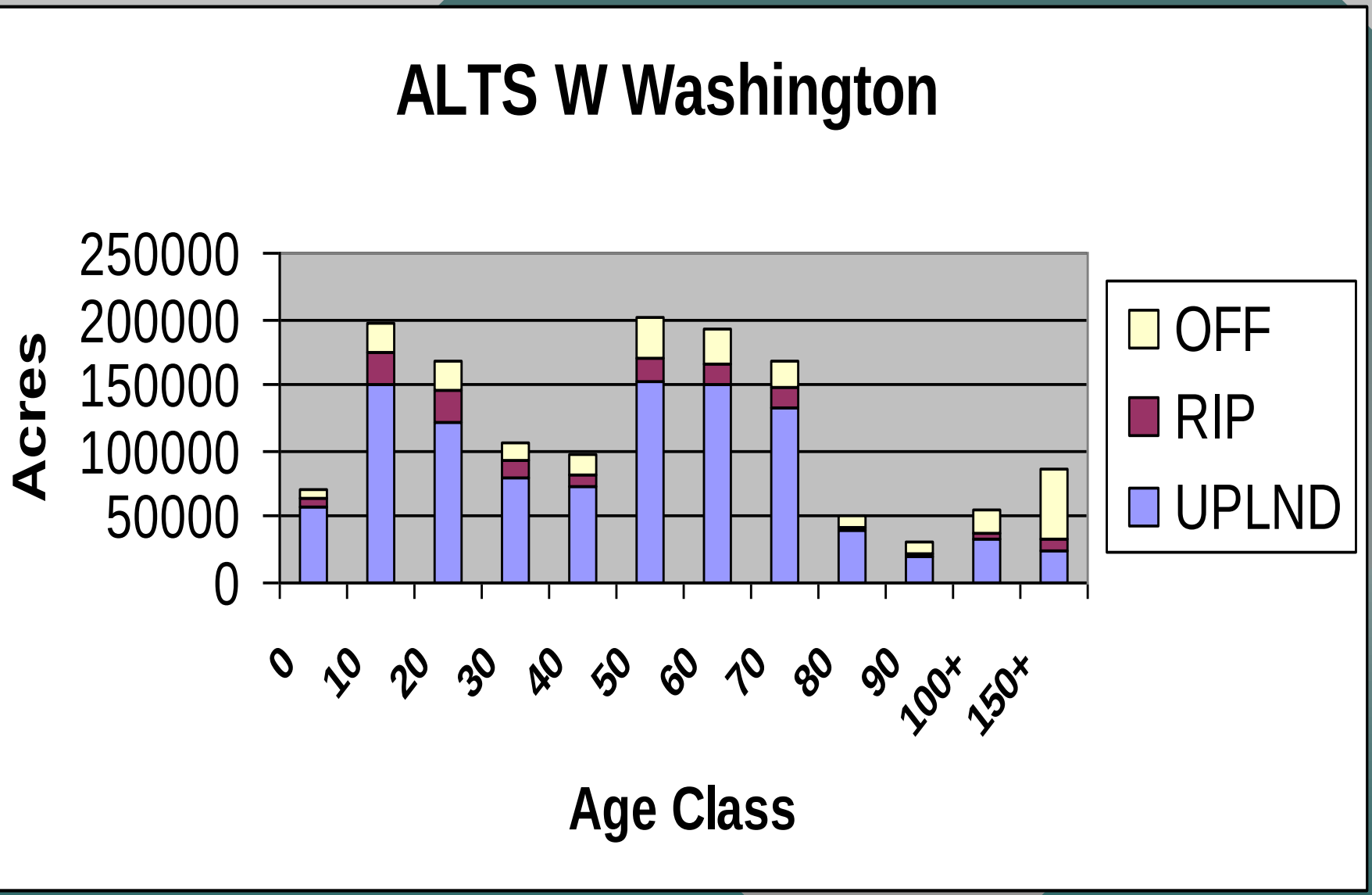
	ALTS	DNR
	Acres	Acres
On Base	1,178,154	1,035,586
Off Base	247,937	390,508
Total	1,426,091	1,426,094

Models

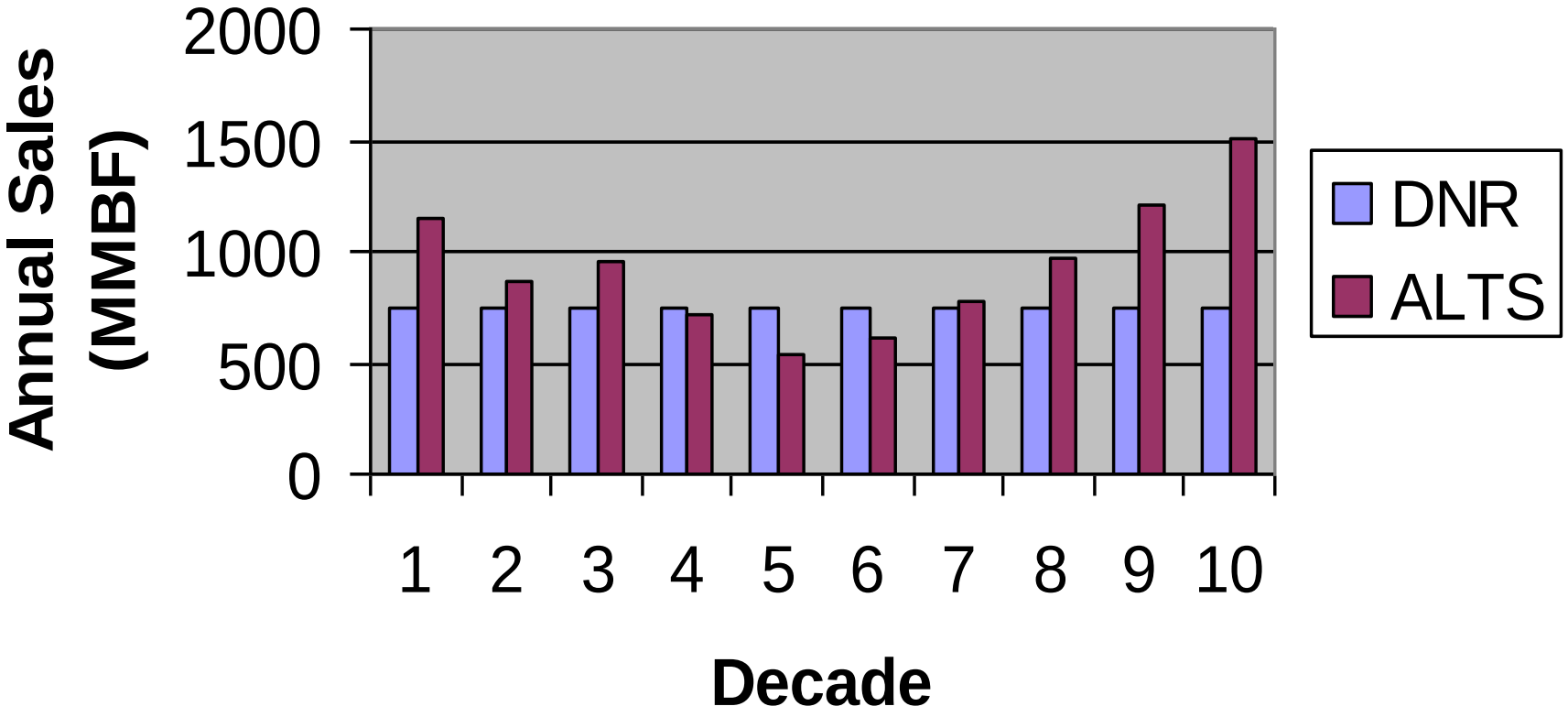
- In following results, a simulator estimates the consequences of a defined series of silvicultural alternatives over the 100 year planning horizon.
- A linear programming model is used to optimize an objective (usually net present value) subject to a set of constraints.

	Asset Values ($ Billion)			
	DNR	ALTS	% Difference	
W Washington	7.505	9.799	31%	ACRES
North Puget	1.945	2.487	28%	381,403
South Puget	0.85	1.091	28%	141,815
Columbia	1.581	1.976	25%	283,021
Straits	0.715	1.034	45%	113,143
OESF	0.781	1.379	77%	240,835
South Coast	1.416	1.746	23%	265,877
Six Unit Total	7.288	9.713	33%	1,426,094
% Difference	3%	1%		

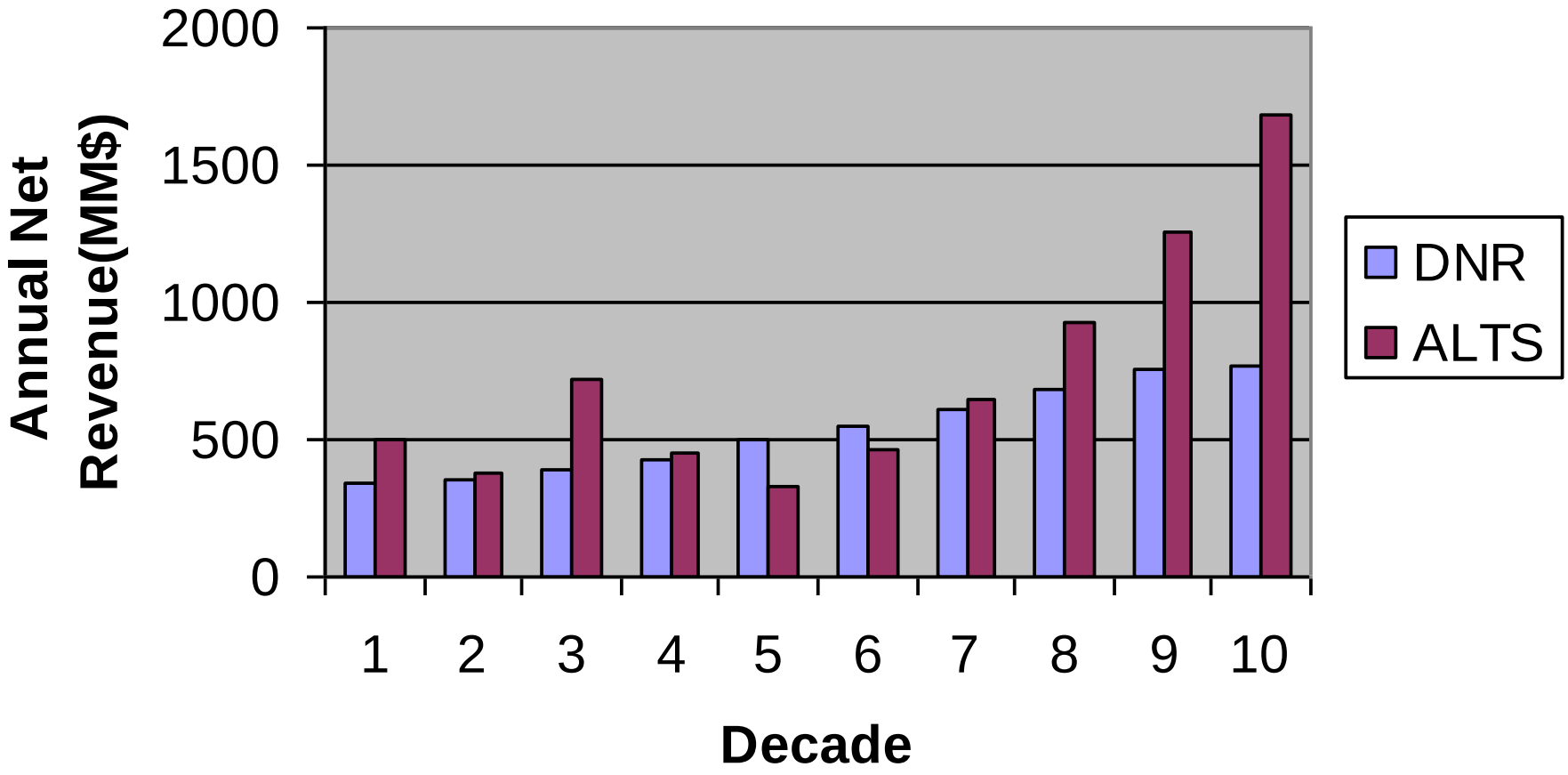

DNR W Washington
Acres
250000
200000
150000
100000
50000
0
0
10
20
30
40
50
60
70
80
90
100+
150+
Age Class
OFF
RIP
UPLND


ALTS W Washington
Acres
250000
200000
150000
100000
50000
0
0
10
20
30
40
50
60
70
80
90
100+
150+
Age Class
OFF
RIP
UPLND

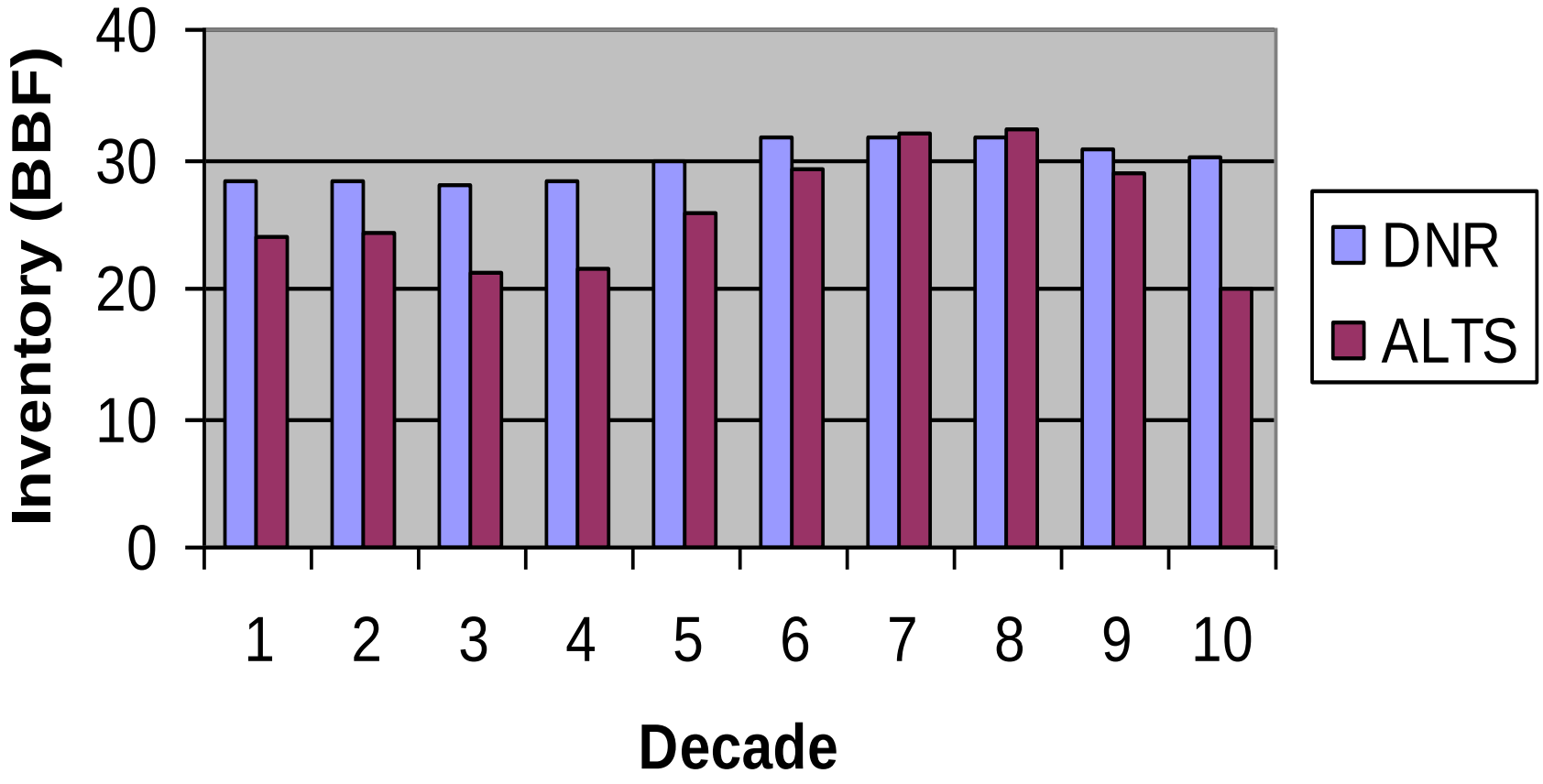
W Washington Timber Sales (DNR$7.5;ALTS$9.8)



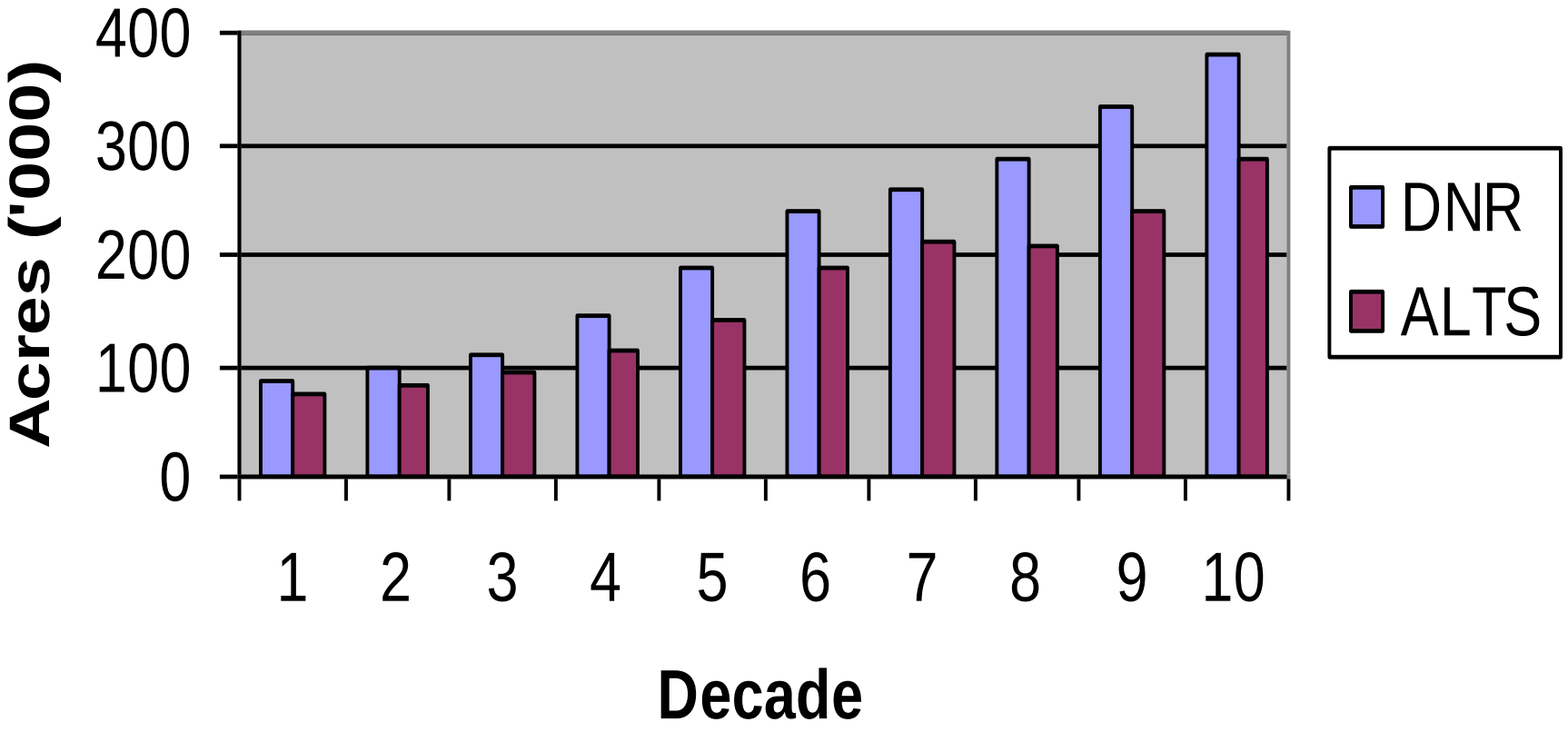
W Washington Net Revenue

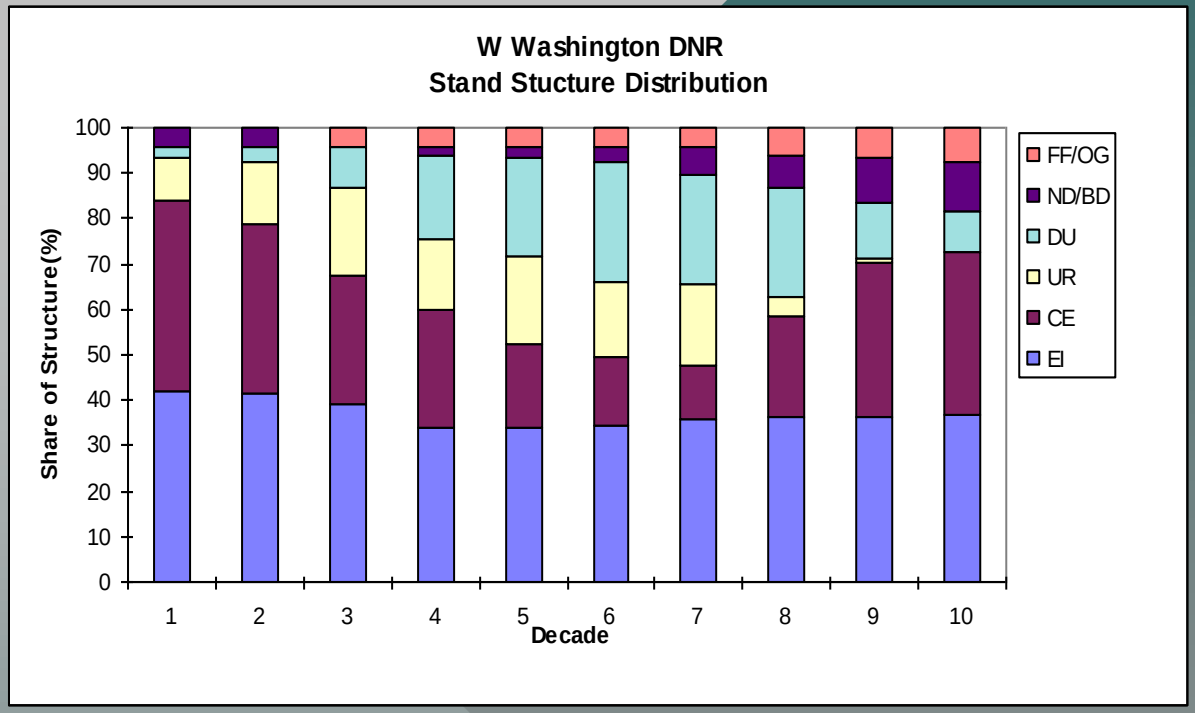


W Washington Inventory



W Washington Old Forest Habitat




W Washington DNR
Stand Stucture Distribution
Share of Structure(%)
100
90
80
70
60
50
40
30
20
10
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Decade
FF/OG
ND/BD
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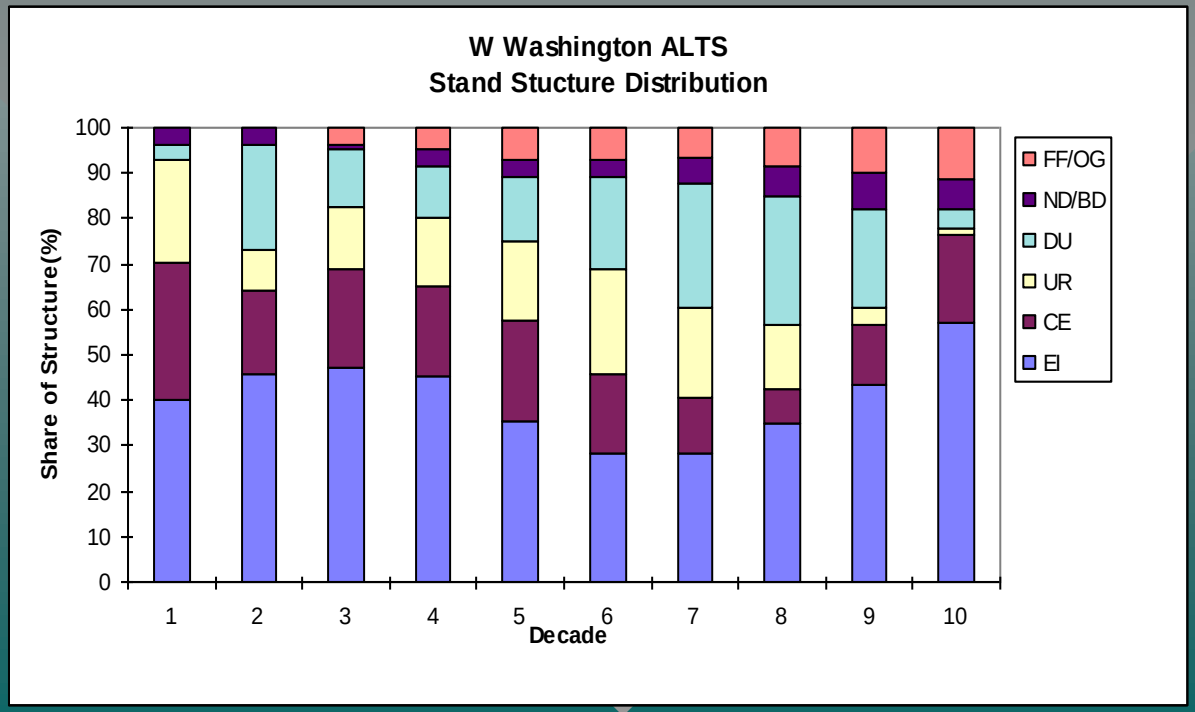
W Washington ALTS
Stand Stucture Distribution
Share of Structure(%)
100
90
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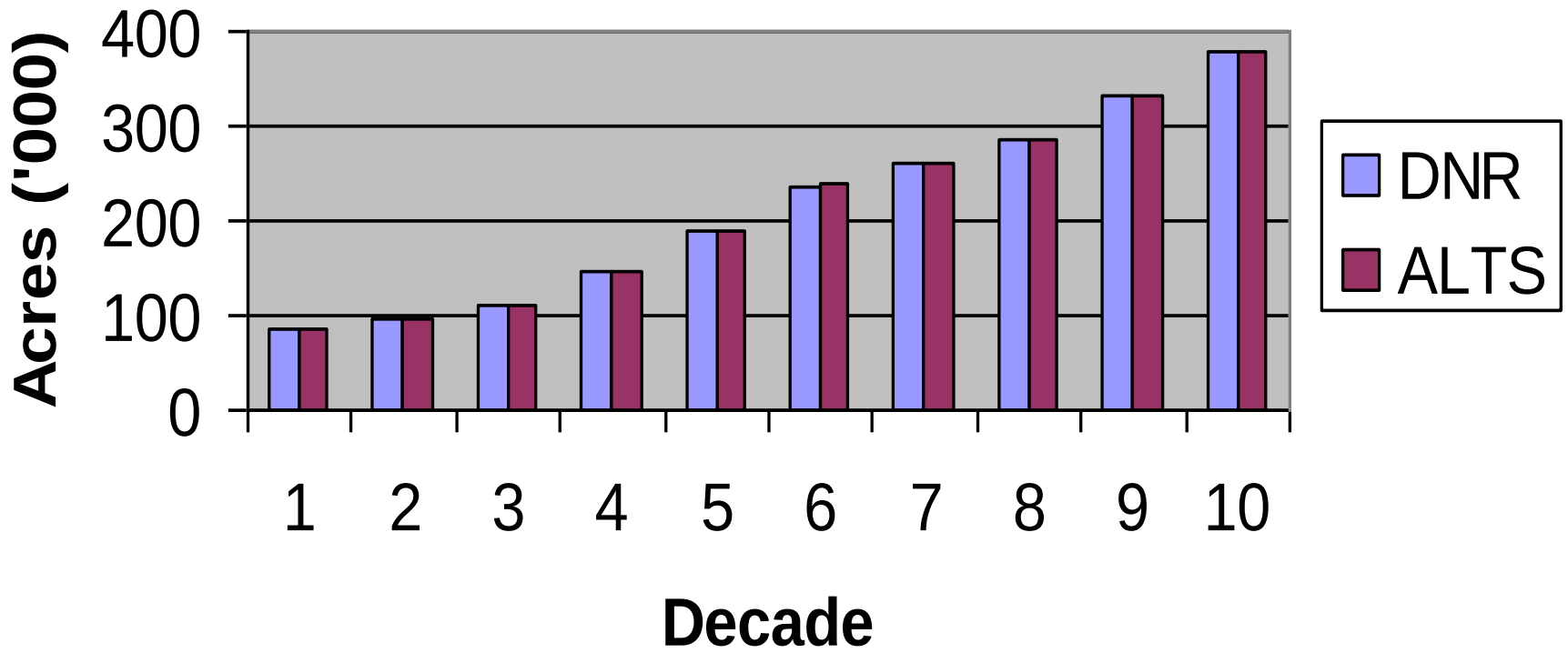
Modified ALTS

- Add a constraint to force ALTS to produce same old forest acreage as DNR simulation in western Washington.

W Washington Old Forest Habitat (Modified ALTS)



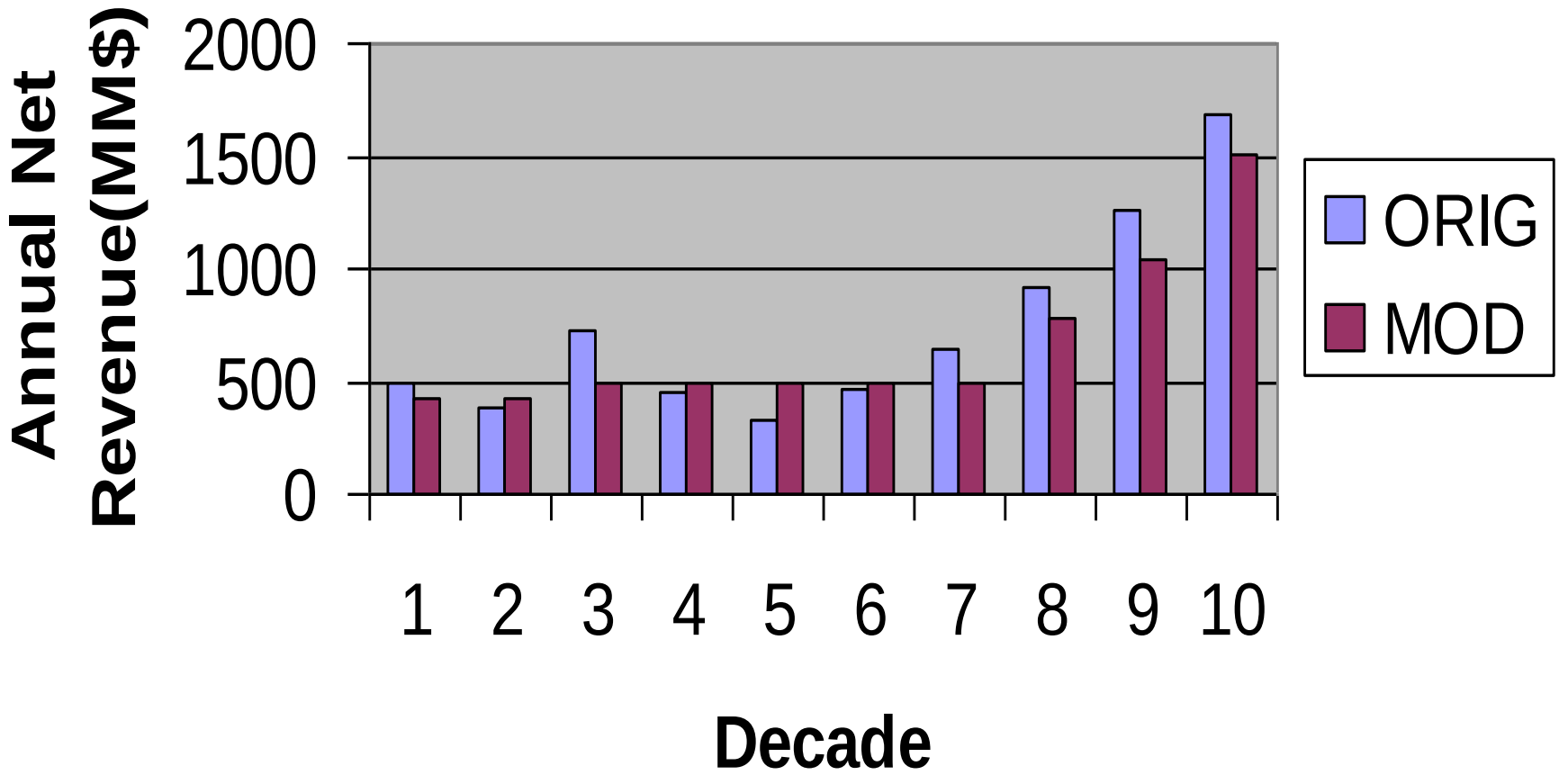
Modified ALTS

- NPV = $9.137 (billion) modified ALTS vs. original ALTS NPV of $9.799 (billion).
- Proportion of W Washington landscape in late seral structures increases to 23% in 10th decade from original ALTS (and DNR) of 18%. (Note: Presently this is 4%.) [Late seral = ND/BD + FF/OG.]

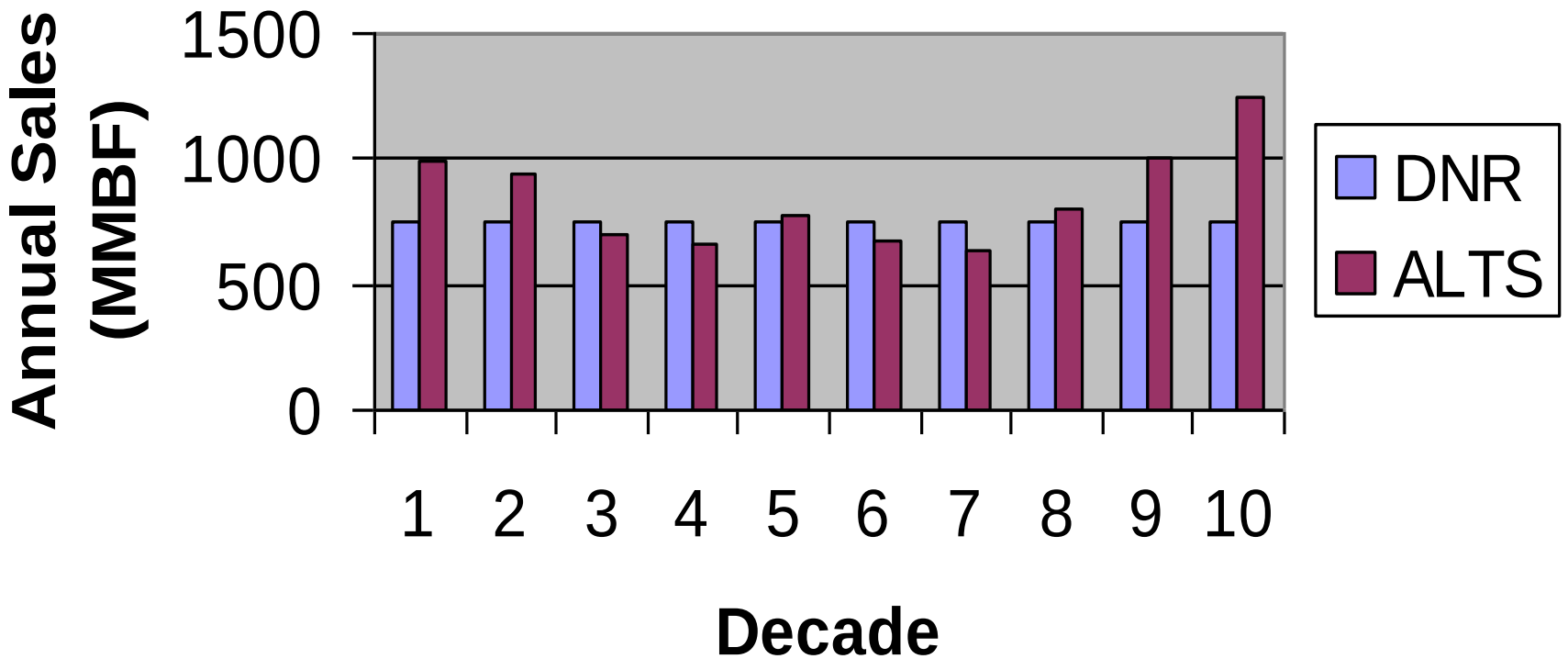
Modified ALTS

- Modified ALTS meets the old forest condition but decadal net revenues still fluctuate up and down.
- ALTS further modified to impose a NDF constraint on decadal net revenue.
- NPV = $8.977 (billion); harvest volume flow "smoother" over time.

ALTS W Washington Net Revenue



W Washington Timber Sales (Modified ALTS)



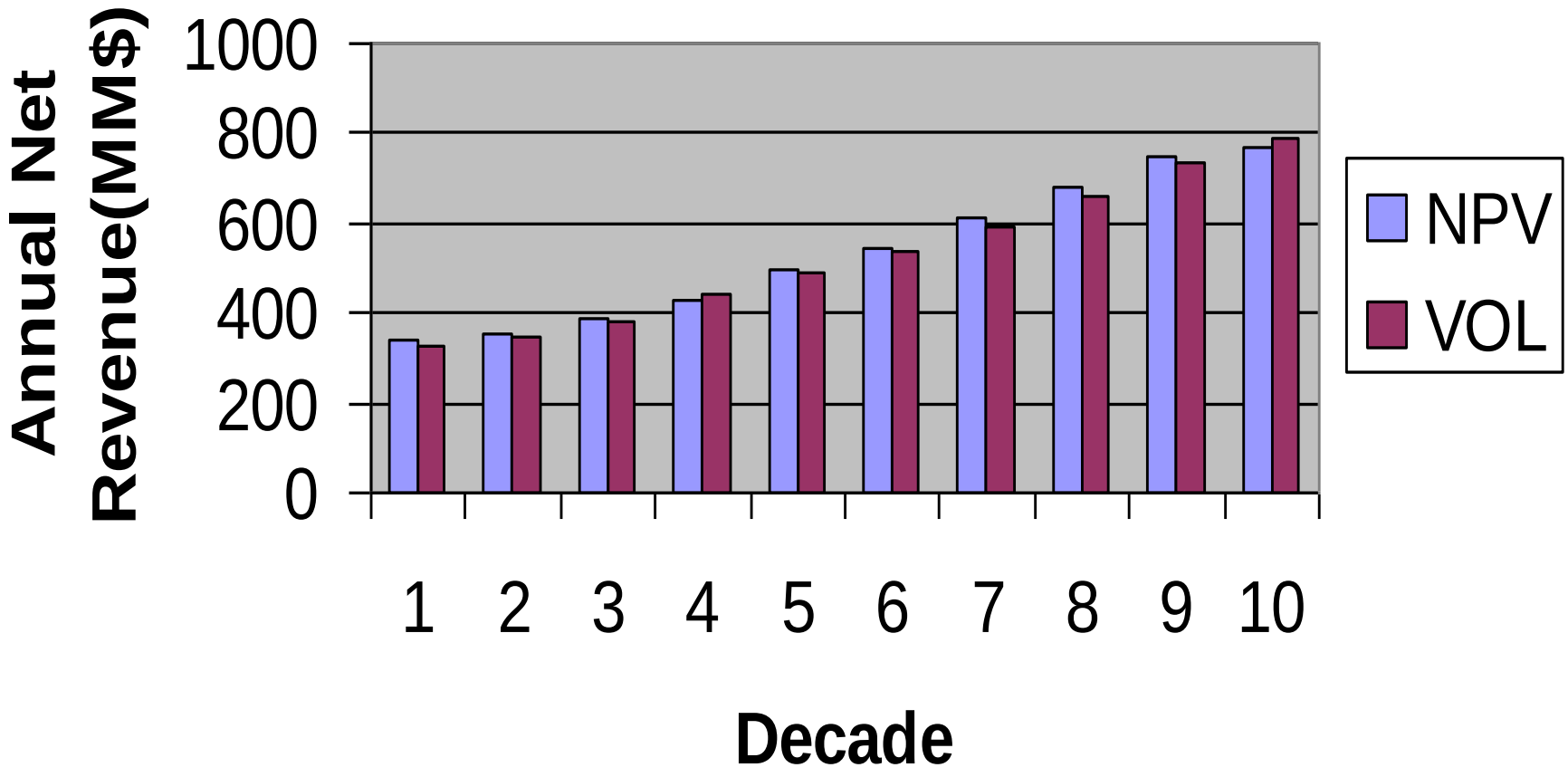
Modified DNR

- Change objective to volume maximization.
- Maximize first decade sale volume subject to same constraints as before.

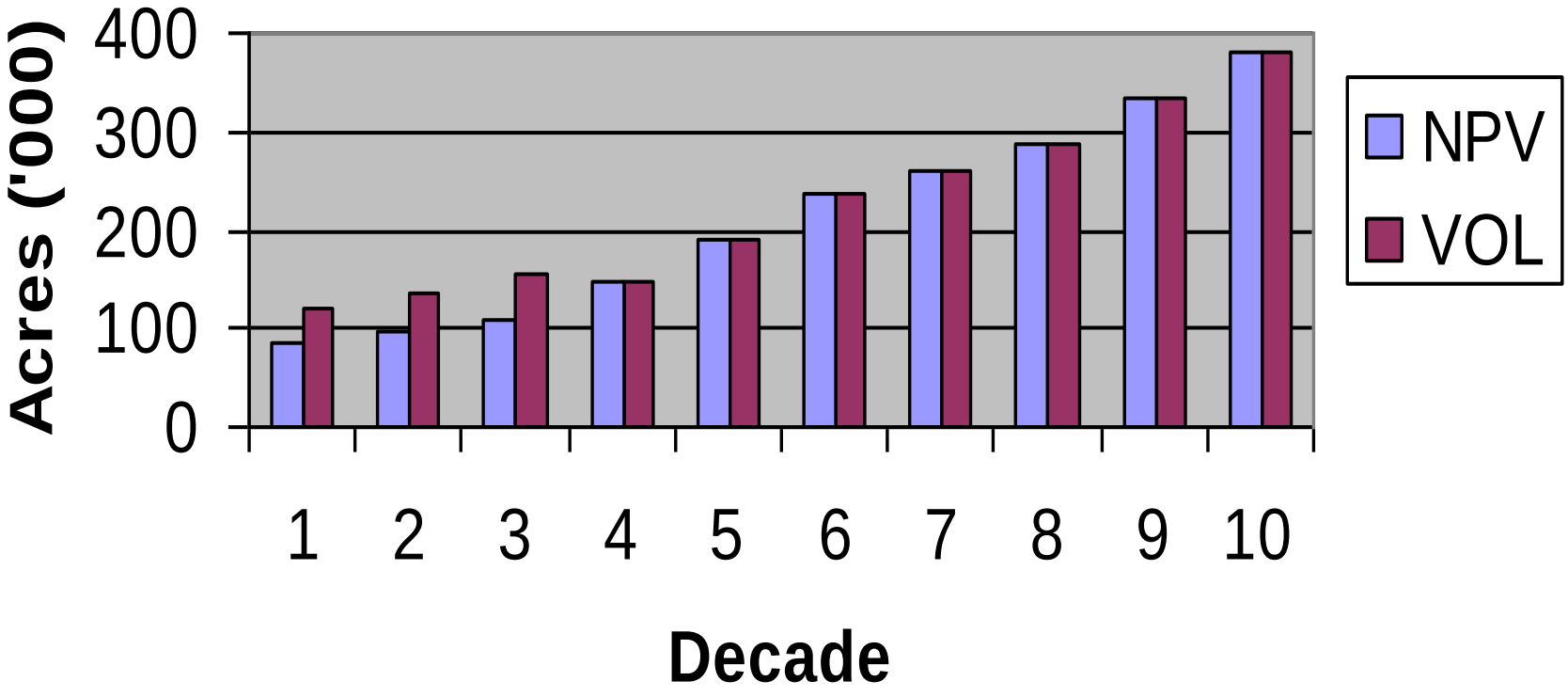
Modified DNR

- Results: Harvest (sell) 750 MMBF/year in first decade and every decade thereafter.
- Identical sustainable harvest as when we maximize net present value.
- Examples of some differences.

DNR W Washington Net Revenue

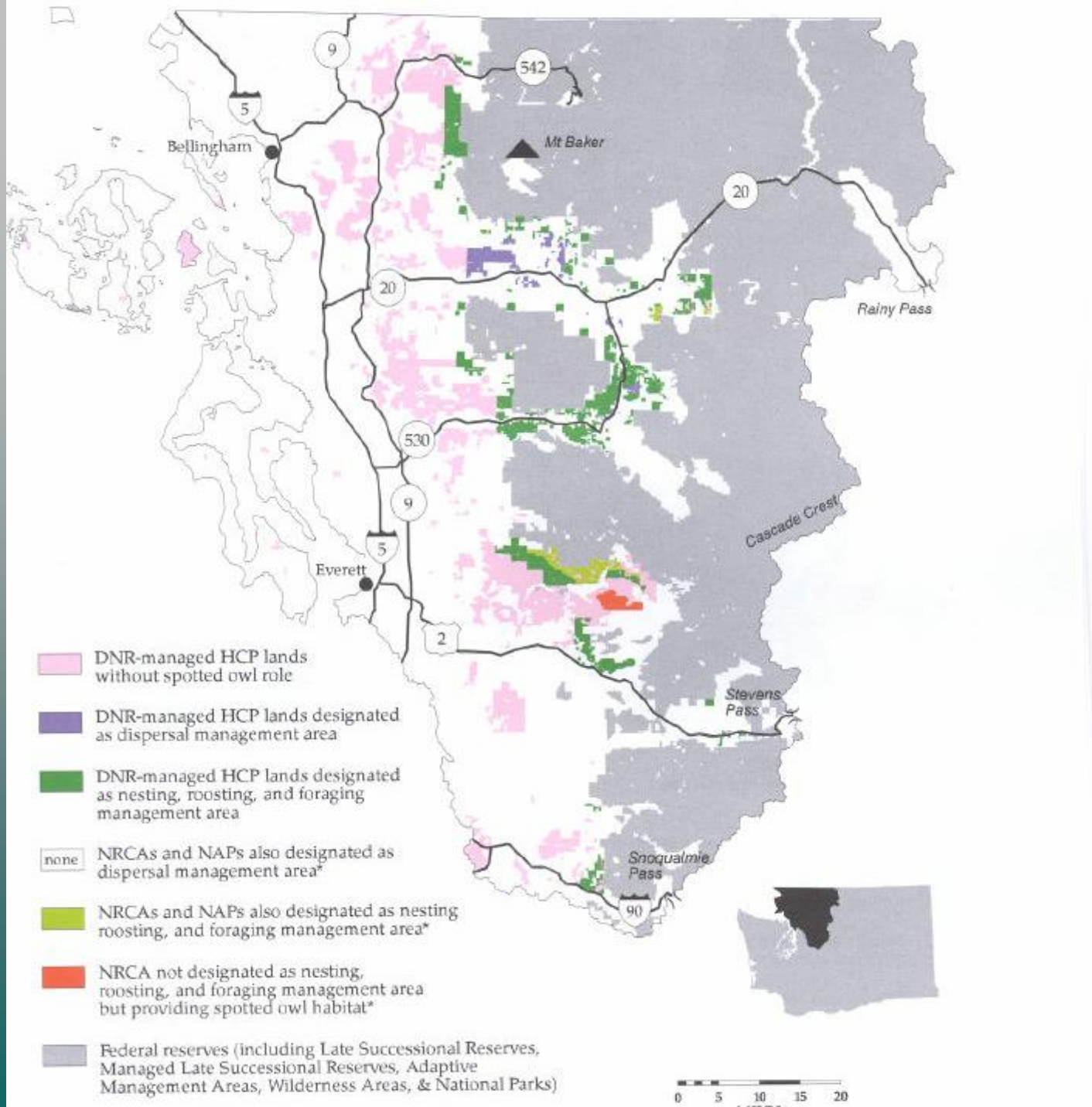


DNR W Washington Old Forest Habitat



Individual Planning Units

- Each planning area was analyzed separately using the two scenarios.
- Results for the North Puget Planning Area shown.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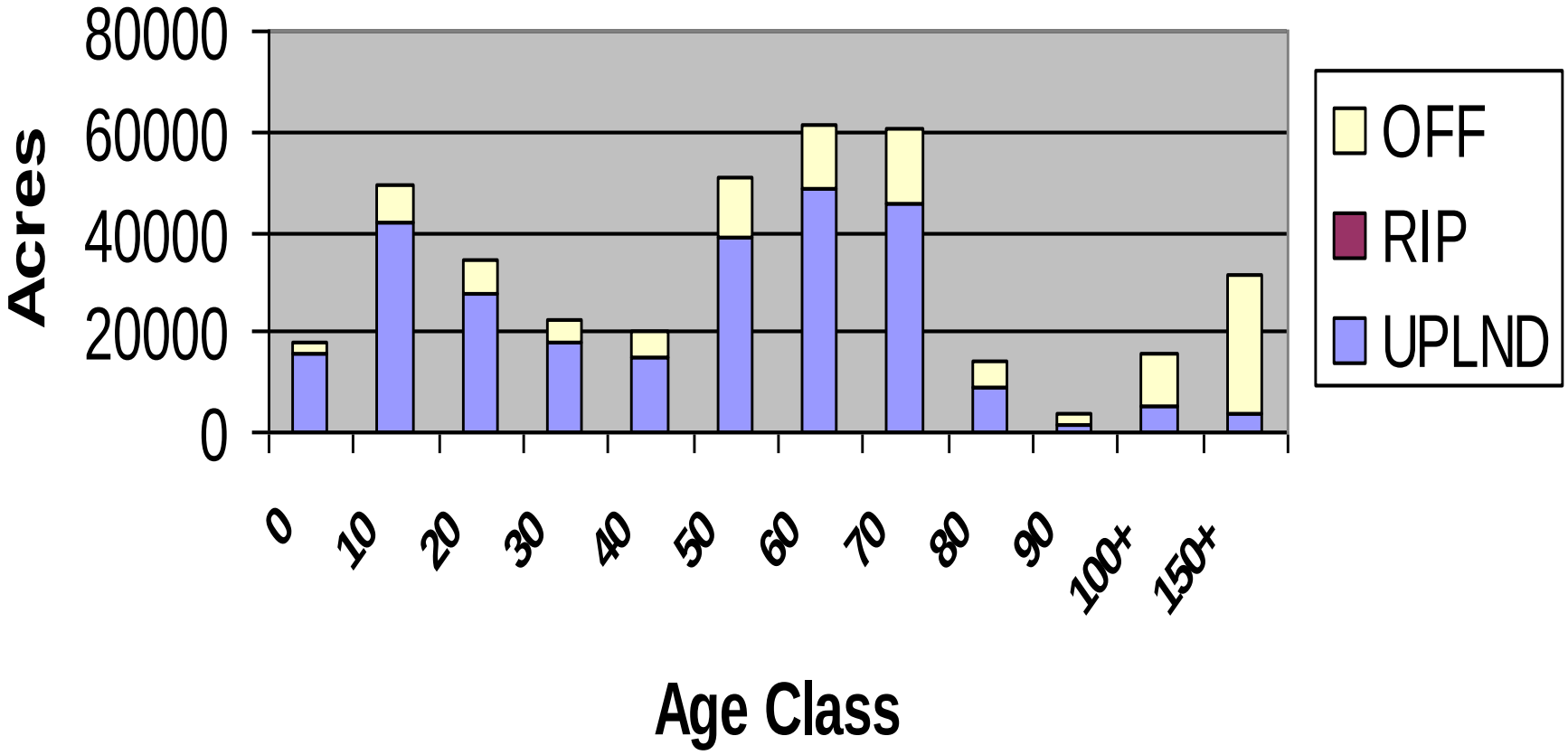
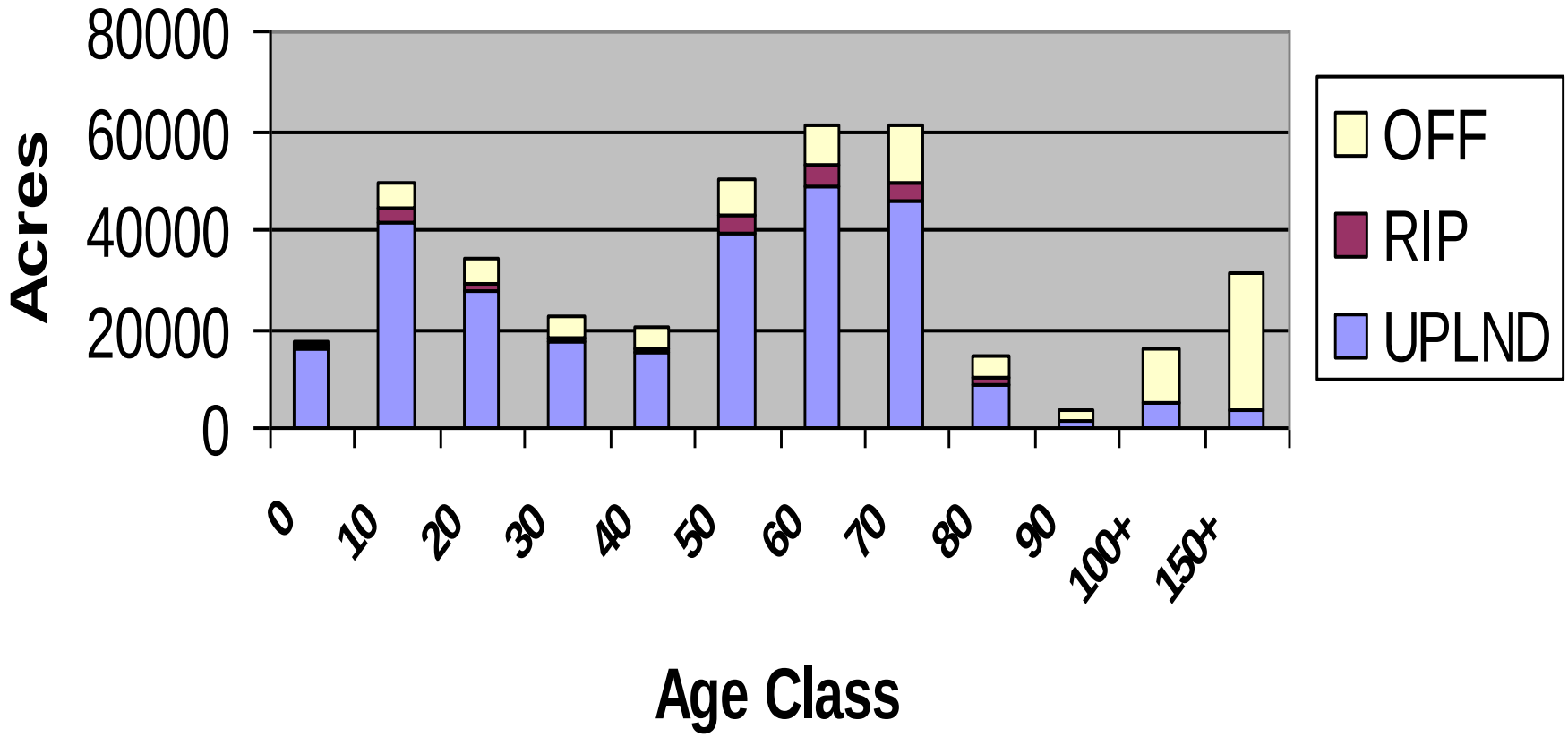
0 5 10 15 20

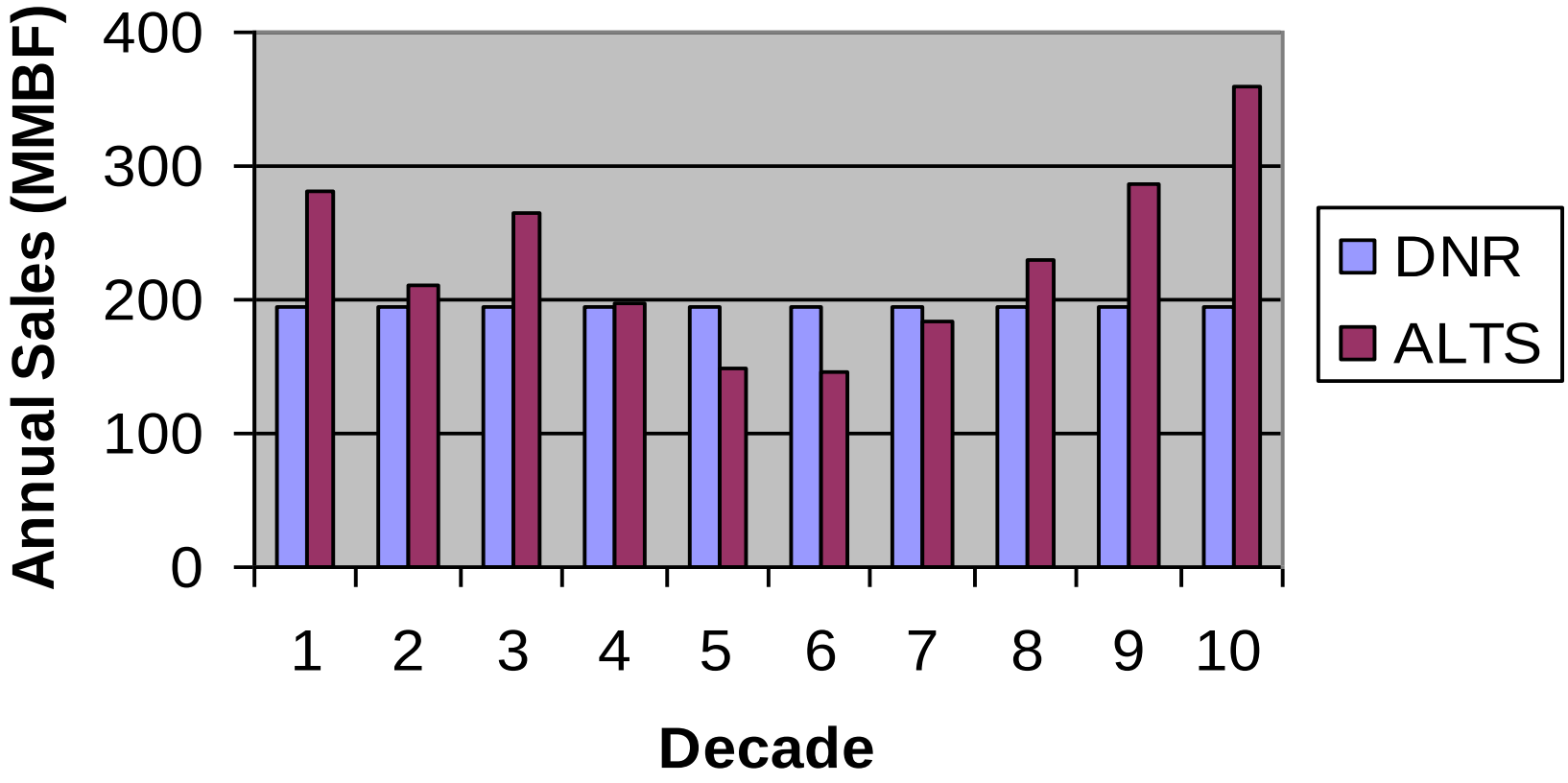
DNR North Puget



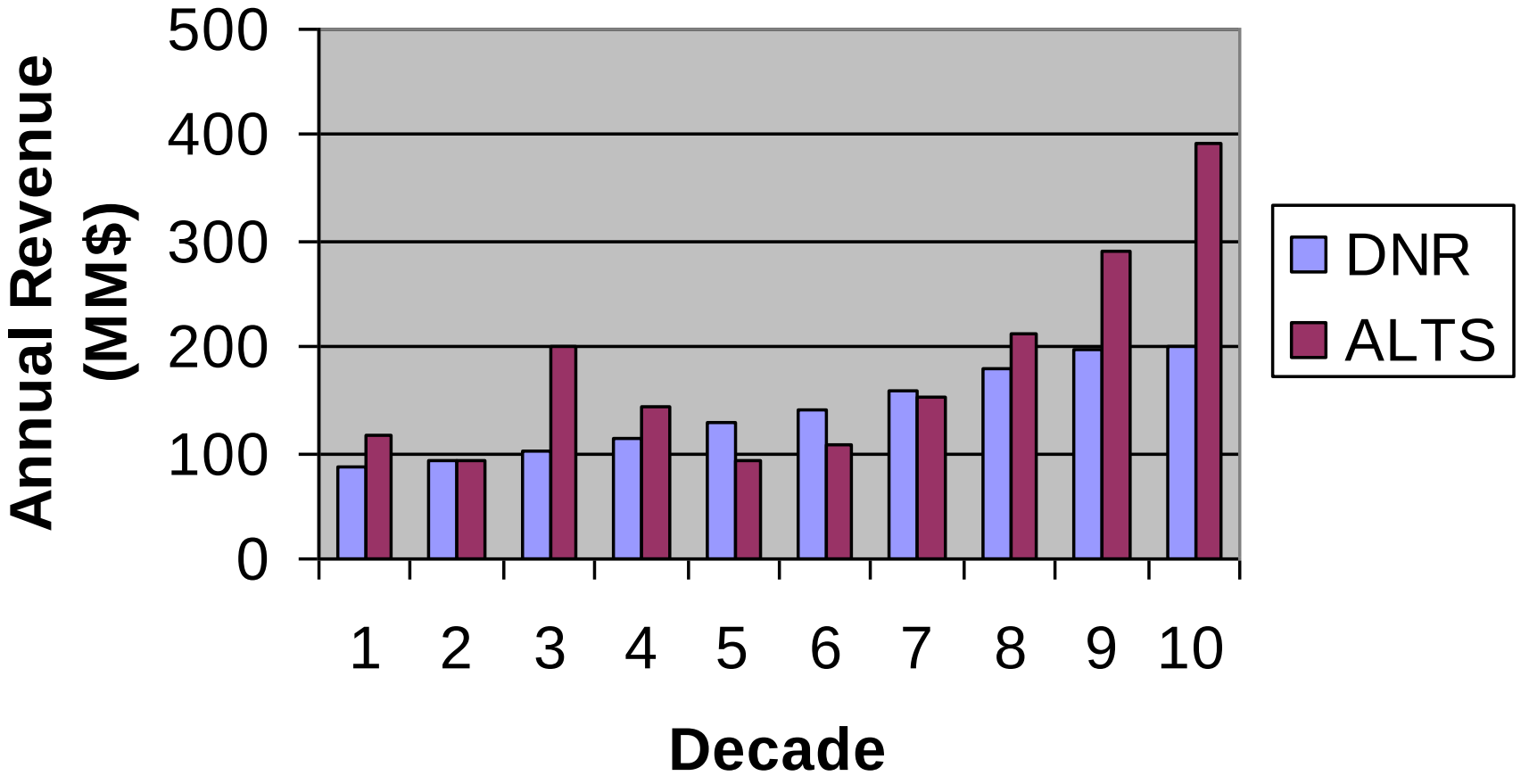
ALTS North Puget



North Puget Timber Sales (DNR$1.9;ALTS$2.5)



North Puget Net Revenue



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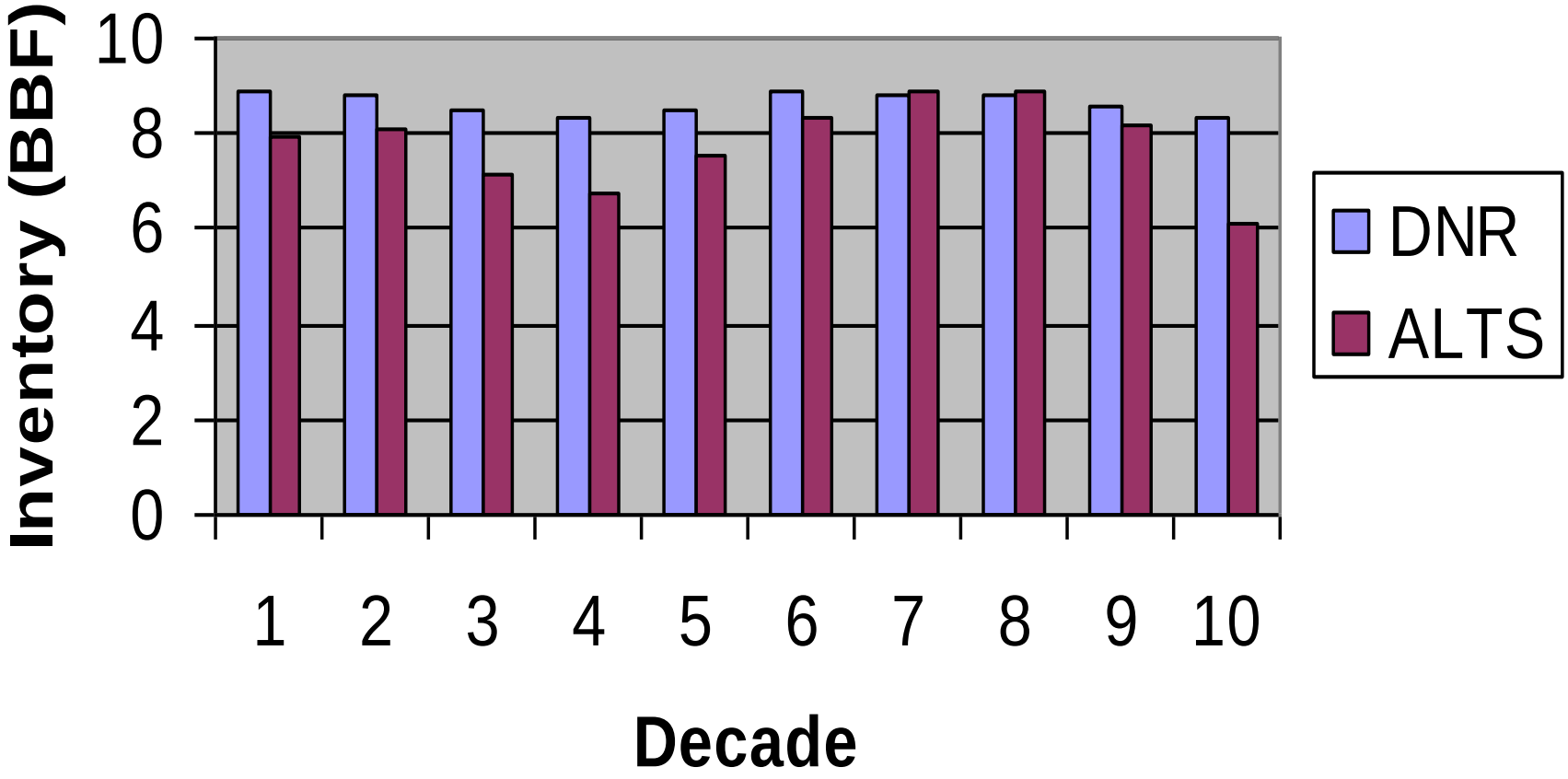
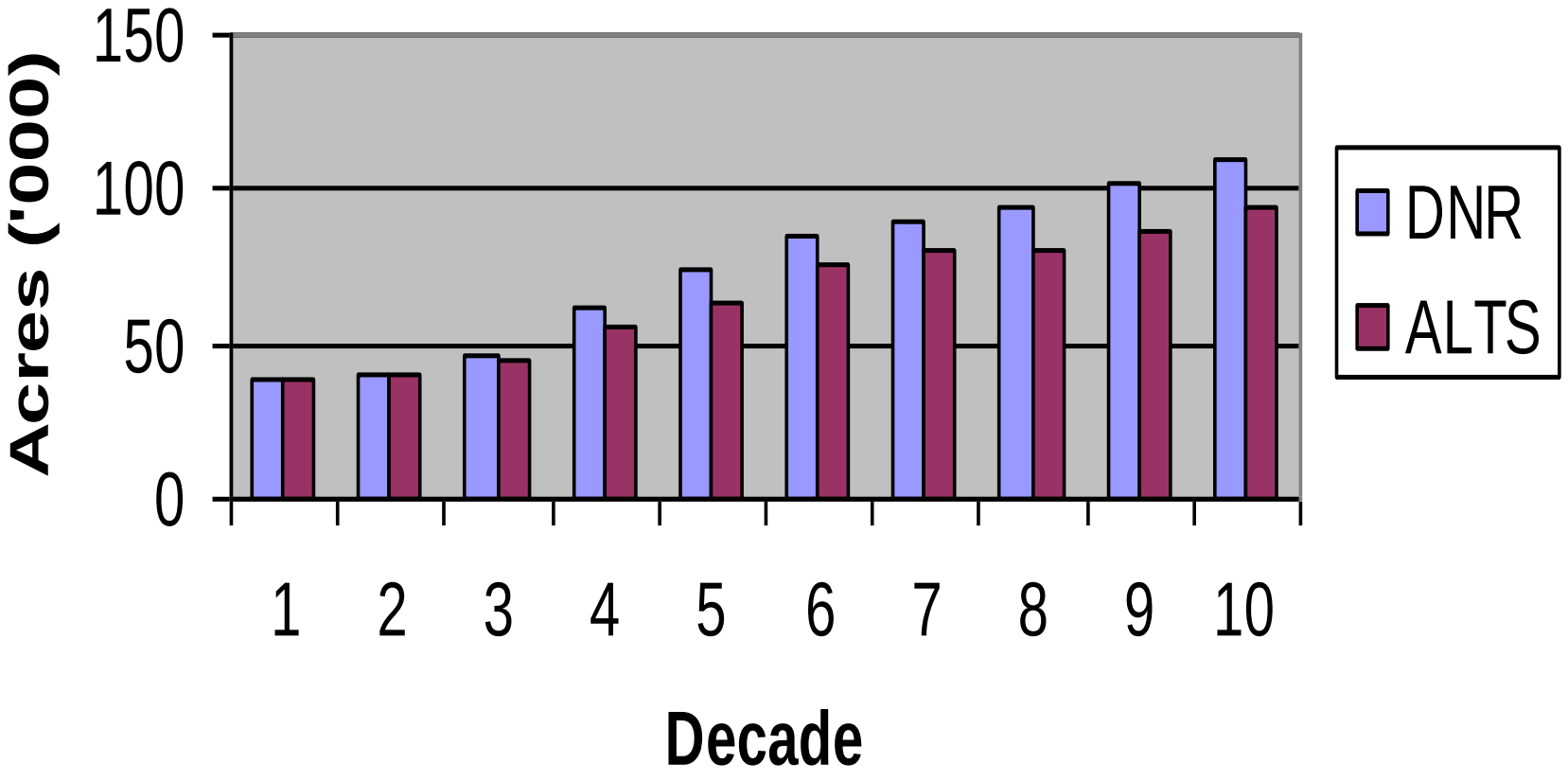
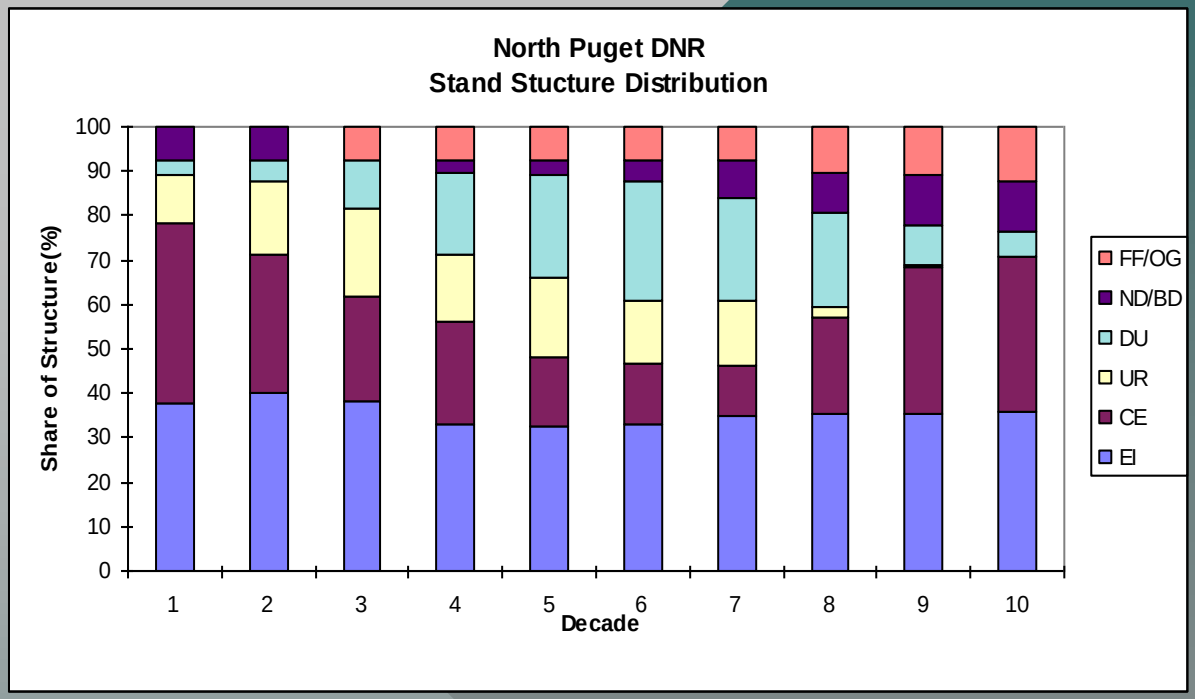


North Puget Old Forest Habitat

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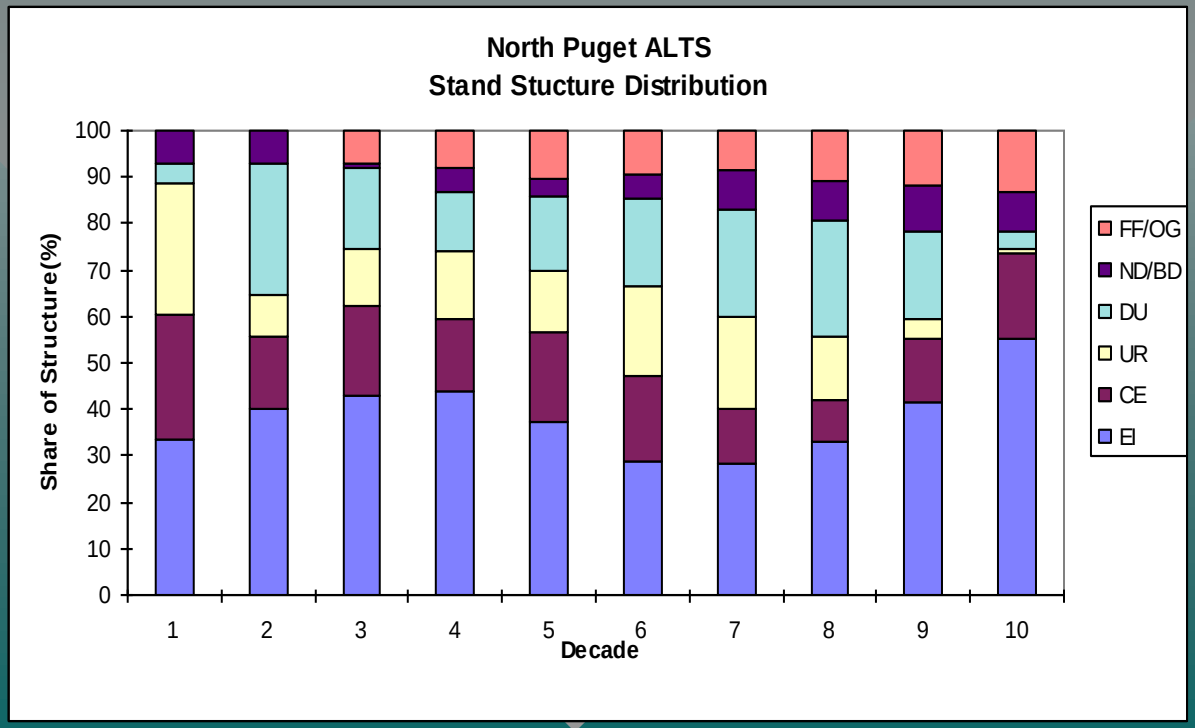
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	Asset Values ($ Billion)			
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South Puget	0.85	1.091	28%	141,815
Columbia	1.581	1.976	25%	283,021
Straits	0.715	1.034	45%	113,143
OESF	0.781	1.379	77%	240,835
South Coast	1.416	1.746	23%	265,877
Six Unit Total	7.288	9.713	33%	1,426,094
% Difference	3%	1%		

Take Home Points

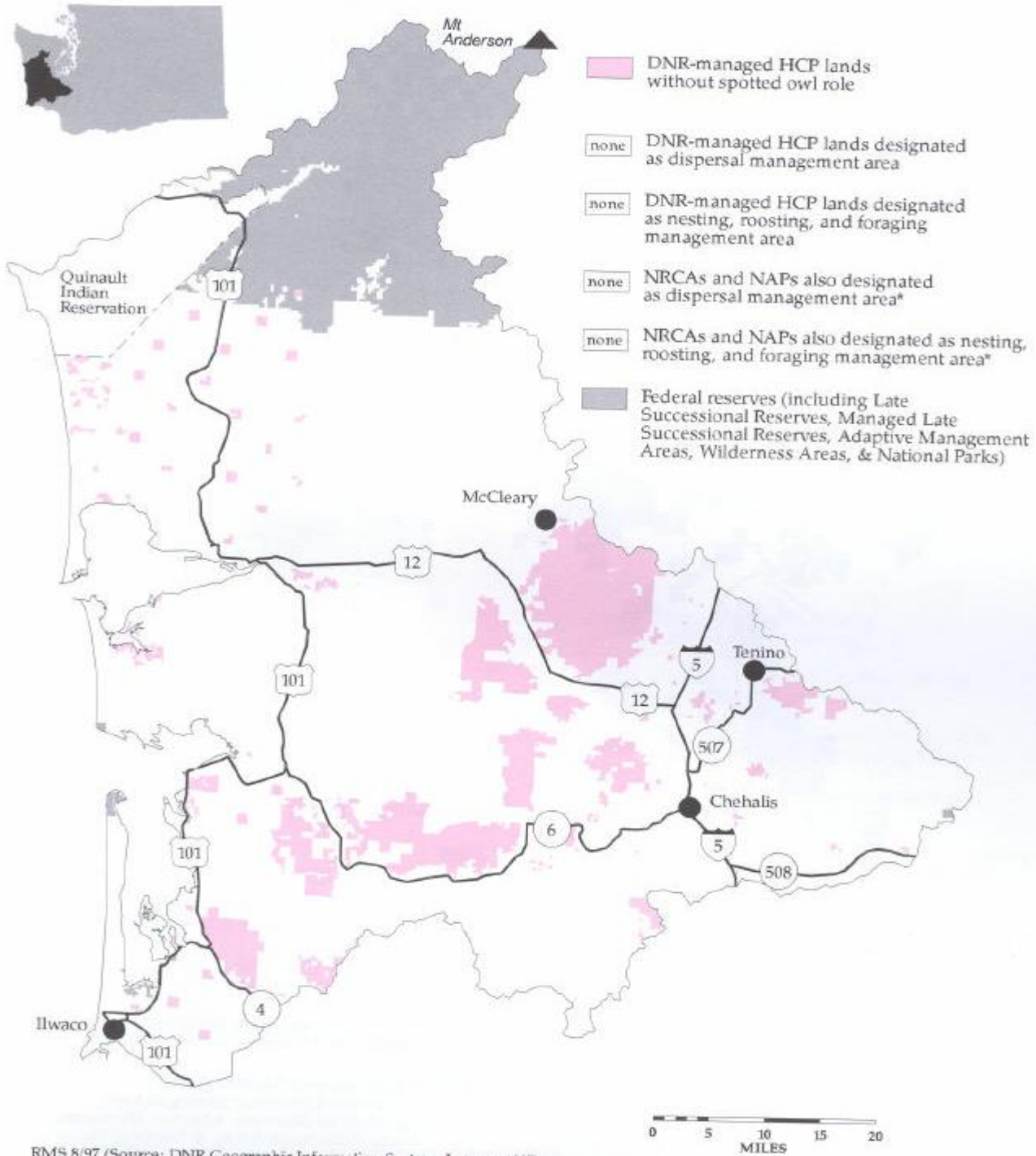
- Combination of many factors influences determination of sustainable harvest volume:
  - board of natural resources interpretation of legal requirements when setting policies:
    - number of independent geographical units for which a harvest is calculated
    - individual trust-specific management planning
    - type of harvest (sale) volume flow constraint used

Take Home Points

- exceeding minimum regulations
- level of habitat conservation and biodiversity goals necessary to satisfy regulations
- pre-stratification of land base into on/off categories
- objective used when calculating the sustainable harvest

The End: Topics Covered

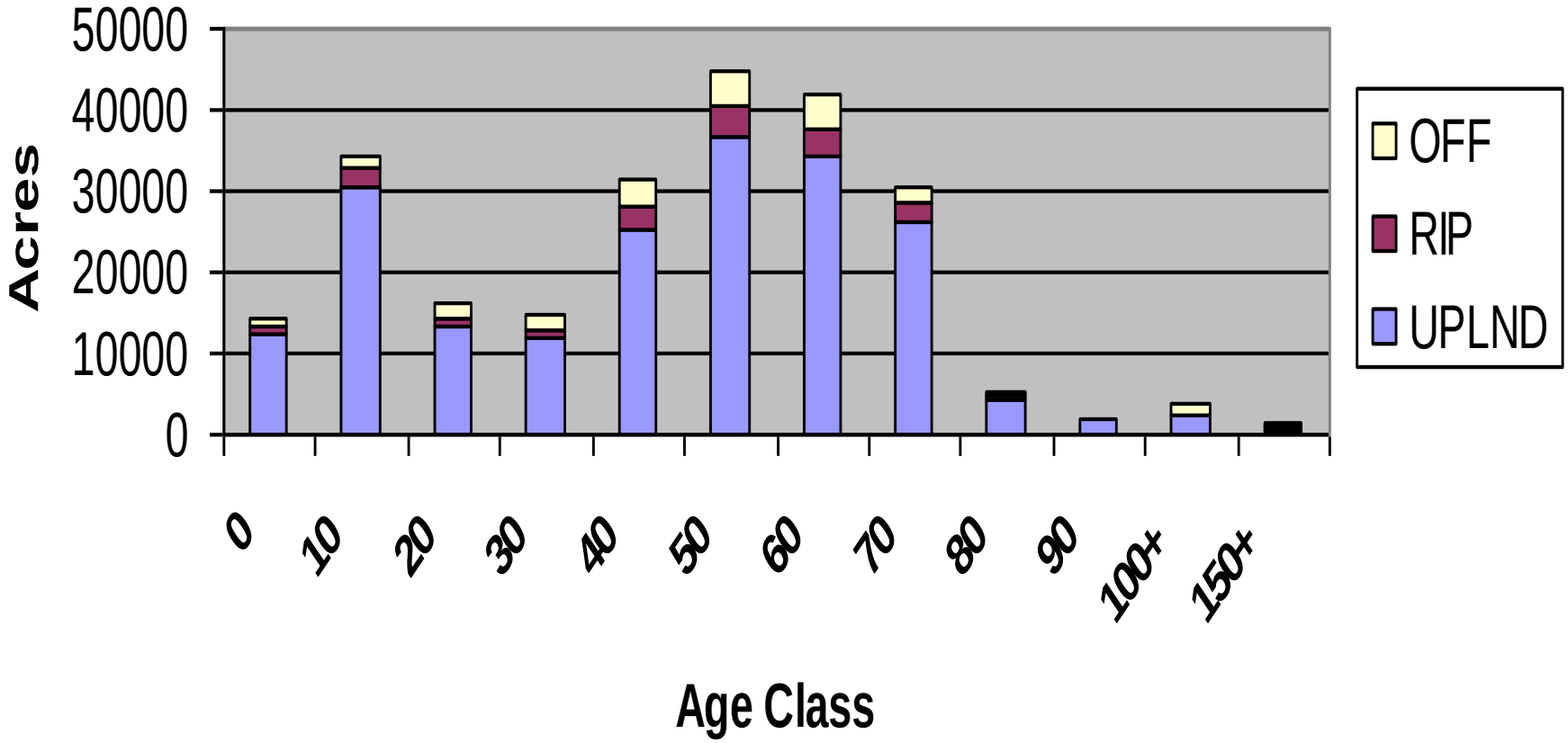
- Definition of key terms
- Input parameters to consider
- Sample sustainable harvest calculations for western Washington



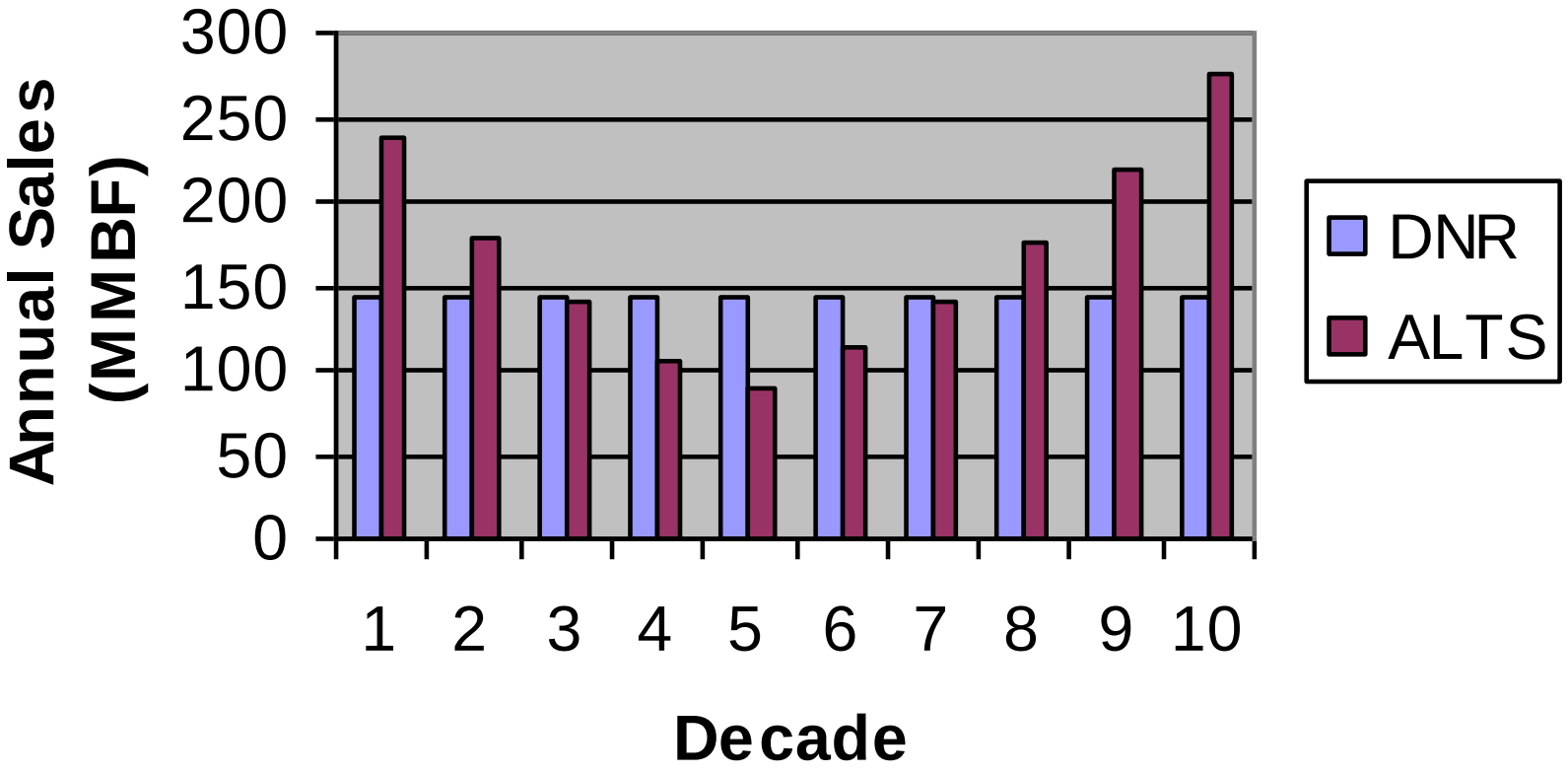
RMS 8/97 (Source: DNR Geographic Information

DNR South Coast

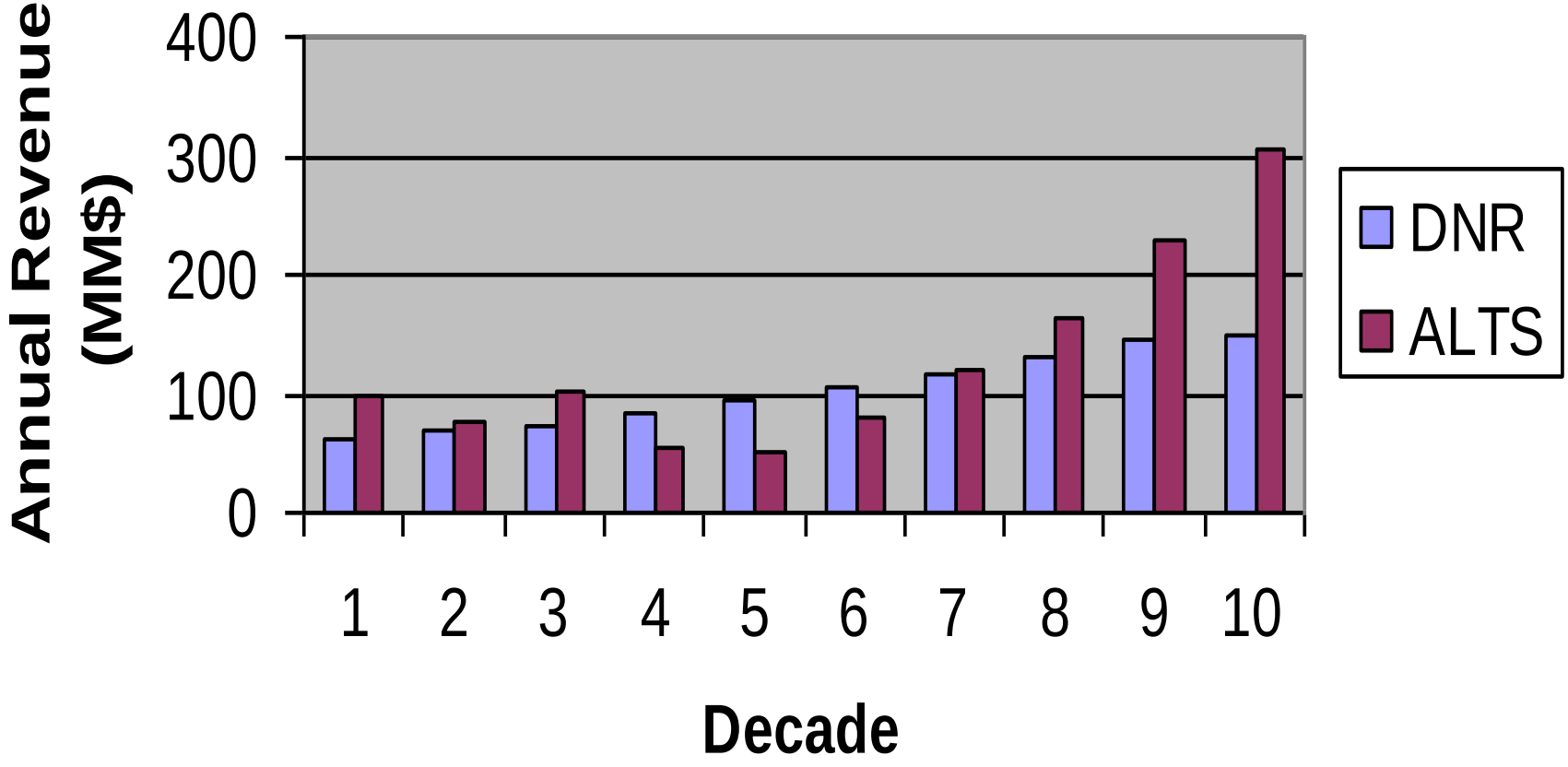
ALTS South Coast



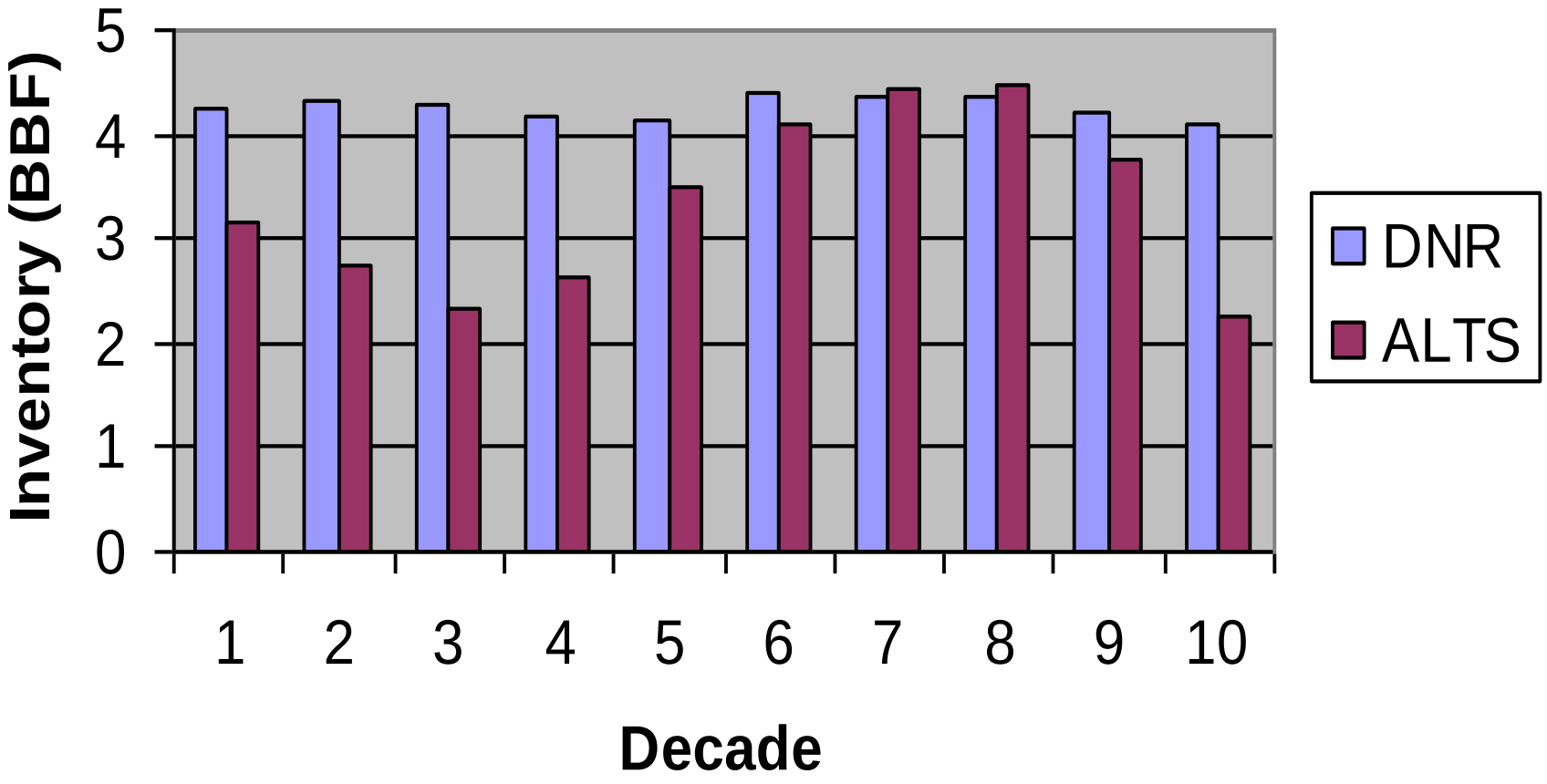
South Coast Timber Sales (DNR$1.4;ALTS$1.7)



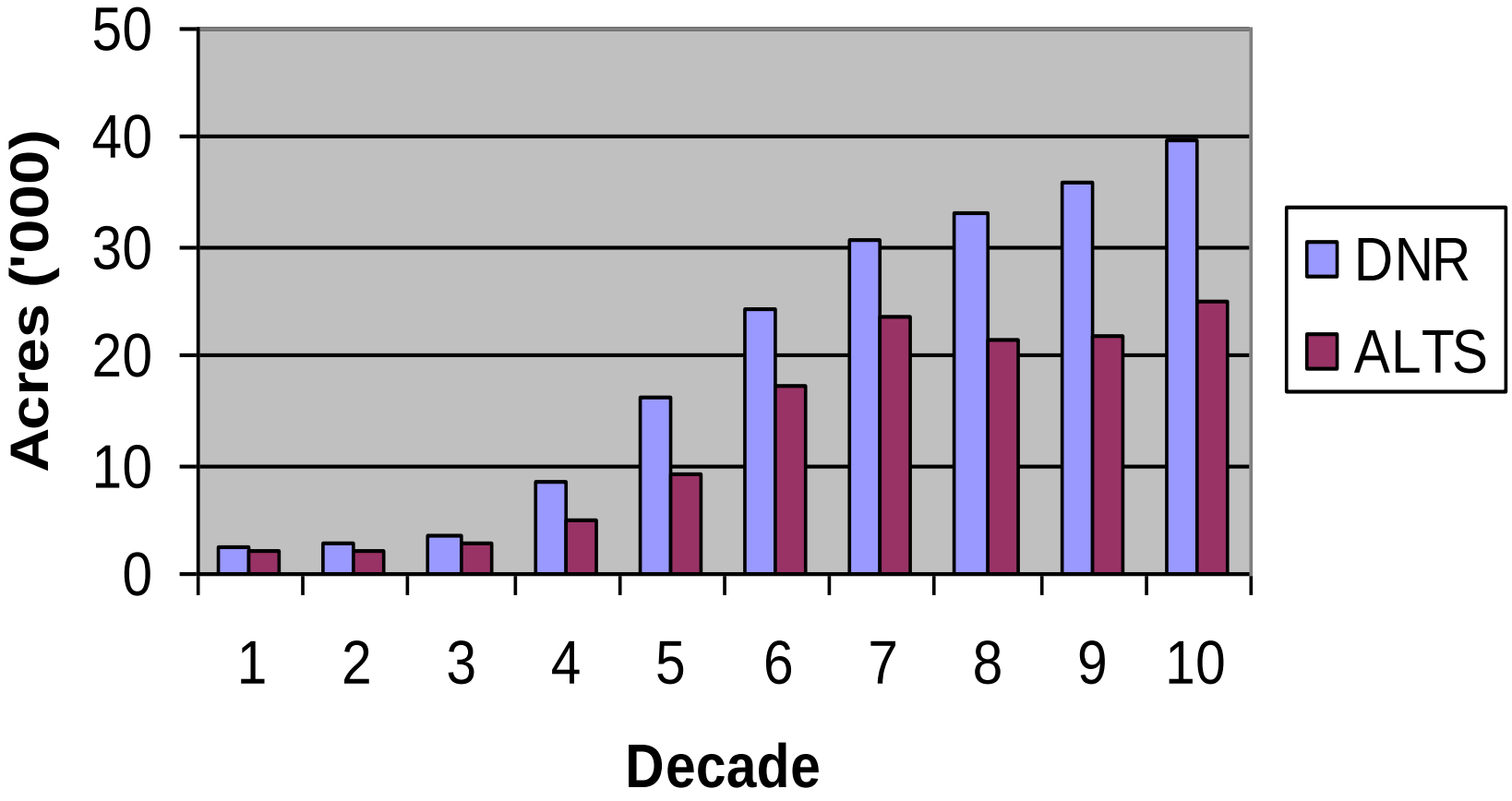
South Coast Net Revenue

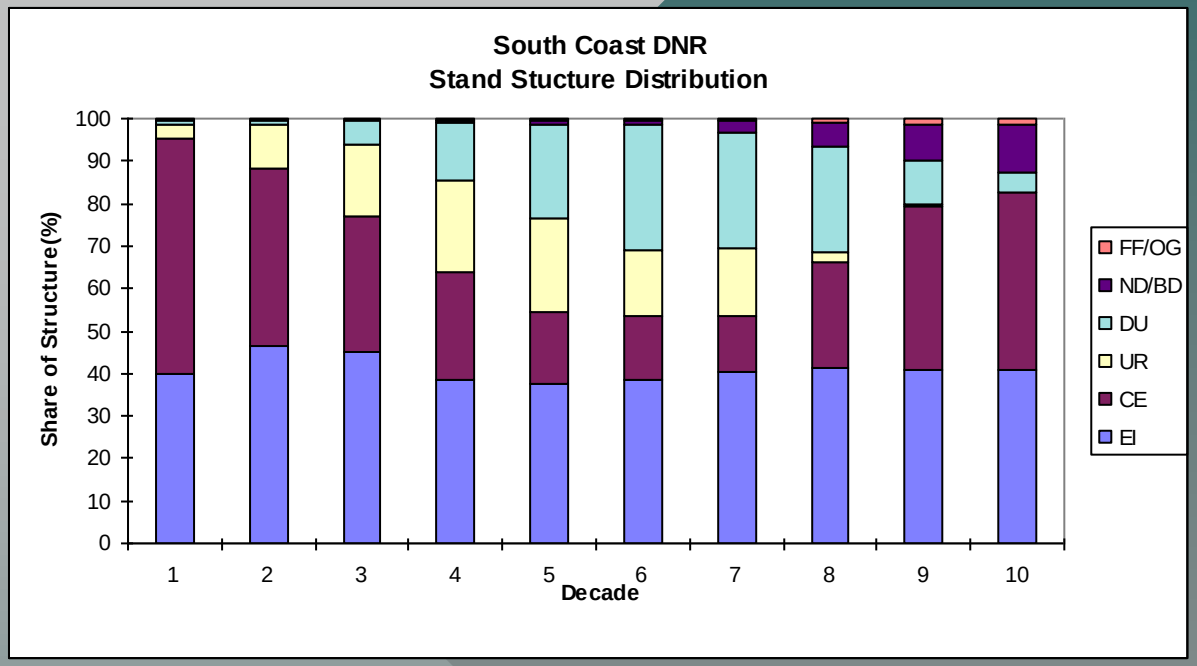


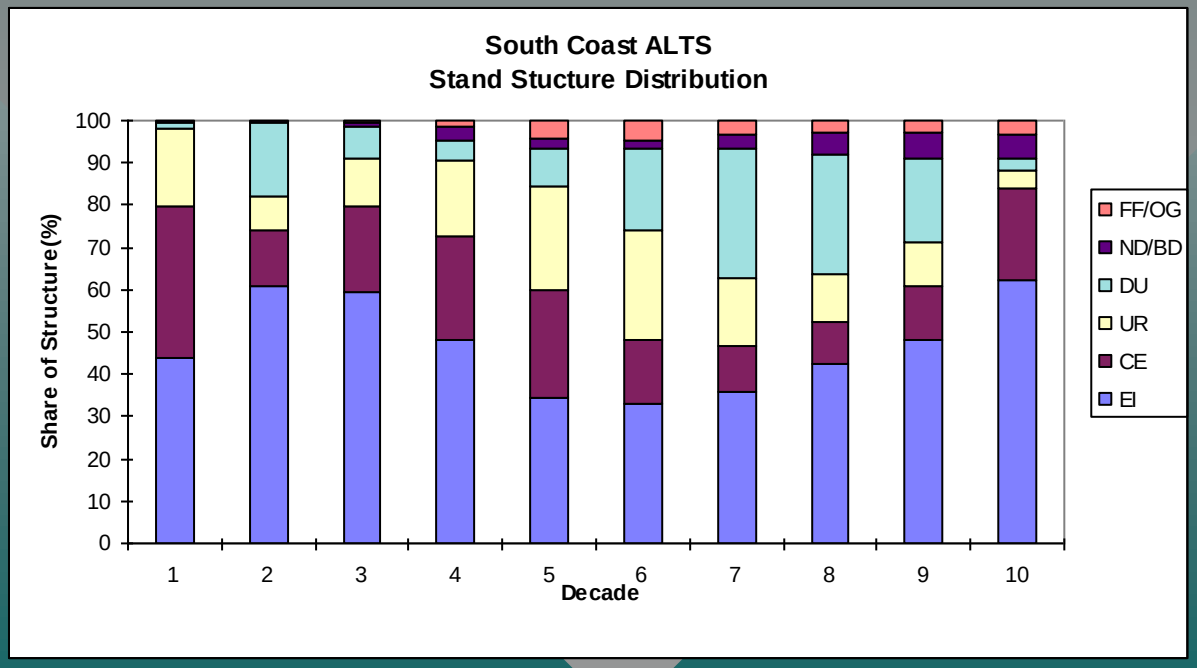
South Coast Inventory



South Coast Old Forest Habitat




South Coast DNR
Stand Stucture Distribution
Share of Structure(%)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
Decade
FF/OG
ND/BD
DU
UR
CE
EI


South Coast ALTS
Stand Stucture Distribution
Share of Structure(%)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
Decade
FF/OG
ND/BD
DU
UR
CE
EI