

Influence of ownership institutional and environmental history on fire-prone forest landscape change: applications of historic FIA data



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BROWN-BAG TALK FOR
PNW RESEARCH STATION, PORTLAND LAB
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FPF Research Team



Team Organization: social and natural forest scientists

Collaboration: PNW Research Station, USFS- OSU

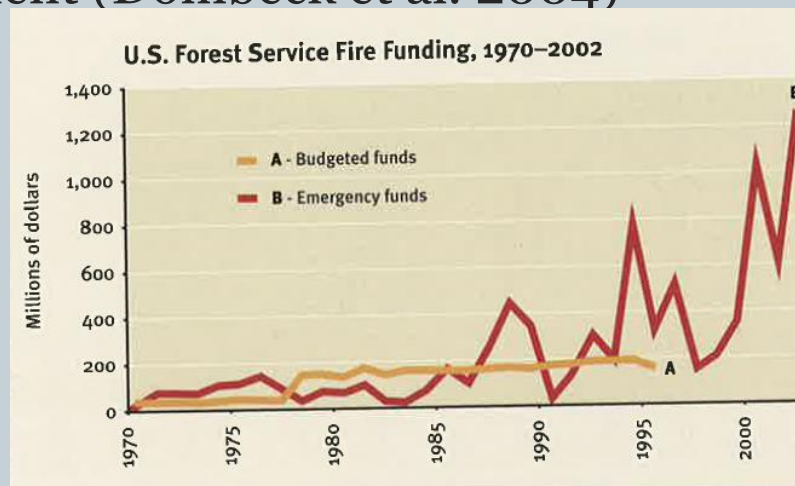
- Tom Spies, Co-lead, PNW
- John Bolte, Co-lead, OSU
- Jo Albers, OSU
- Alan Ager, PNW
- John Bailey, OSU
- Susan Charnley, PNW
- Sally Duncan, OSU
- Paige Fischer, PNW
- Sarah Gregory, OSU
- Roger Hammer, OSU
- Derric Jacobs, OSU
- Jeff Kline, PNW
- Jennifer Koch; OSU,
- Christine Olsen; OSU
- Keith Olsen, OSU
- Rob Pabst, OSU
- Emily Platt, OSU
- Bruce Shindler, OSU
- Michelle Steen-Adams, UNE
- Brent Steel, OSU
- James Sulzman, OSU
- Eric White, OSU

Fire-prone forest landscape restoration policy and management issue:

Forests, People, Fire Problem

- Wildfire management, policy issue: “Our task is to find some way through” (Pyne 2014; Pyne 2007)

- Practical issue of increasing acreage and unsustainable cost
 - ✦ Agencies already stretched for basic inventory, monitoring and management (Dombeck et al. 2004)



- Projected climate change: expect more fires (Stephens et al. 2013);
- WUI settlement

WUI Fires, Deschutes NF, 1990s

Policy issue: National Fire Plan: Need to shift from disproportionate focus on WUI zone (1% of landscape area), piecemeal, fragmented restoration to whole landscape restoration (Schoennagel and Nelson 2009)



Awbrey Hall Fire, 1990



Skeleton Fire, 1996

Fire-prone forest landscape restoration policy and management issue:

Forests, People, Fire Problem

- Fire-prone forest landscapes of the interior PNW need restoration:
 - Restore characteristic pattern /heterogeneity (structure and composition: address shift to more homogeneous landscape pattern (Spies et al. 2006)
 - Restore fire regimes and ecological processes
 - Restore resilience
 - GSV relevance: restore capacity to deliver the full range of GSV

Coupled Human and Natural Systems (CHANS) approach of *Forests, People, Fire* project



- Need for All Lands Management, whole landscape approach, yet limited progress. Why not?
- “Despite significant ecological concerns, learning to live with fire remains primarily a social issue...” (Dombeck et al. 2004)
- ...learning to live with fire primarily a cultural issue—one of values (Pyne 2002; 2007; 2014)
- CHANS approach of FPF project: examine “how humans adapt (or not) to living in fire-prone forests and how policies could be made more effective” (NSF proposal)
 - Feedbacks
 - Complexity: time lag effects and unintended consequences
- Social science prj. emphasis: Influence of institutions and social networks on actor (e.g., federal manager, tribal manager, landowner) fuels/forest/ fire decisions
 - How do institutions influence (mediate) actor decisions?
 - How to improve institutions to promote more adaptive decisions?

Environmental history/ Historical ecology contributions



- FPF Qu: “How do land management policies, social networks and institutions, and actor decisions interact to influence landscape dynamics and produce intended and unintended consequences for biodiversity and ecosystem services (e.g., carbon)?”
- FPF H: “Actor groups (ownerships) will have different degrees of influence on landscape-level ecosystem services and fire risk as a result of different historical legacies of management and wildfire, environment, land values, and spatial context.”
- *H1- modified: Actor groups (ownerships) will have different decision outcomes and in turn, varying influences on forest landscape pattern (composition, size distribution) as a result of different legacies of institutional history (policies, organizational structure) and environmental history (transportation/ technology, culture, economic system).*
 - Ownerships: Public forest (Deschutes National Forest), Tribal (Warm Springs) Private (formerly Shevlin-Hixon; Brooks-Scanlon)

FPF Study Area

Forested zone of eastside Cascades

- Single ecoregion unit: Cascade Mixed Forest Province, M242C (Bailey)
- FPF study area: 8.1 m. acres (3.3 m. ha)

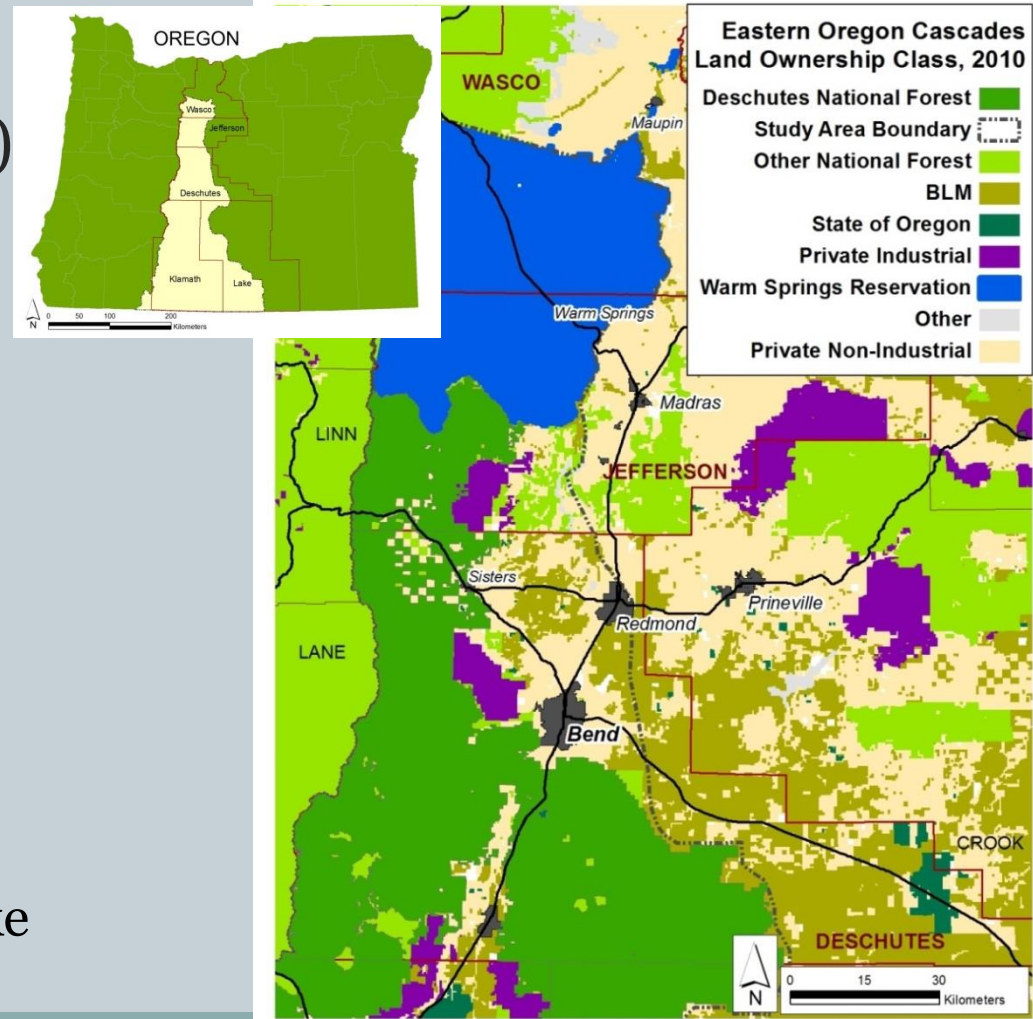
- Northern zone: Wasco, Jeff., Deschutes Co.:

- 2.37 m. acres (959,000 ha))

Ownership pattern

- ✦ National Forest: 48.0%
- ✦ Tribal: 26.6%
- ✦ Private: 18.0%
- ✦ Other- public: 7.4%

- Southern zone: Klamath, Lake Counties



Hypotheses, continued



- H2: Differing social-ecological feedbacks will be propagated among actor groups (ownerships) as a result of varying institutional history and environmental history.
- H3: Differing institutional and environmental histories among ownerships will generate varying forest conditions, and in turn, varying trajectories of forest products, values, and services, and demography.

Env. history influence on management decisions

What we know...

- Case study evidence that environmental historical factors influence forest decision outcomes:
 - Ecological knowledge/ management paradigm (Langston 1995 (Blue Mountains))
 - Fire culture (Pyne 2002, 2007)
 - Technology, economic system (Robbins (Oregon); Robbins and Wolf 1994 (Interior PNW); White 1979 (Whidbey Is.); Cronon (Great Lakes) 1992)
- Environmental historical factors influence forest change
 - Ownership social history (Steen-Adams et al. 2011)
- Environmental historical factors influence social-ecological feedbacks
 - Ownership history influence (Steen-Adams et al., in press)
- Significance:
 - Critically assess current policies viz. unintended consequences;
 - Retrospective analysis explaining current conditions, compared to alternative trajectories (“path dependence”)

Fire history influence on management decisions

What we know...



[In reference to research in the southeastern and western US (Chapman 1926, Weaver 1943, Cooper 1960, Biswell 1961)], “For the first time, significant changes in the structure, composition, and fuel loads were documented in forests that primarily experienced frequent, low- to moderate-intensity fire regimes. ***The implications of these investigations were profound but not utilized by contemporary policy.*** The very policy of fire suppression that had been adopted decades earlier was actually producing forests with high fire hazards, and these forests were being burned by high-severity wildfire” (Stephens and Ruth 2005:533 (emphasis not in original)).

Institutional history influence on decision outcomes; Research Gaps



- Institutions: *prescriptions/ rules to organize forms of structured interactions... among forest landscape stakeholders and in turn, choices/ decision-outcomes*
- Institutions structure opportunities and constraints
- Ownership institutional history: land tenure and property regimes influence forest sustainability (Ostrom and Nagendra 2006)
- Research gap: “The theory of institutions for common-pool resource management has been remarkably ahistorical.... Yet it is clear that options available for institutional design are historically contingent... The nature of such historical contingencies is an important topic for future research.” (Stern et al. 2002:477).

H4. Cross-boundary management of wildland fire management commons resources among *heterogeneous* user groups

- Context: consider coordinated, All Lands wildland fire management as a commons resource management problem (Charnley and others, proposal).
- Environmental history finding (primarily based on studies of New England fisheries and woodlands (Judd 2000; Donahue 2007): commons resources can be sustainably managed when:
 - (a) Users share a culture of commons resource management: “obligation to the common good”
 - (b) Users share a sense of place; implication of enduring, multi-generation tenure
 - (c) Resource depletion/ degradation is at risk
 - (d) Relatively small geographic area

H4. Cross-boundary management of wildland fire management commons resources among *heterogeneous* user groups

- Environmental history finding based on western, California resources (McEvoy 1986). When diverse new-comer groups apply dissimilar resource management strategies in the context of a non-adaptive agency, the resource risks collapse (CA sardine fishery)
- Qu: What happens when diverse new-comers manage a complex, difficult to perceive, broad-scale resource?
- H: Durable commons resource institutions require a process of negotiation among users across time and space. When the resource is characterized by heterogeneous user groups who have experienced rapid, dramatic demographic, land tenure, and social change, durable commons institutions must be flexible, engaging and provide incentives.

Materials and methods



Data Sources



Forest landscape data

- FIA inventories
 - Oregon and Washington Survey (Andrews and Cowlin)- 1935
 - County-scale 2nd FIA inventory- 1953

Social data

- Interviews (n = 38)
- Management plans
- Archival materials (National Archives, Forest History Society archives)
 - Forest reports
 - Correspondence
- Demographic conditions and change: US Census
- Forest products: FIA Forest Statistics reports

Historic FIA sample data

1953 re-survey map:
Jefferson Co., OR
Western half

Warm Springs

Mt. Jefferson

Camp Sherman

Solid orange = > 22" dbh
Ponderosa Pine is
dominant commercial
species by volume

Solid red = recent burns

Solid green = > 22" dbh
Douglas Fir is dominant
commercial species by
volume

Hatched blue = > 12" dbh
True Fir – Mountain
Hemlock is dominant
commercial species by
volume

Solid yellow = grassland
or not vegetated

methods



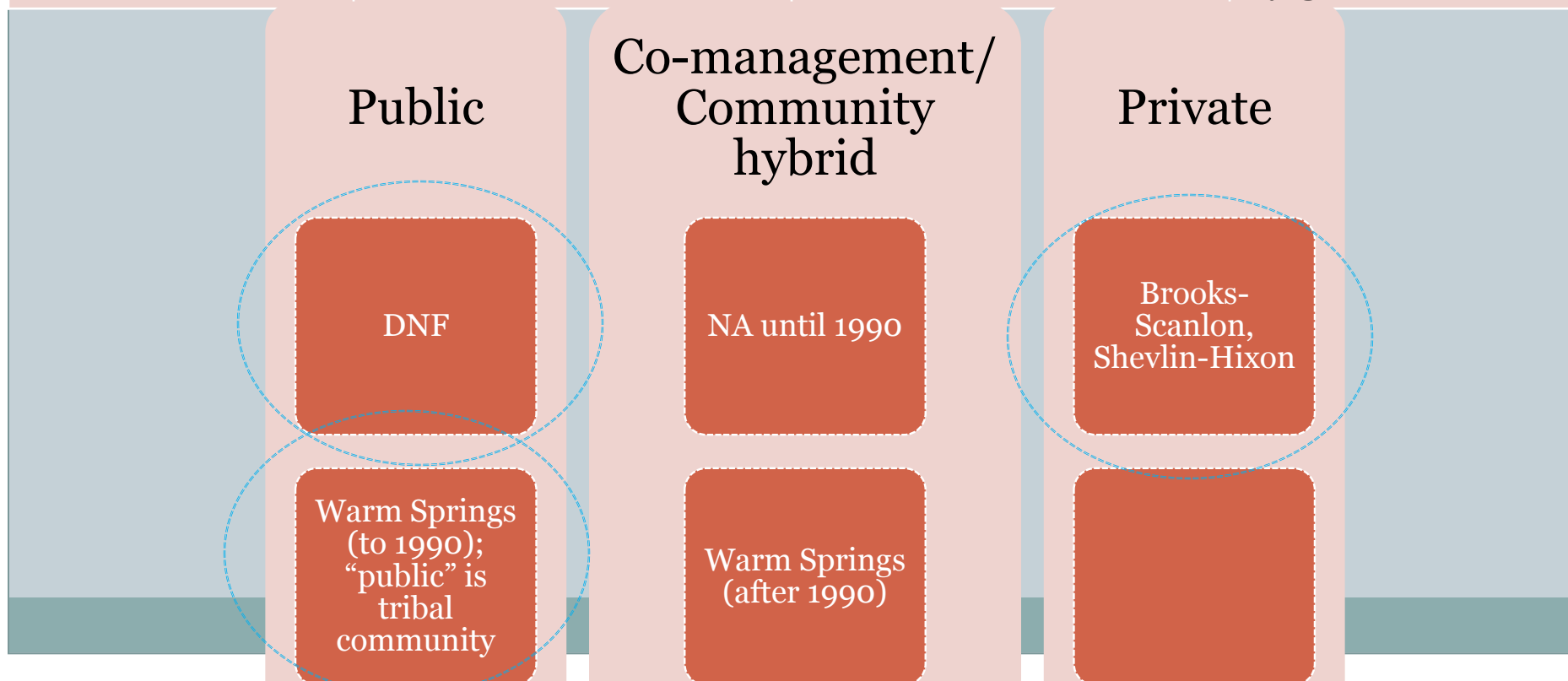
Mixed-methods approach

- Social-historical analysis
- GIS/ landscape ecology
- Multivariate regression (in development)

Variable	Scale	Source
Forest land-cover and size distribution; land-cover change (dependent variables)	16 ha (40 ac) quarter-quarter sec. (Wimberly & Ohmann 2004)	FIA
Potential Vegetation Type (biophysical var.)		USDA FS
Ownership Institutional Type (social var.)		
Transportation network/ mill distance (soc. var.)		Historic maps
Population density (soc. var. (2-way))		US Census

Institutional typology (Ostrom and others)

Public	Co-management	Community	Private
Central agency decision-making structure/ governs stakeholder access rights	“the sharing of power and responsibility between government and local resource users” (Berkes et al. 1991)	the community is driving land use decisions; development based on multiple ES resources (Beckley 1998)	Autonomous decision structure -controls on access and use; -some constraint by government



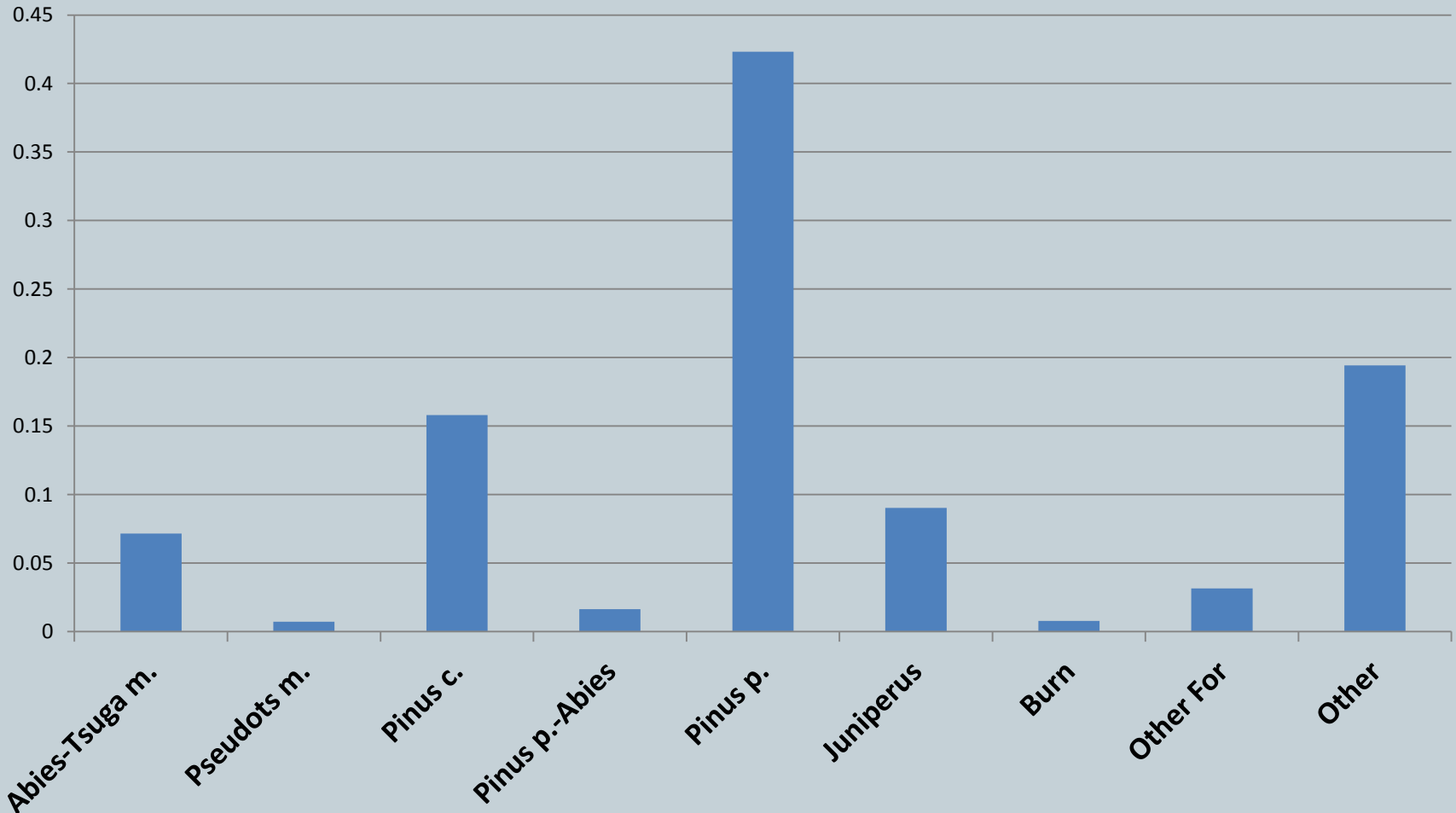
results



Historic (1935) forest landscape composition

Whole landscape analysis: All land-covers

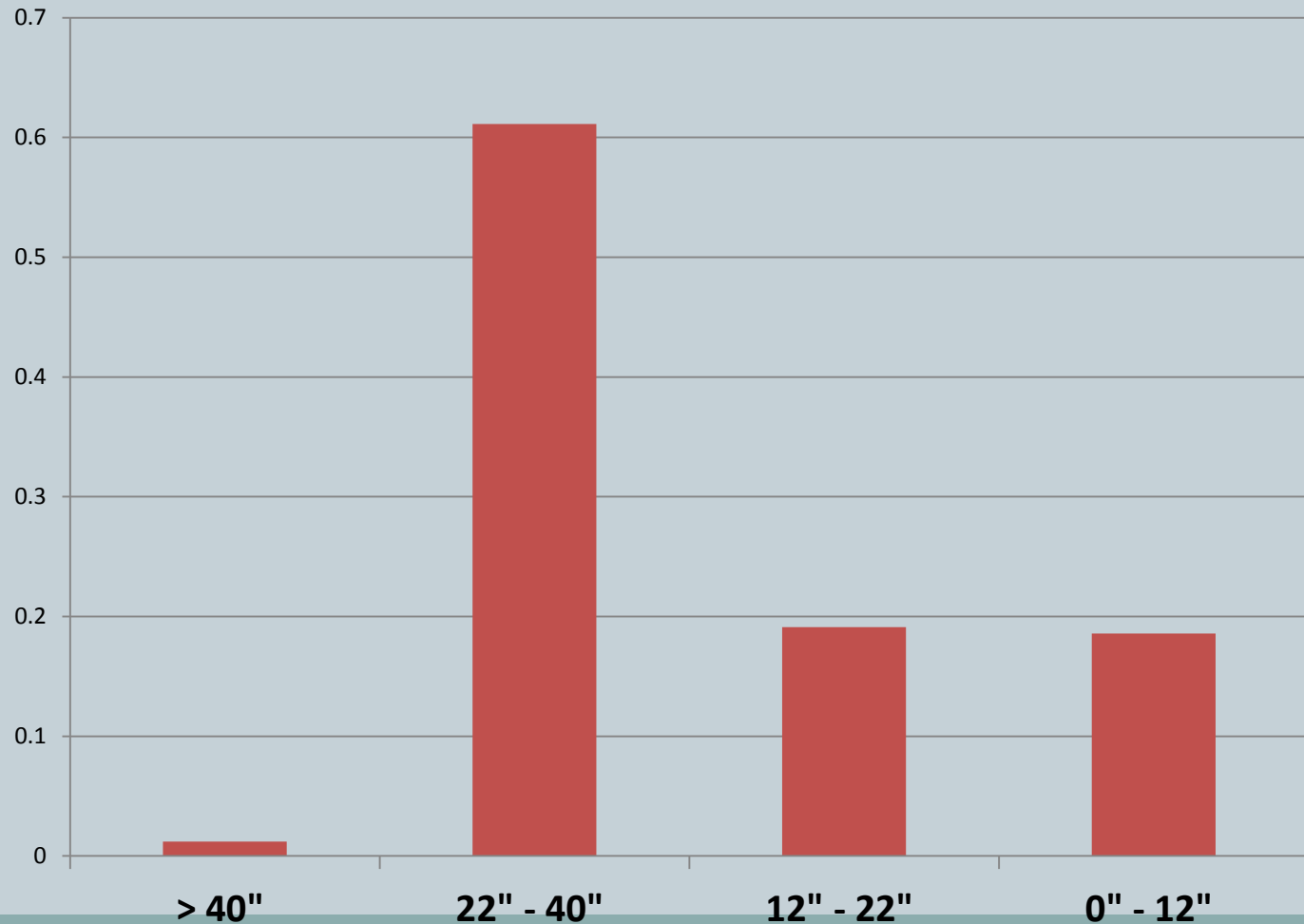
Eastside Cascades forested area, Wasco, Jeff., Deschutes Counties



Historic (1935) forest landscape structure

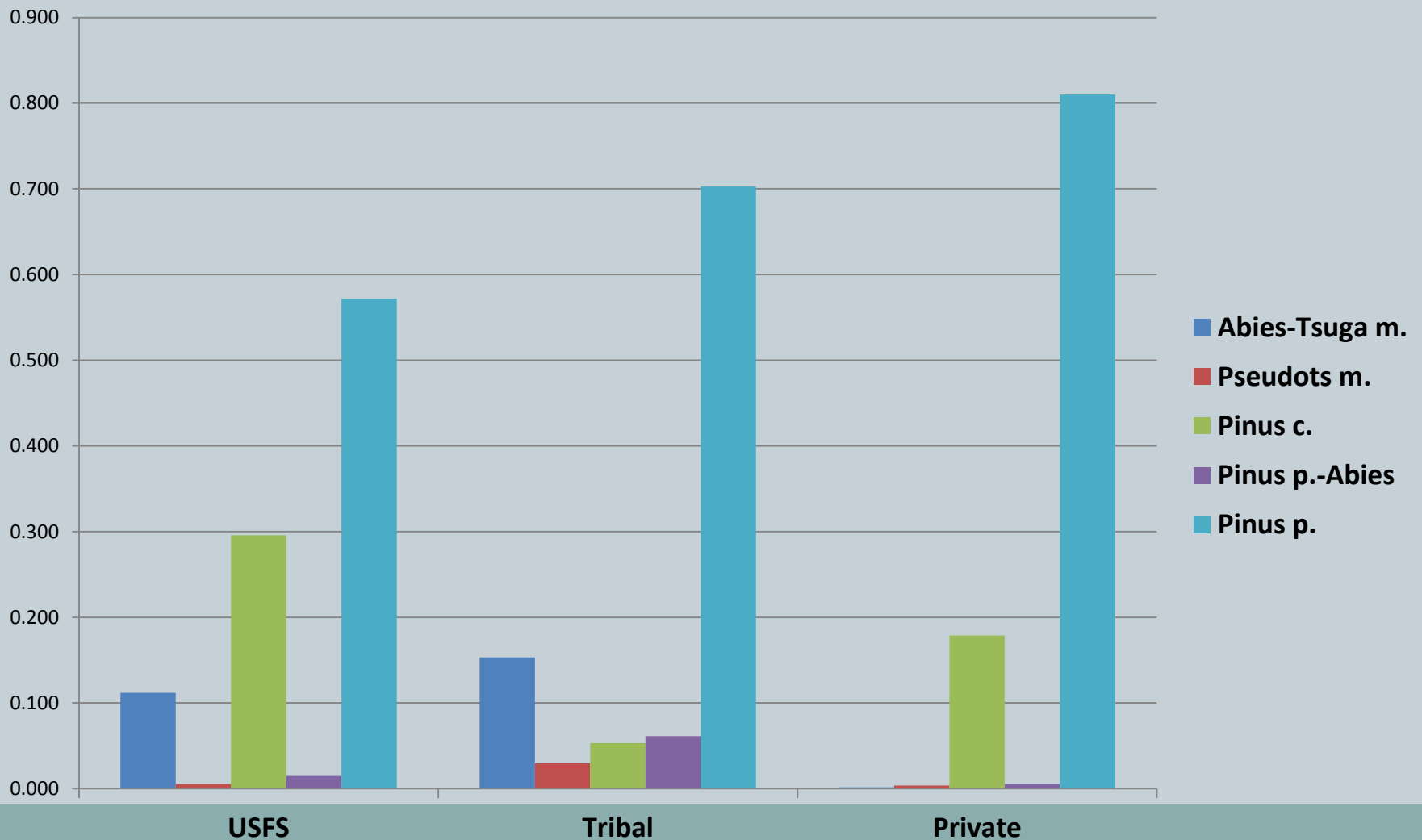
Timber forest covers only, other land-covers excluded

Eastside Cascades forested area, Wasco, Jeff., Deschutes Counties



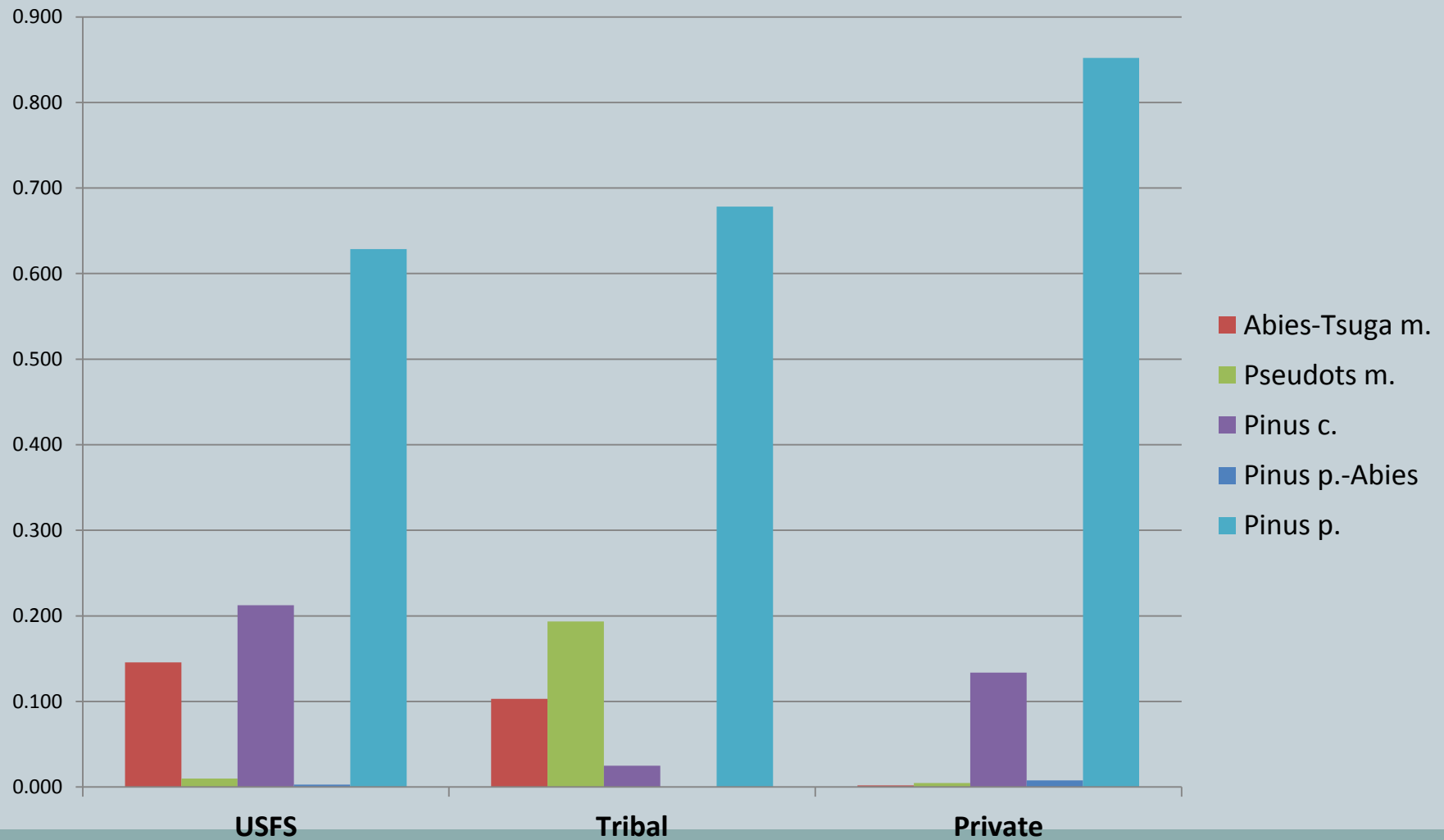
Forest landscape composition, 1935

Commercial timber species only



Forest landscape composition, 1953

Commercial timber species only



Forest landscape change (1935- 1953): *Forest composition*



Forest landscape change (1935- 1953): *forest structure*



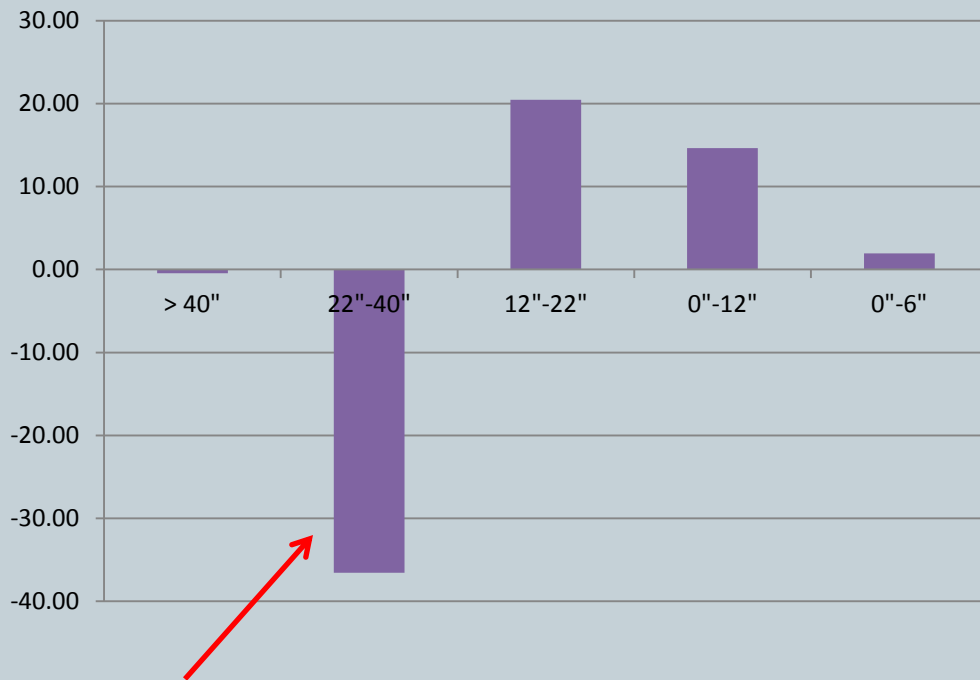
Explanatory variables



1. INSTITUTIONAL HISTORY

2. ENVIRONMENTAL HISTORY

(A) *private* Institutional history influence



Policies:

- maximize resource use
- promote town economic growth through forest product industry

“the history of Bend is the history of the lumber industry” (Briegleb 1936, FIA Report)

Organizational structure: top-down, autonomous

(A) *Private* Environmental history influence

Env. History factors

Transportation /
Tech. history

Culture/ Mgmt.
Paradigm

Economic history

1916-1930

Developed transportation
network (OR Trunk RR-
Bend 1911)

Maximize forest
resource use: old-
growth liquidation

Natural resource-
dependent town
economy

1930-1960

Gas-/Oil powered
transportation (trucks)
and mill machinery

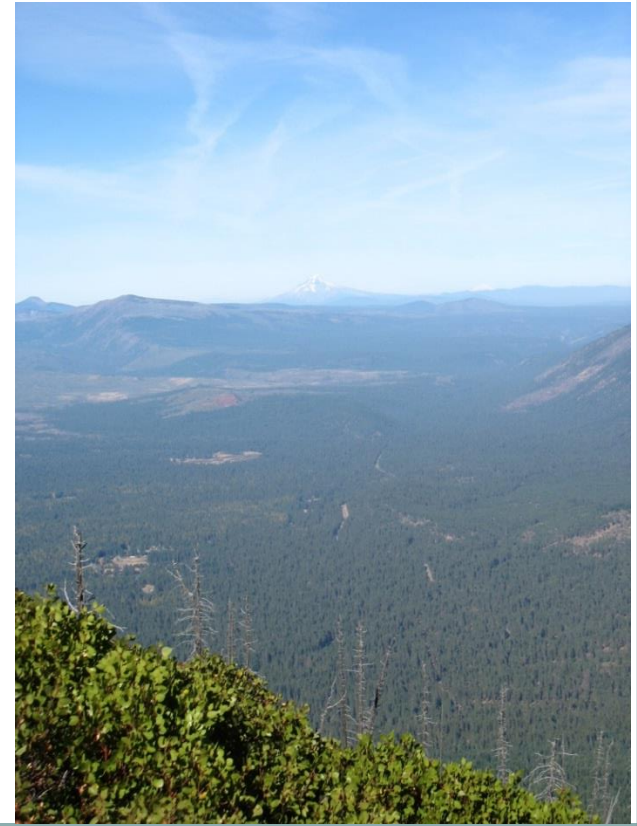
maximize forest
product utility

Nosedive in timber
production (1940-1950)
Land Exchanges with
DNF of cutover land

Deschutes National Forest



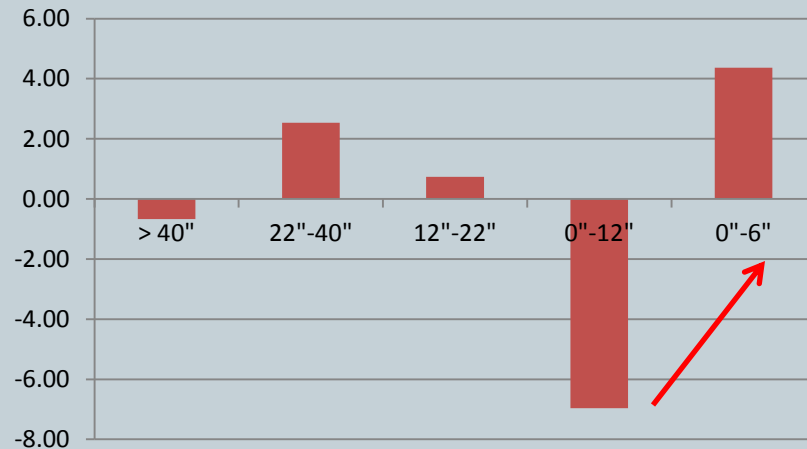
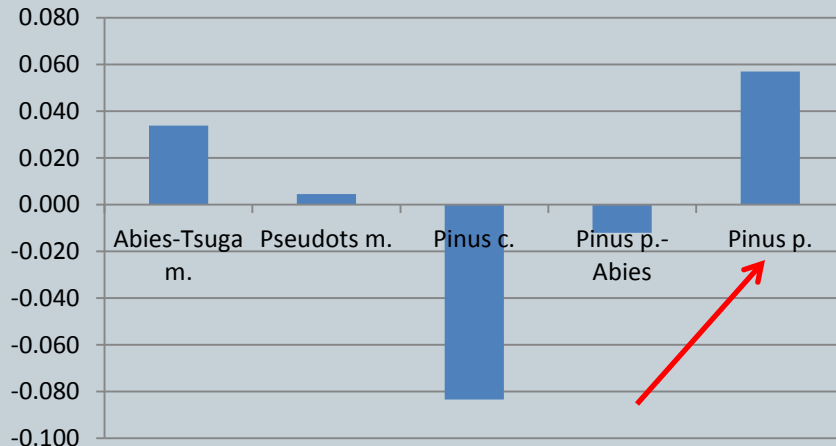
Three Sisters



Metolius Basin

(B) *public forest*

Institutional history influence



Policies:

- Forest protection (Clarke-McNary (1924),
- Science research -based forestry (McSweeney-McNary (1928)
- Sustained Yield (Knutsen-Vandenburg (1930)

Organizational structure:

- centralized, bureaucratic, science-based
 - Pringle Falls Experiment Station

(B) *public forest*

Environmental history influence

Env. history factors

Culture/ Mgmt. Paradigm

Economic system

1900-1930

Forest protection

‘Highest use’ (Pinchot)
Sustained-yield
old-growth liquidation

1930-1960

Forest protection

Sustained-yield

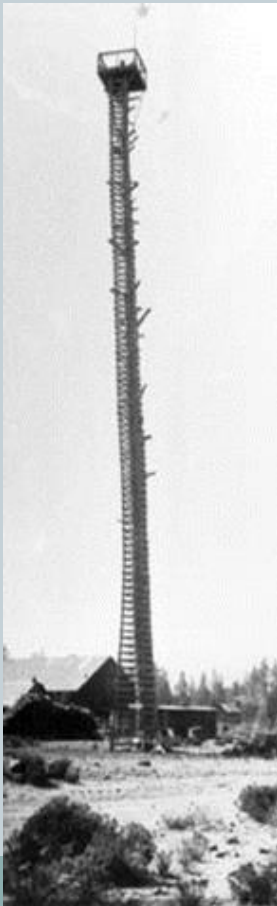
Public forest must
provide timber volume
when private lands
depleted

The image shows a historical document titled "SUMMARY OF FIRE REPORTS" for the National Forest, Leelanau District, for the calendar year 1904. The document is a detailed table with multiple columns including location, acreage, and fire statistics. The table is organized into sections for different types of fires and their impacts on the forest land.

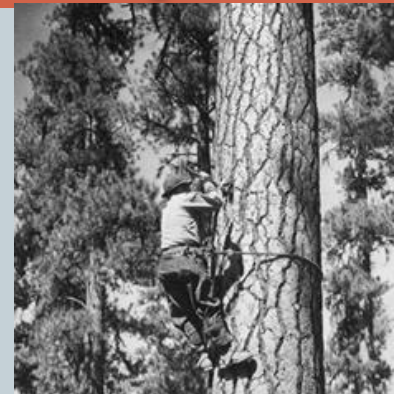
DESCRIPTIONS		NATIONAL FOREST		LEELANAU DISTRICT		CALENDAR YEAR 1904	
LOCATION	ACREAGE	ACREAGE	ACREAGE	ACREAGE	ACREAGE	ACREAGE	ACREAGE
1. FIRE IN THE FOREST	100	100	100	100	100	100	100
2. FIRE IN THE FOREST	100	100	100	100	100	100	100
3. FIRE IN THE FOREST	100	100	100	100	100	100	100
4. FIRE IN THE FOREST	100	100	100	100	100	100	100
5. FIRE IN THE FOREST	100	100	100	100	100	100	100
6. FIRE IN THE FOREST	100	100	100	100	100	100	100
7. FIRE IN THE FOREST	100	100	100	100	100	100	100
8. FIRE IN THE FOREST	100	100	100	100	100	100	100
9. FIRE IN THE FOREST	100	100	100	100	100	100	100
10. FIRE IN THE FOREST	100	100	100	100	100	100	100

Management paradigm: fire suppression

Fire surveillance



Fire Communication and transportation



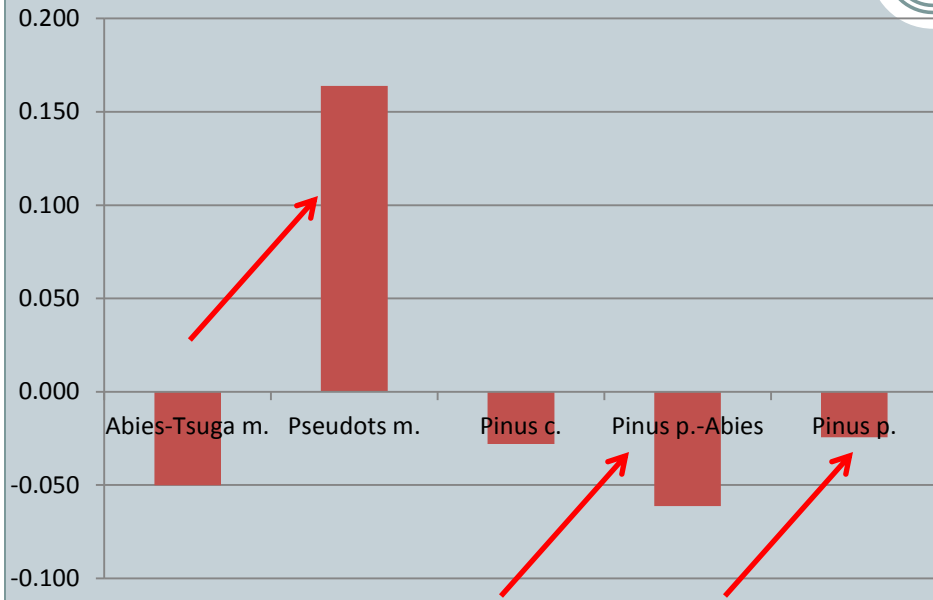
Deschutes N.F., Oregon. Source: Forest History Society.

Warm Springs Reservation



(C) *tribal*

Institutional history influence



Policies:

- Assimilation (General Allotment Act (1887);
- capitalize on natural resources to develop reservation economy

Organizational structure:

- centralized, bureaucratic,
- some local science

(C) *tribal*

Environmental history influence



Env. History Factors

Culture/ Mgmt.
Paradigm

Transportation
history

1910-1930

Sustained yield/
forest protection
2.5 MMBF/ \$10 M

Undeveloped
transportation
network
Deteriorating mills

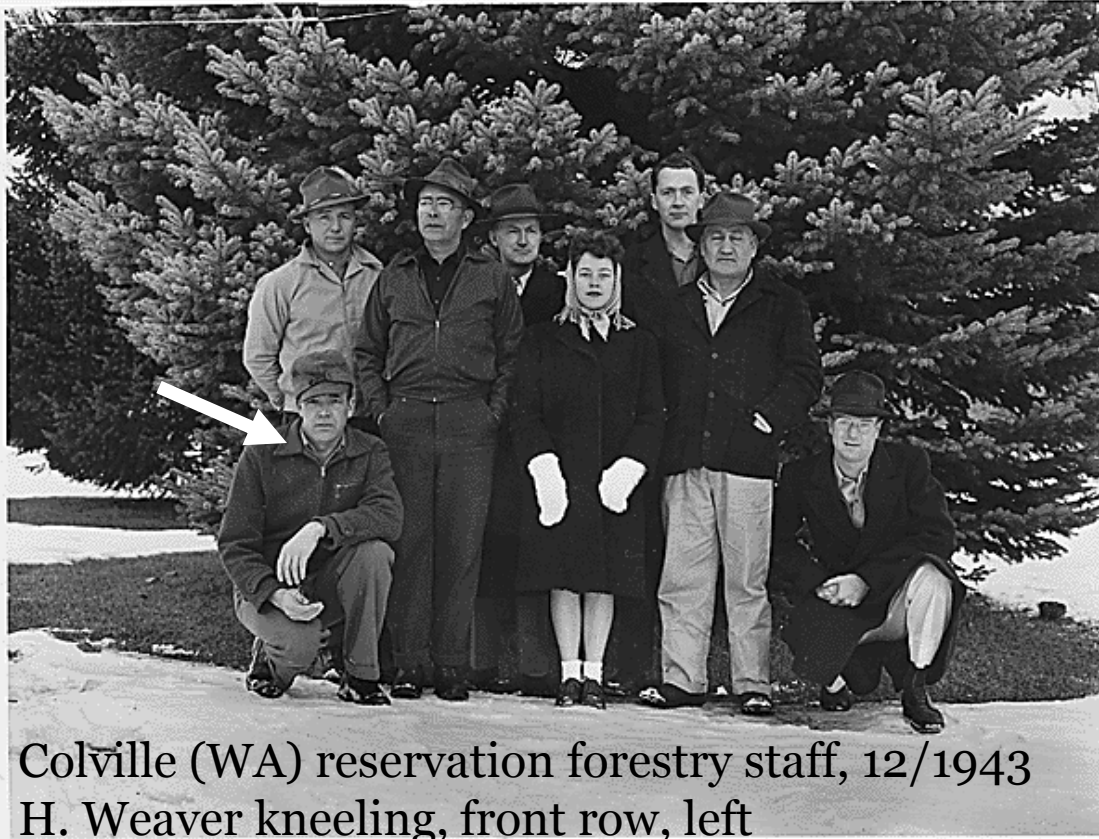
1930-1960

Sustained yield/
forest protection

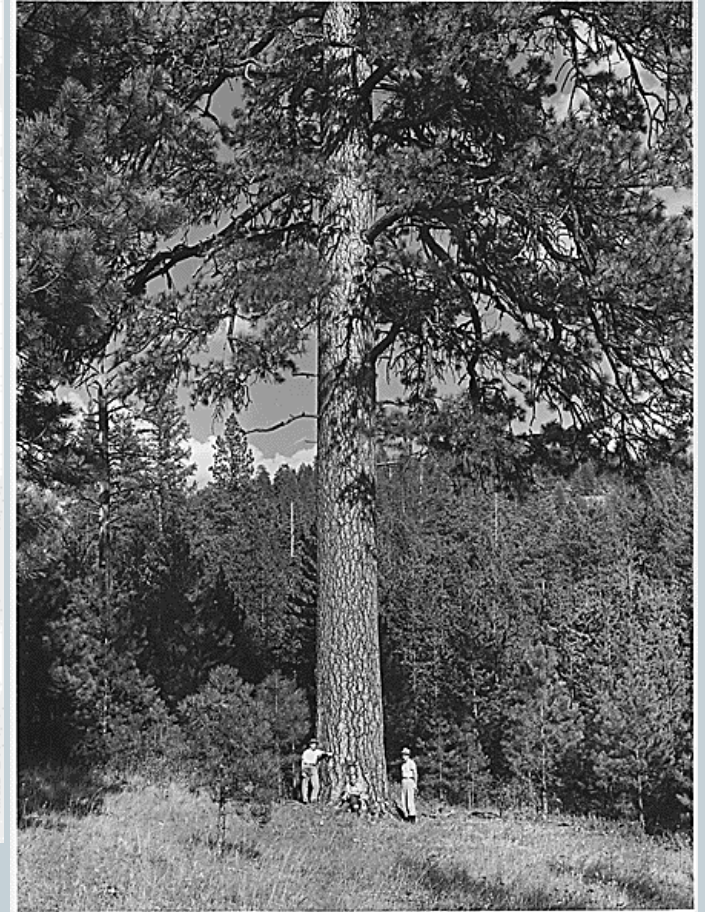
Informal
silviculture science
(H. Weaver)



Harold Weaver



Colville (WA) reservation forestry staff, 12/1943
H. Weaver kneeling, front row, left



H. Weaver poses with the largest Ponderosa
Pine on the Colville (WA) reservation, 1941

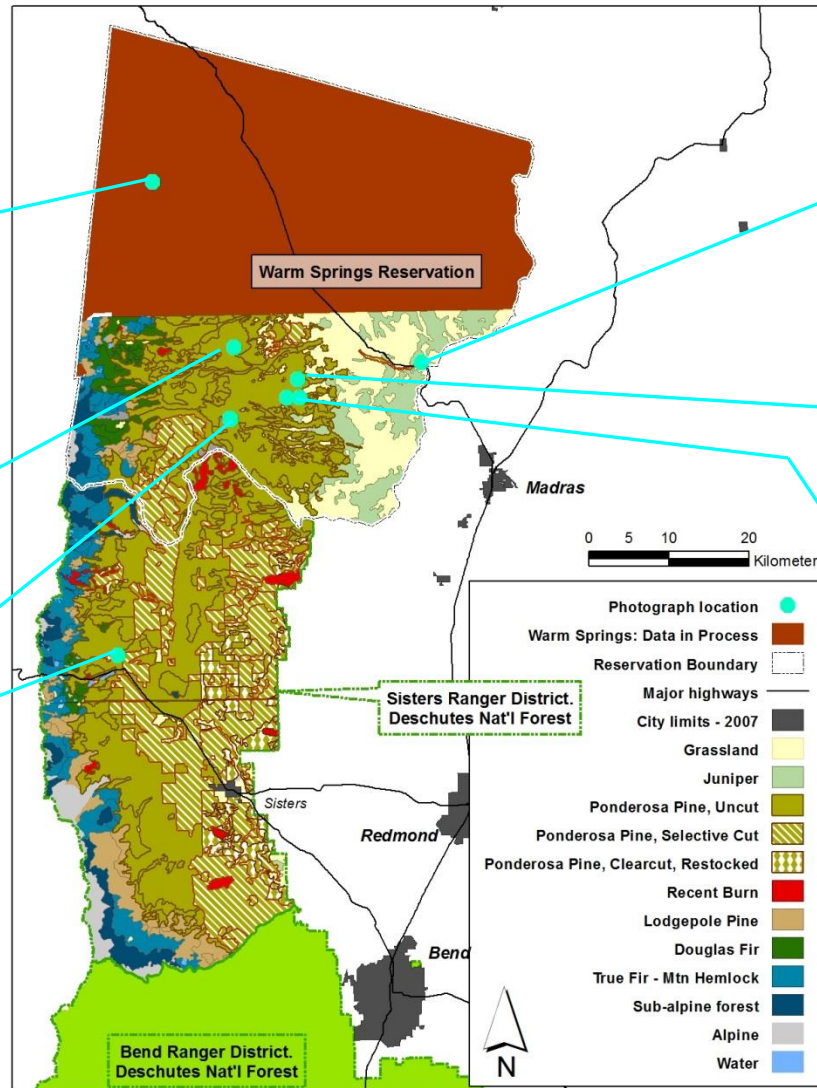
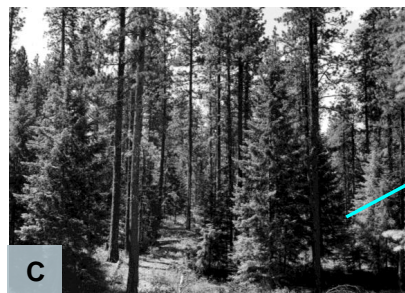
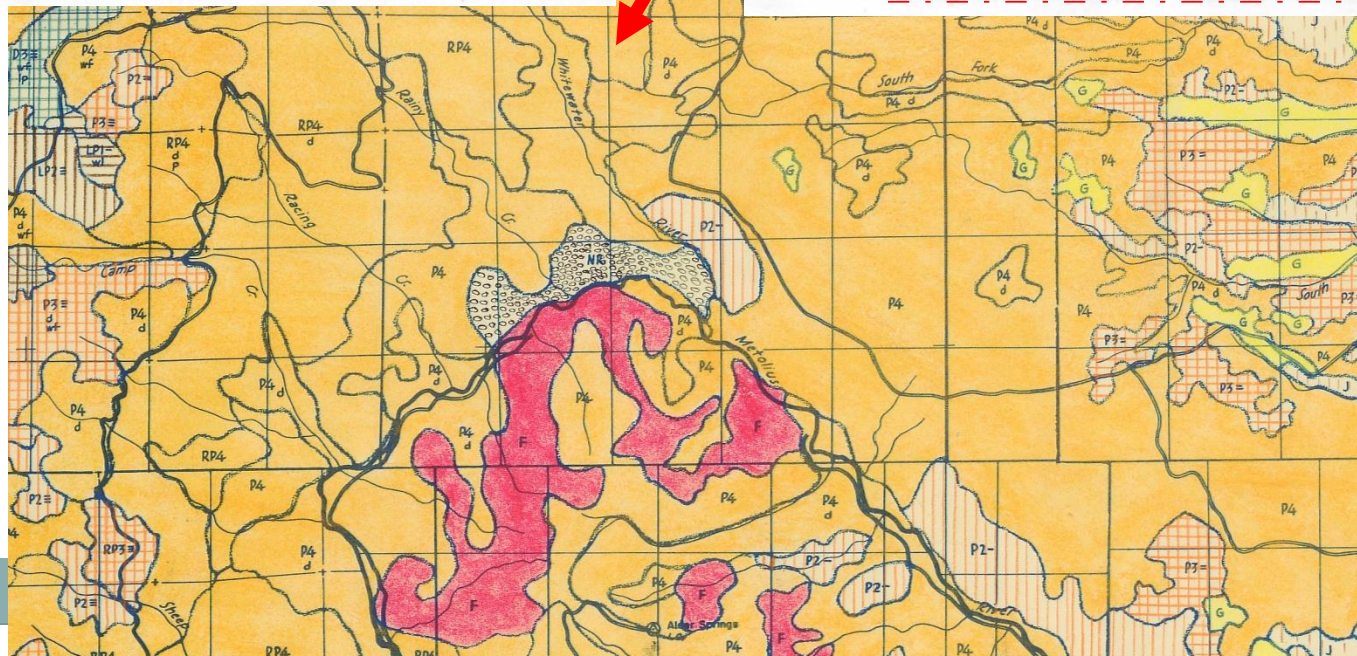




Photo #17 - Parts of extensive western portions of Metolius and Tenino Benches still appeared open and parklike, with comparatively little debris, brush and advance reproduction when this photo was taken in December 1939. This is on the east slope of Middle Butte in NWNW Section 15, T. 10 S., R. 10 E.



Photo #18 - This photo, taken August 8, 1957, is of the same scene photographed almost 19 years before and depicted in Photo #17. Note the development of dense advance reproduction, predominantly of incense cedar and the added accumulation of snags from beetle-killed pines. There has been great increase in the fire hazard.



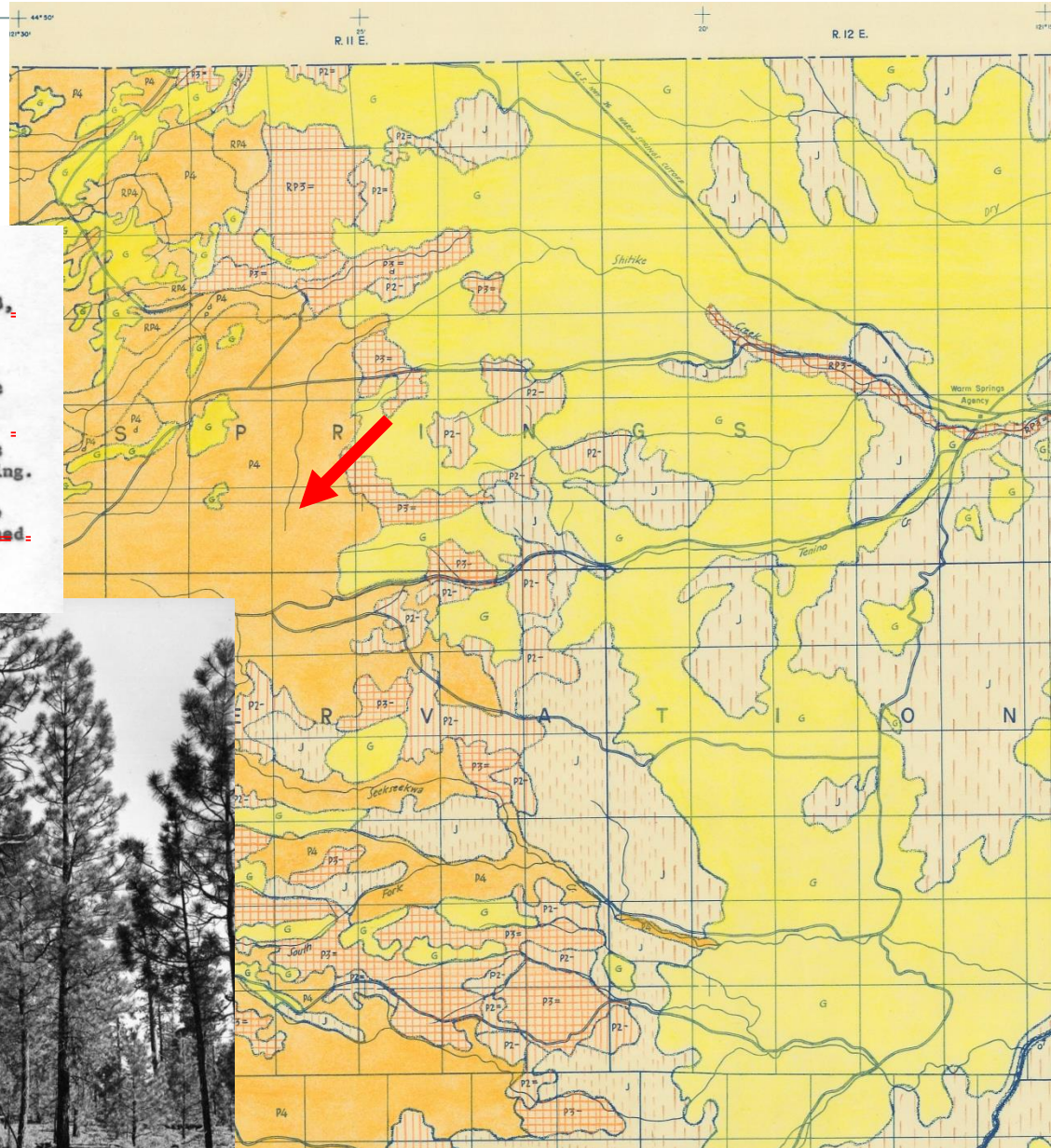


Photo #14 - This is typical of the several thousands of acres of Tenino Bench that were burned by the great fire of July 1938. This photo was taken in N.E.N.W. Section 33, T. 9 S., R. 11 E., on May 18, 1961, approximately 23 years and 22 growing seasons after the fire. Note remains of fire-deadened ponderosa pine saplings and poles that litter the ground. Despite poor growth site conditions (estimated at Site V), the surviving poles are now making excellent growth. Robert Reutlinger, Forester, is standing by a dominant tree from which was taken the increment core pictured in Photo #15, following.

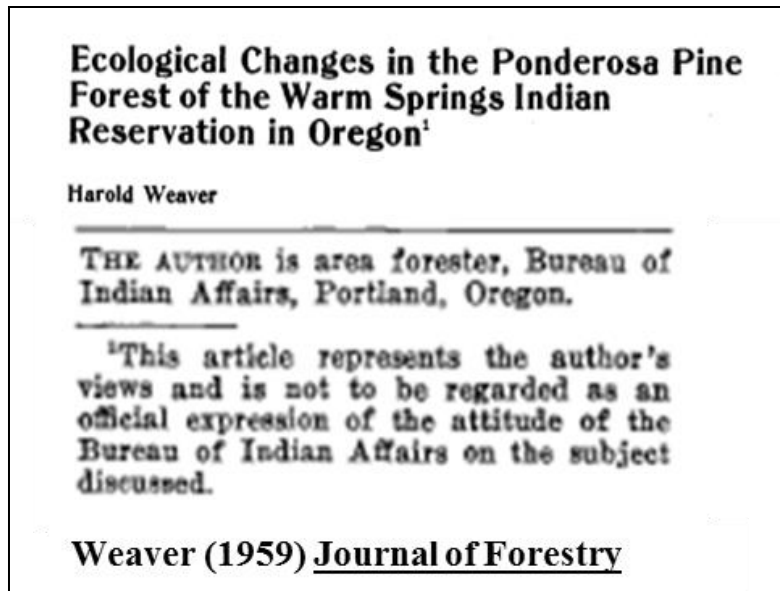
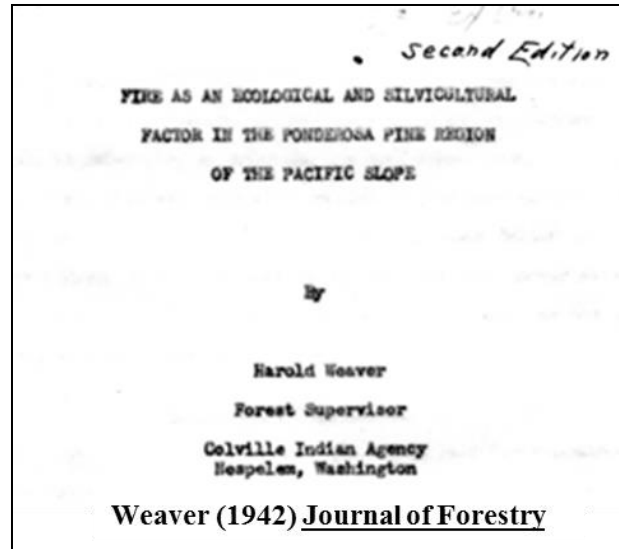
Most of the pole groups on the burned portion of Tenino Bench were fire thinned in such manner. Severely thinned spots have seeded to subsequent pine reproduction that is also making rapid growth. Stocking is considered adequate.



Fire science knowledge generation

- Incursion of Shade-tolerant species on fire-adapted sites
- Shrub /fuel load accumulation
- Controlled burning experimentation

Source: Forest History
Society Archives



Institutional failure to adopt science knowledge

Factors:

- Lack of alignment with agency policy
- Exposure to criticism
- Demand on managers' time
- Program Funding structure not yet developed
- Historical contingency: WWII era

Source: Forest History Society Archives

REFER IN REPLY TO THE FOLLOWING

Forestry

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF INDIAN AFFAIRS
WASHINGTON

Mr. Harold Weaver,
Forest Supervisor,
Colville Indian Agency,
Nespelem, Washington.

JAN 15 1942



My dear Mr. Weaver:

I have read with much interest your report entitled "Fire as an Ecological and Silvicultural Factor in the Ponderosa Pine Region of the Pacific Slope" which you loaned to Mr. L. D. Arnold last fall with the request that you be authorized to publish it in the Journal of Forestry.

The manuscript has been read by several persons in the Department and I enclose copies of memoranda by Mr. J. D. Coffman, Chief of Forestry of the National Park Service, and by Mr. Lee Muck, Assistant to the Secretary in Charge of Land Utilization. As indicated by Mr. Muck this is a controversial subject. If you were authorized to publish the article it would undoubtedly require a great deal of your time and thought in answering criticisms.

Controlled burning might help to reduce forest fire losses in areas where the hazard has increased due to protection but it will take time to develop the necessary efficient technique. It would also take time to secure funds applicable for controlled burning.

In view of the fact that our efforts for some time will be directed to winning the war, I doubt the advisability of having the article printed in the near future and until you have had the opportunity for further study and revision. In view of the policy of the Department and this Office, based on experience, we do not wish to approve the paper officially for publication. If, however, you wish to publish the paper as an individual without reference to your official position you may do so. I wish to commend you for the initiative you have shown in developing this study. We need more of this type of progressive thinking by foresters. The article is enclosed herewith.

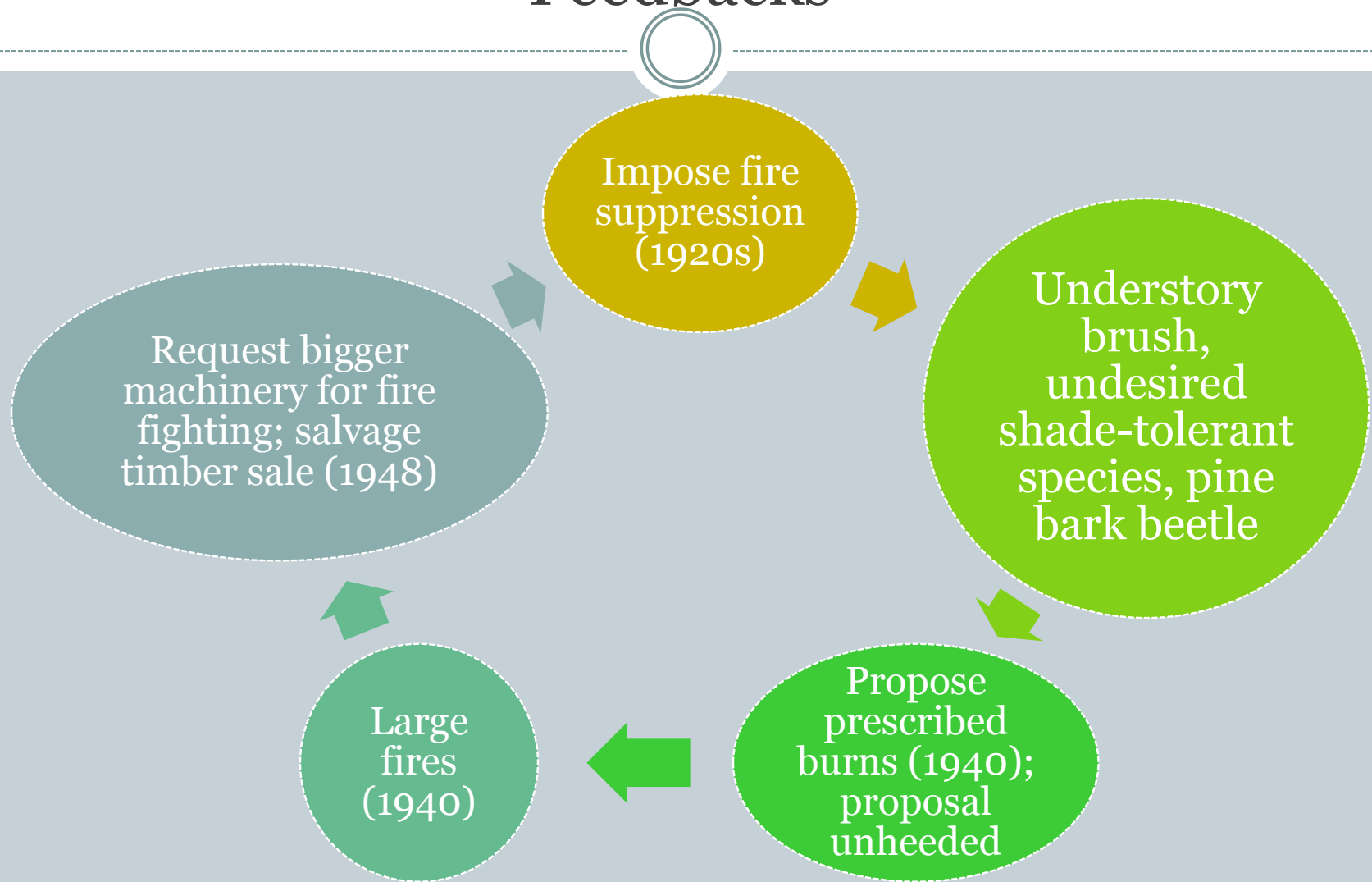
Sincerely yours,

Assistant to the

Commissioner.

I initiated controlled burning experiments on Southern Pacific cut-over lands 125 years ago. I'm wondering whether there was a notice made use of these experiments. W.W.

(C) *tribal* Feedbacks



Demographic – forest products relationships through time



- Stay tuned!

Significance & implications



Do past management decisions and land-cover change vary with institutional and environmental histories?

Significance?

- Yes.

	<i>Pinus p.</i>	<i>Pseudosuga m.</i>	<i>Abies-Tsuga m.</i>	<i>Pinus c.</i>	bugs	Under story shrub
Public forest	+		+	-	+	?
Tribal	-	+		-	++	+
Private	+			-	?	?

- (1) “For the first time, significant changes in the structure, composition, and fuel loads were documented in forests that primarily experienced frequent, low- to moderate-intensity fire regimes. ***The implications of these investigations were profound but not utilized by contemporary policy*** (Stephens and Ruth 2005:533).
- (2) Institutional explanations:
 - (1) (a) political: exposure to criticism
 - (2) (b) organizational: hierarchical structure
 - (3) (c) programmatic/ budgetary: controlled burning program didn't exist; staff positions already allocated
 - (4) (d) historical contingency: event (WWII) that dominated national attention

Do past management decisions and land-cover change vary with institutional and environmental histories?

Significance?

- Yes.

	<i>Pinus p.</i>	<i>Pseudosuga m.</i>	<i>Abies-Tsuga m.</i>	<i>Pinus c.</i>	bugs	Under story shrub
Public forest	+		+	-	+	?
Tribal	-	+		-	++	+
Private	+			-	?	?

- Retrospective historical insights:

(2) Of the three ownerships, the timber losses were likely greatest on the reservation: longest period of negligible commercial timber harvest during fire suppression conditions.

- (1) Significant loss for tribal social system: timber-based economy
- (2) Institutional failure, despite excellent on-the-ground science, and emerging progressive administration (Bob Marshall, BIA For. Div.)
- (3) Historical contingency effect: Poor transportation network/ market access; poor infrastructure (tribal ownership), compared to good market access (public forest, private) at a time (1910s- 1920s) when other supplies (Great Lakes) depleted.

Do past management decisions and land-cover change vary with institutional and environmental histories?

Significance?

Policy implication:

- An organizational structure that promotes field-based, scientific research is more likely to monitor ecological response to management interventions and propose novel adaptations.
- Loosely networked organizational structure
- Organizational structure that allows for two-way communication and decision-making (bottom-up, top-down) are more likely to develop adaptive decisions than those with one-way (top-down) communication and decision-making alone.
 - especially important if paradigms are to evolve in sync with on-the-ground, emerging knowledge generation, rather than atrophy in earlier generation (potentially outdated) knowledge.
- Especially relevant during turning points when humans impose strong departure from inherent disturbance regime/system dynamics.

Next steps



- Bring forest landscape change analysis to ca. 2000 (?GNN, GAP or late 20th c. FIA data)
- Complete GIS layers of FPF southern zone
- Improve ownership history geography/ refine ownership analysis of land-cover
- Develop forest products analysis dataset
- Multivariate analysis

Acknowledgements



- National Science Foundation Coupled Human and Natural Systems Program (NSF Grant CNH-1013296)
- PNW Research Station, Portland Lab, USDA Forest Service
- University of New England
- Interviewees:
 - CTWS Natural Resources Dept.
 - Deschutes National Forest
- GIS Database of FIA data: Dale Weyermann, Andy Gray
- GIS Mapping & Analysis: Mark Adams, Keith Olson
- Research Assistance: Kendra Wendell

Post-talk Discussion / q & a slides



Framework of Environmental history influences on forest landscape decisions:

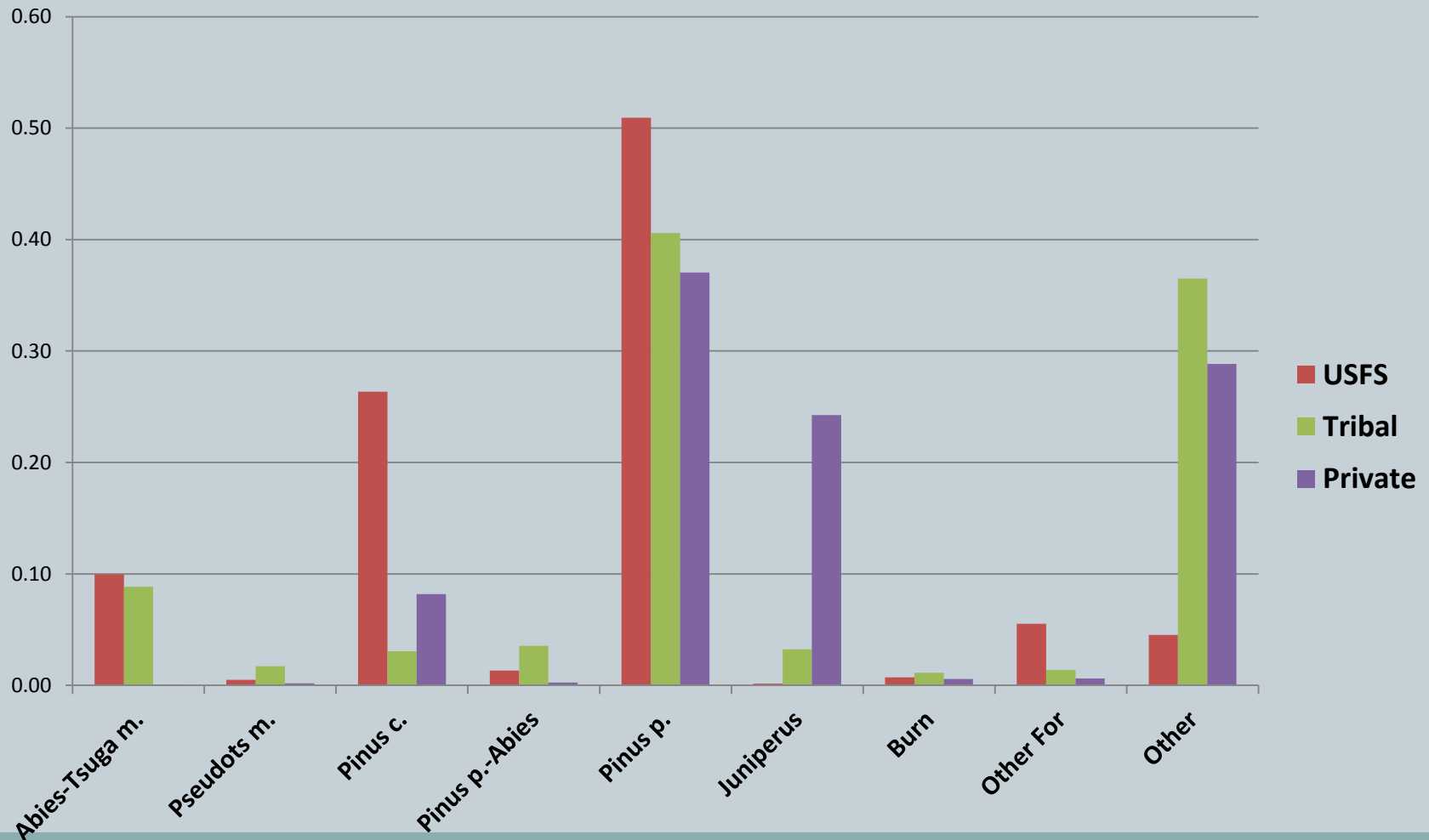
humans as landscape modifiers

Economic system	Pre-industrial, non-extractive (transition with fur trade)	Pre-industrial, extractive	Industrial	Post-industrial
Culture	Traditional/tribal	Frontier/Euro-American settlement	“Highest use” (Pinchot) Utilitarian	Forest sustainability: ecological stewardship
Knowledge system	TEK	Bureaucratic knowledge	Bureaucratic knowledge	TEK/ LEK
Transportation system	Trails, waterways, horses	Railroads; regional	Highways (trucks), airways; global	
Technology		Handsaws, steam donkey	Gas combustion	

Period	National Forest- DNF	Tribal- WS	Private: Shevlin-Hixon, Brooks-Scanlon
Administrative establishment	1893/ 1905/1908	1855 18XX: local use sawmills	NA
Develop forest harvest/ fire suppression network	1910 1935: 10:00 am policy		1916: Shevlin-Hixon, Brooks-Scanlon co. est. By 1936: land exchanges of cutover land with uncut land
Post-WWII: industrial forestry, industrial fire suppression		Expanded tribal sawmill built	1940: Production peak: 258 MMBF 1940-1950: production nose-dive: 1950: 42.5 MMBF
Turning points/ System collapse:	1988, 1994, 1996, 2000, 2002: major fire events; ICBEMP	1992: Tribal governance of resource management— BIA only assist	1980: Brooks-Scanlon merges with Diamond Interational
Revision			

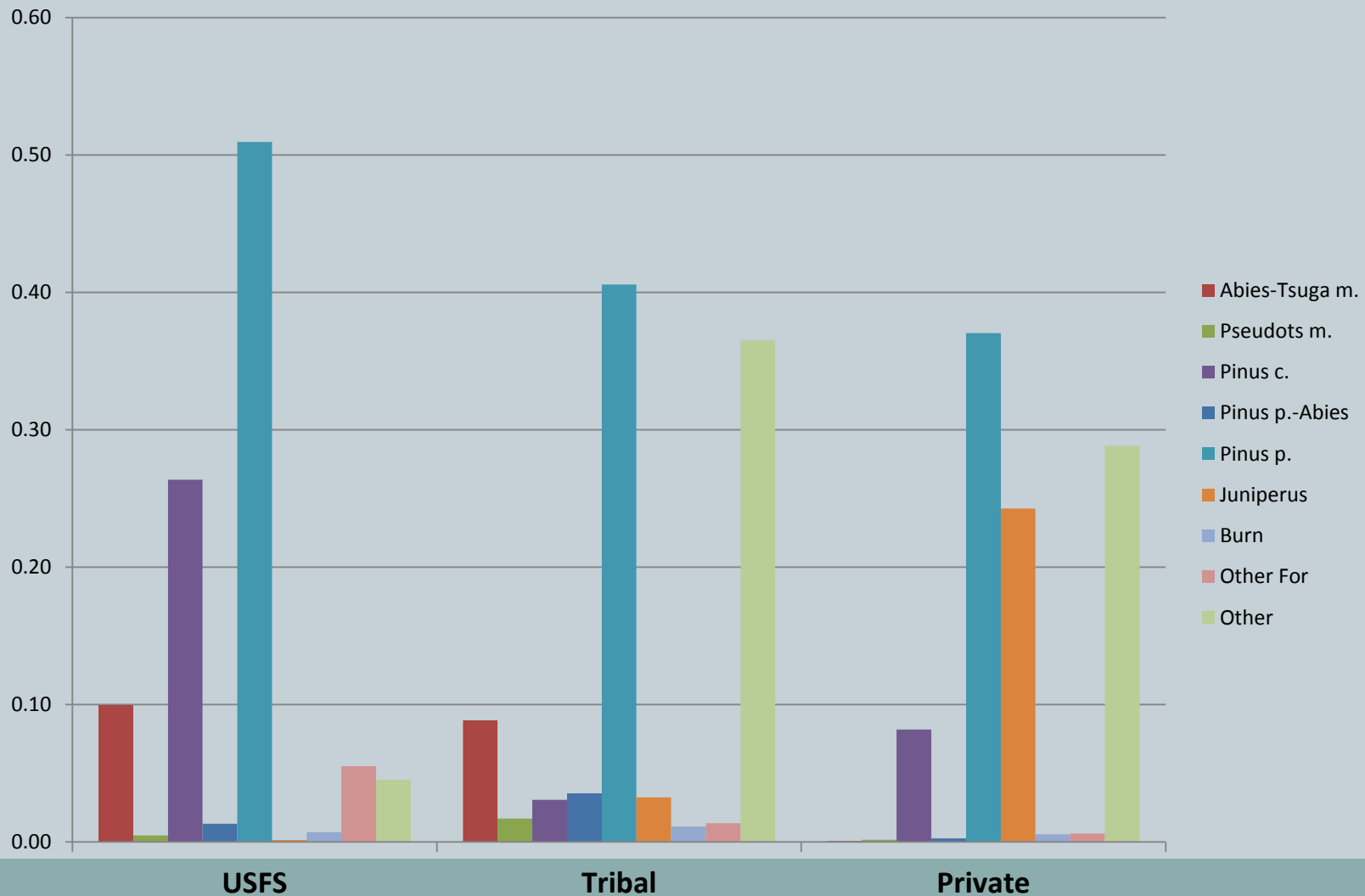
Forest landscape pattern, 1935

Oregon and Washington Forest Survey



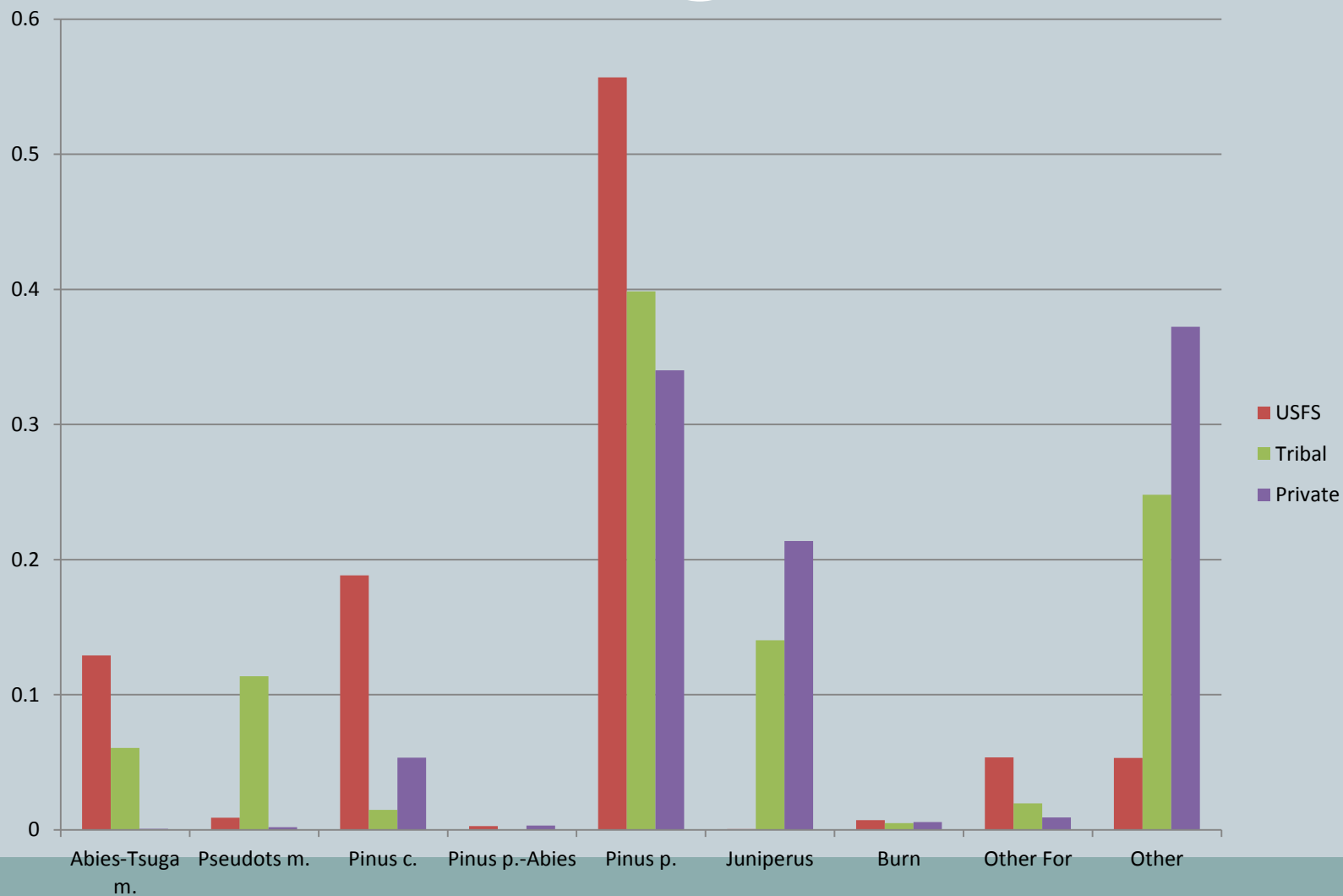
Forest landscape pattern, 1935

Oregon and Washington Forest Survey



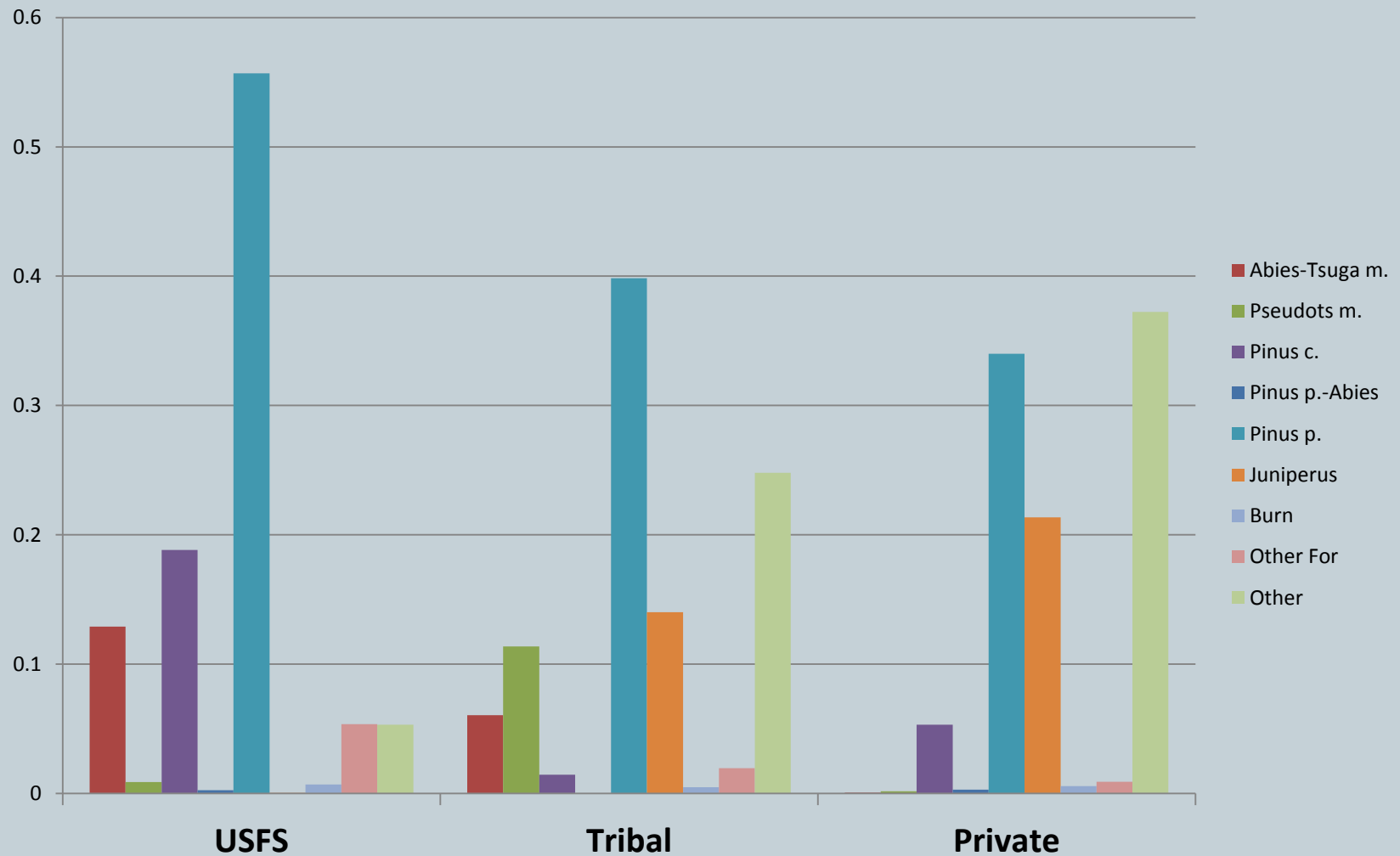
Forest landscape pattern, 1953

County reinventory



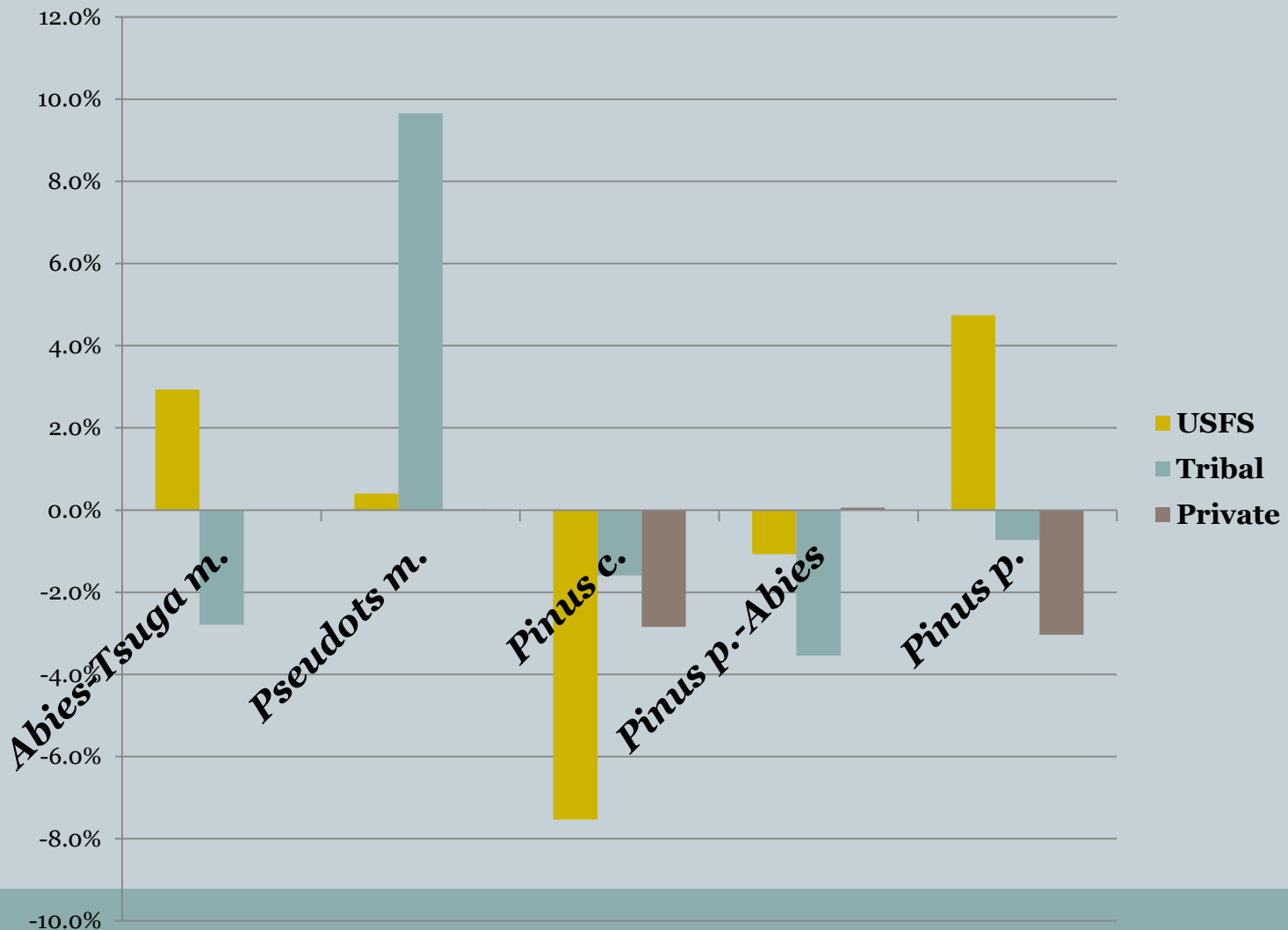
Forest landscape pattern, 1953

County reinventory



Forest landscape change: composition, 1935- 1953

Commercial timber species only



Forest landscape change: structure, 1935- 1953 Commercial timber species only

