



Wildfire Risk in the Northern Rockies, Southwest & Northwest Geographic Areas

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Outline

1. Introduce how land managers make decisions on wildland fires: the Wildland Fire Decision Support System (WFDSS)
2. Introduce how land managers make an initial assessment of risk on wildland fires
3. Show how risk is different spatially for the U.S. with a focus on the Northwest, Northern Rockies and Southwest
4. The role of barriers for the Southwest; how barriers can provide more flexibility in decision making



Risk

The Wildland Fire Decision Support System

**Wildland Fire
Decision Support System**

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Welcome!

Wildland Fire Decision Support System

Welcome to the Wildland Fire Decision Support System (WFDSS).

Note: Click [WFDSS Known Issues](#) to see the list of the most current issues and suggested workarounds for WFDSS.

This system assists fire managers and analysts in making strategic and tactical decisions for fire incidents. It has replaced the WFSa (Wildland Fire Situation Analysis), Wildland Fire Implementation Plan (WFIP), and Long-Term Implementation Plan (LTIP) processes with a single process that is easier to use, more intuitive, linear, scalable, and progressively responsive to changing fire complexity.

WFDSS integrates the various applications used to manage incidents into a single system, which streamlines the analysis and reporting processes.

WFDSS provides the following advantages over previous systems:

- Combines desktop applications for fire modeling into a web-based system for easier data acquisition.
- Provides an easy way for fire managers and analysts to accurately document their decision-making process by allowing results of analyses to be attached to the decision point and included in the final incident report.
- Provides one decision process and documentation system for all types of wildland fires.
- Is a web-based application for easier sharing of analyses and reports across all levels of the federal wildland fire organization.
- Introduces economic principles into the fire decision process.

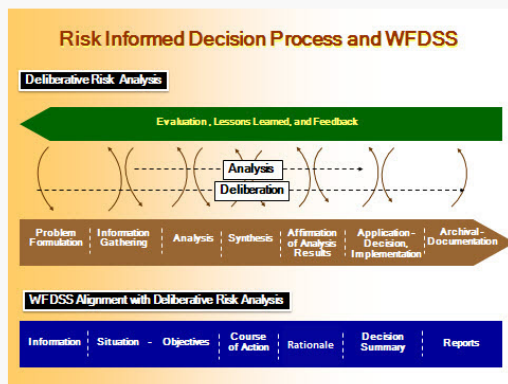
Before you log into WFDSS, make sure you read and understand the system [Rules of Behavior](#).

WFDSS follows an analytic deliberative process for decision making. The following graphic displays this process. Click [here](#) for further information.

Figure 1: Risk Informed Decision Process and WFDSS

WFDSS Help Desk
<https://iia-hd.peckham-enclave.us/>
(Add WFDSS to subject line)
+1 866.224.7677 or
1 616-323-1667

**Analysis & Decision
Content Support**
+1 208-473-8107



Last updated on 5/1/2018 2:26:41 PM.

Relative Risk Assessment

- Users rate three sub elements each for Values, Hazard, and Probability (High, Mod, or Low except for Probability)*
- * Seasonal Severity has 5 categories including Very High and Extreme
- The three main elements (Values, Hazard, Probability) derived from the user-rated sub-elements are used to produce the final relative risk rating
- Users also provide plain text Notes to support their ratings

Relative Risk (Draft)

Probability

Low Mod High

High

Mod

Low

High

Mod

Low

Relative Risk

Incomplete

Saved By

Noonan-Wright, Erin

Potential Fire Duration

Moderate

Assessment Published

Relative Risk Notes

Relative Risk is high. The fire is adjacent to communities, but is exhibiting moderate fire behavior. Control lines are in place.

Select the appropriate radio buttons for Hazards, Values, and Probability to calculate the Relative Risk.

Use 'Continue' to complete your Relative Risk Assessment

View Published Continue Return

*Potential Fire Duration

☐ Low
 ☒ Moderate
 ☐ High

Estimate the Potential Duration from today.

Values

Proximity & Threat of Fire To Values

Low Mod High

High

Mod

Low

High

Mod

Low

Natural/Cultural Resource and Infrastructure Values

Social/Economic Concerns

Values Notes

There are no known cultural values but the fire is burning in the California Gnat Catcher Habitat (T&E Species). There is a community about 0.5 miles from the fire that could be threatened. With current fire

Hazards

Fire Behavior

Low Mod High

High

Mod

Low

High

Mod

Low

Fuel Condition

Potential Fire Growth

Hazards Notes

The fire is burning in grass and chaparral but is headed to 2017 rx fire unit. Fire behavior (flame length and rate of spread) is moderate with 5-8 mph winds from the Southwest. Potential for growth is

Probability

Barriers to Fire Spread

Low / Many Mod High / Few

High / Early

Mod

Low / Late

High

Mod

Low

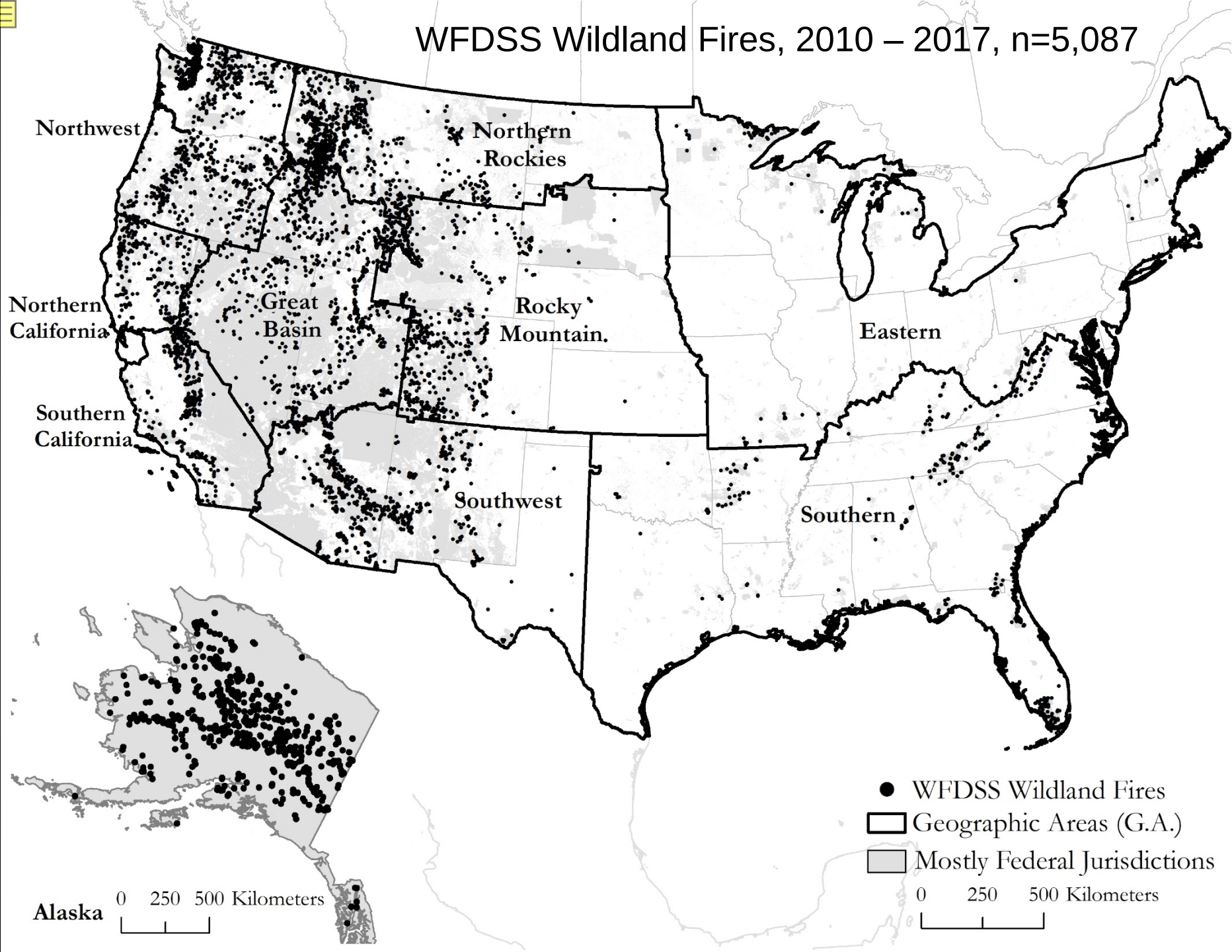
Time of Season

Seasonal Severity

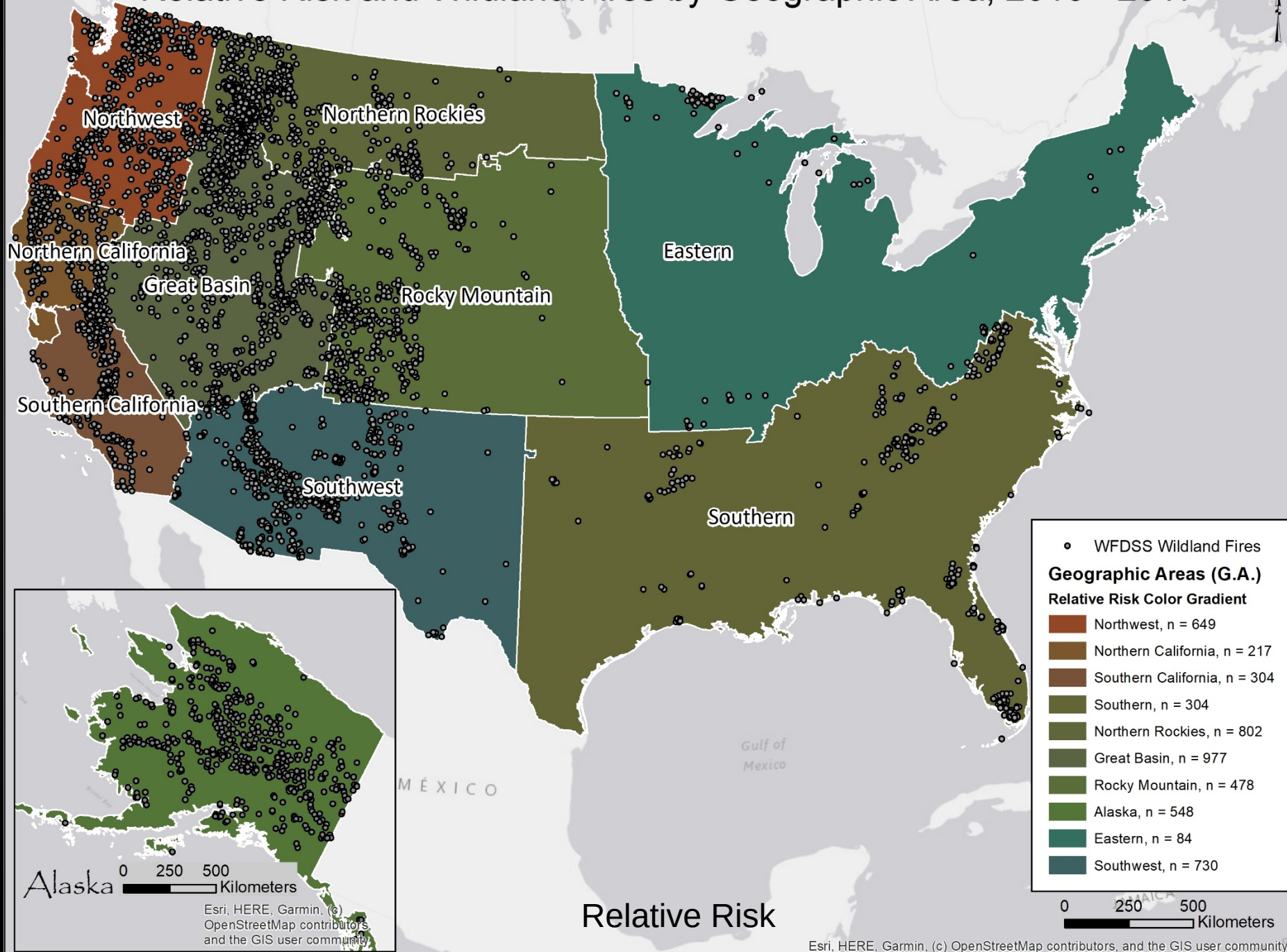
Probability Notes

There are fuel breaks to check the fire on the ridges. We are in the middle part of the fire season with the burning index in the 80th percentile.

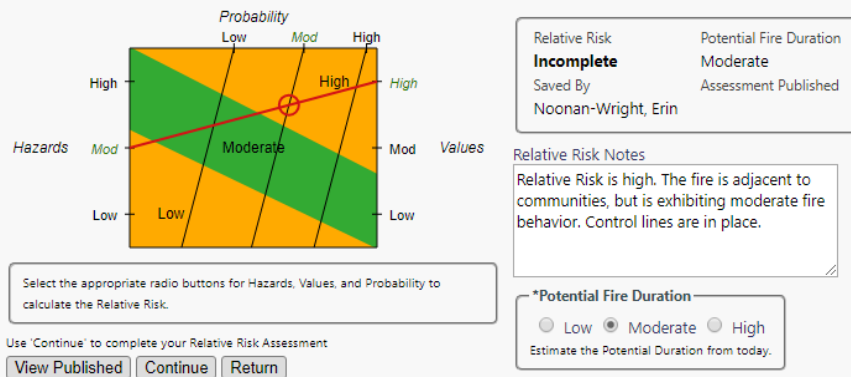
WFDSS Wildland Fires, 2010 – 2017, n=5,087



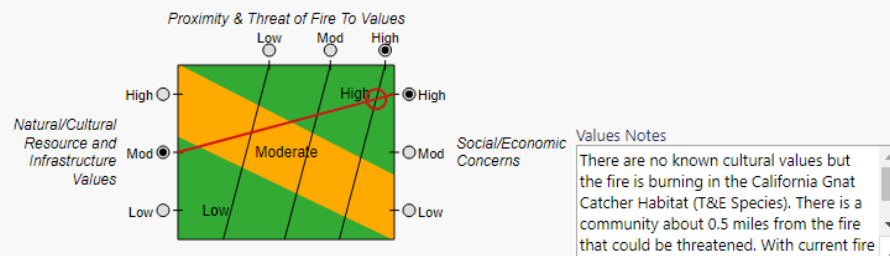
Relative Risk and Wildland Fires by Geographic Area, 2010 - 2017



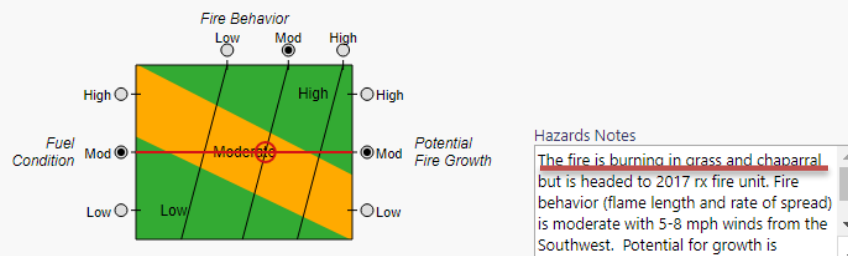
Relative Risk (Draft)



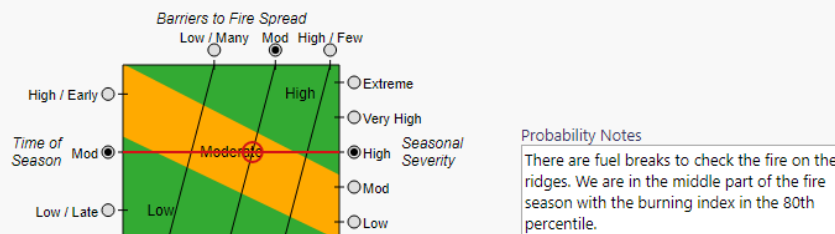
Values



Hazards

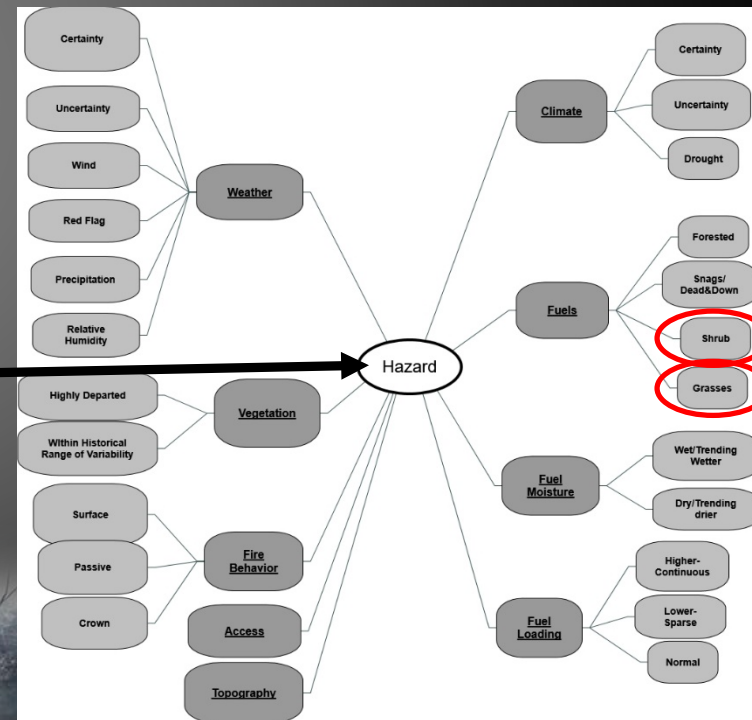


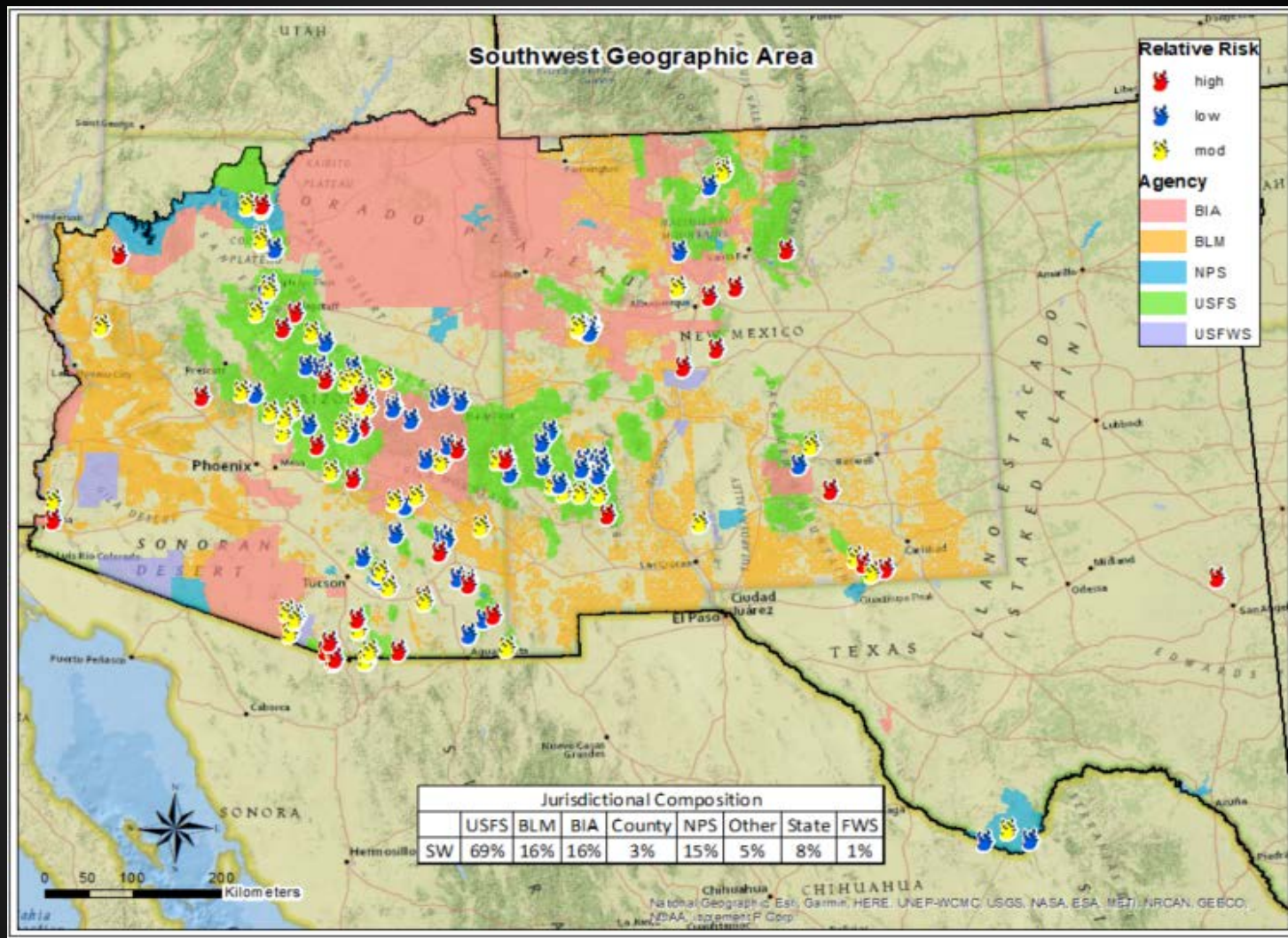
Probability



Methods

- Coding
- Summarize the notes by dividing the what land managers talk about into main subject areas

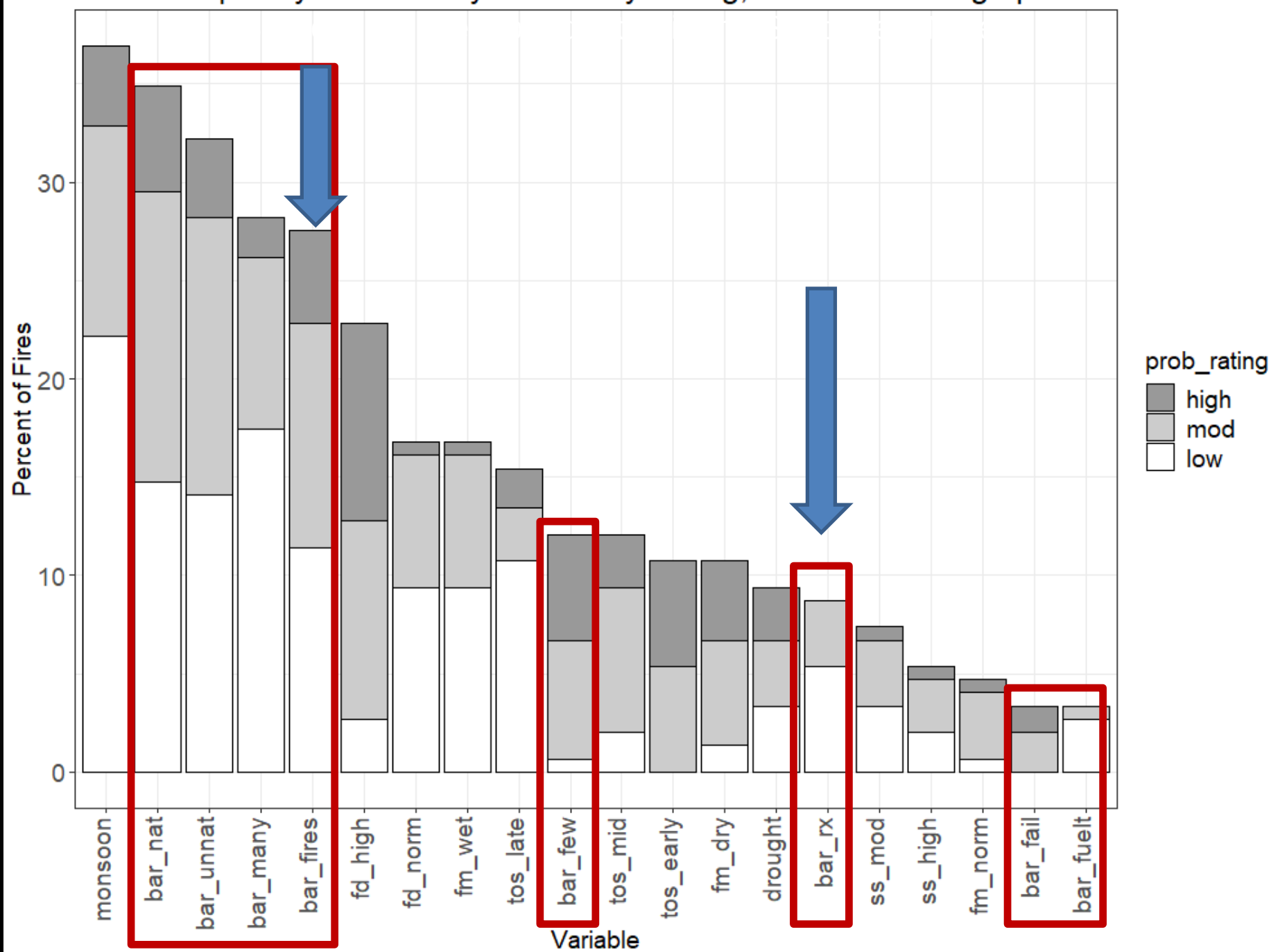




- 20% stratified random sample of the fires from the SW (n=149)



Percent Frequency of Codes by Probability Rating, Southwest Geographic Area



Barriers from Previous Fires in the Southwest

- The Southwest references previous wildfires for 41 out of 149 total fires (28%)
- More for low relative risk fires (n=19).
- Barriers from previous wildfires are mentioned along with references to the monsoon (54%), unnatural barriers (46%), presence of precipitation (45%), and low fire behavior (41%)

For example,

“The fire area has not burned in recent history, but is surrounded by numerous areas that have burned in wildfires or prescribed fires in the last 5 years.” - 1293782 Southwest Low Relative Risk fire

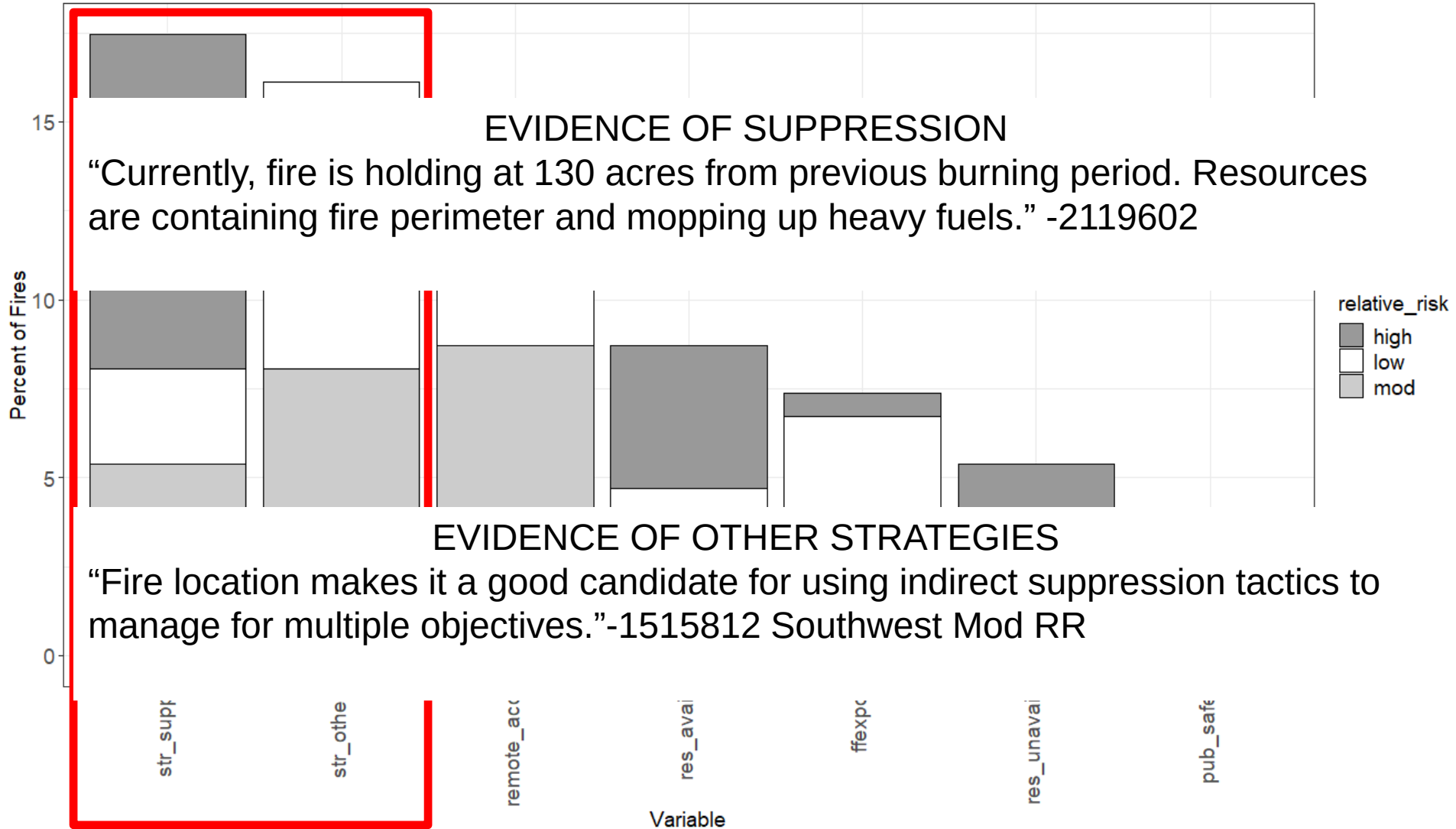
“..most threats to private lands to the Northeast were mitigated by the Eagle Rock fire in 2010.” - 1556389 Southwest low RR





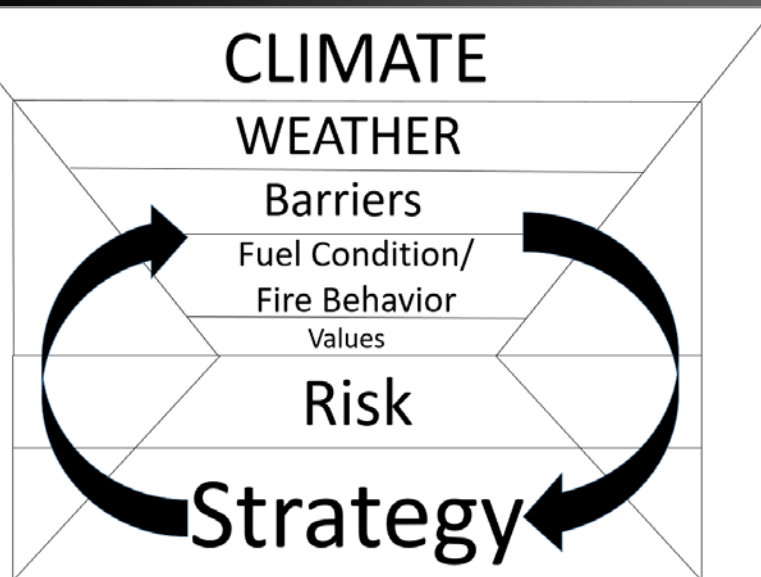
The Link Between Fire Management Strategies to Barriers in the Southwest

Percent Frequency of Fire Management Codes by Relative Risk Rating, Southwest Geographic Area

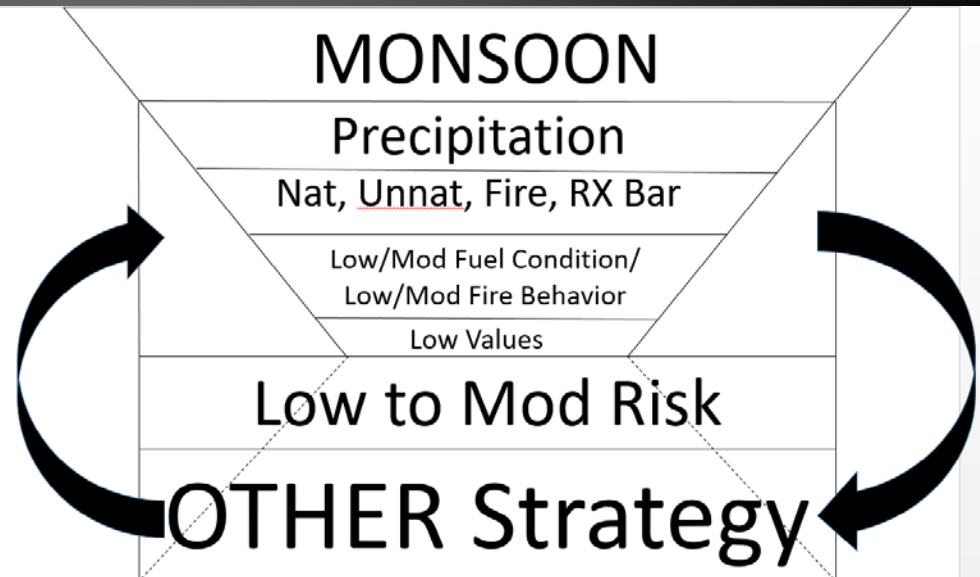


Conclusion

Proposed Conceptual Model of
Controls on Risk & Strategy



Conceptual Model applied to
the Southwest



Evidence that past management decisions to create barriers (i.e. use wildfire and prescribed fires) is allowing for greater management space to use fire in 2010 – 2017 in the Southwest

Relevance for the Northern Rockies

Hypothesis:

In areas with a high number of fire scars (like the Bob Marshall Wilderness Area), fire barriers working in conjunction with other controls (favorable weather, lower fuel loads, mild fire behavior) support more decision space to use fire in some capacity.



Acknowledgements

- Funding from this project provided by the Wildland Fire Management RD&A



- Support for this project provided by the Fire Center, University of Montana



Questions & Comments: send to erin.noonan@usda.gov



END



General Stats

Geographic Area	From WFDSS									FROM NIFC			
	Total (n)				Percent (%)					Total (n)			
	Fires	RRA	Days between Start and Contained Dates	Days between Start and Controlled Dates	Fires	RRA	More than 1 RRA/fire	Single Jurisdiction	WFDSS Incidents/ Total NIFC fires	Fires	Acres	Type 1 IMT	Type 2 IMT
Alaska	542	911	41	44.2	10.7	7.4	60.4	52.0	12.6	4,311	9,516,655	6	27
Eastern	84	222	12.2	31.3	1.7	1.8	83.8	89.3	0.1	83,009	848,657	5	39
Great Basin	977	2003	15.3	20.4	19.2	16.3	69.9	78.0	5.6	17,344	7,307,807	25	143
Northern California	217	903	17.1	29.1	4.3	7.3	90.9	65.4	0.7	31,075	2,834,582	30	79
Northern Rockies	802	1562	36	43.7	15.8	12.7	68.5	77.4	3.5	23,081	4,589,162	35	122
Northwest	649	1813	28.5	40.4	12.8	14.7	84.8	67.3	2.5	26,130	7,315,057	60	228
Rocky Mountain	478	1183	15	23.9	9.4	9.6	77.9	69.7	1.8	25,909	3,850,664	23	70
Southern California	304	1313	21.6	32	6.0	10.7	91.3	61.2	0.9	34,867	2,161,433	28	79
Southern	304	799	12.7	22.4	6.0	6.5	81.7	76.3	0.1	260,353	10,279,050	33	60
Southwest	730	1615	17.2	24.8	14.4	13.1	74.6	81.6	3.2	22,844	5,050,397	43	79
U.S.	5087	12324	22.8	31	100.0	100.0	77.4	72.1	1.0	528,923	53,753,464	288	926



Conclusion

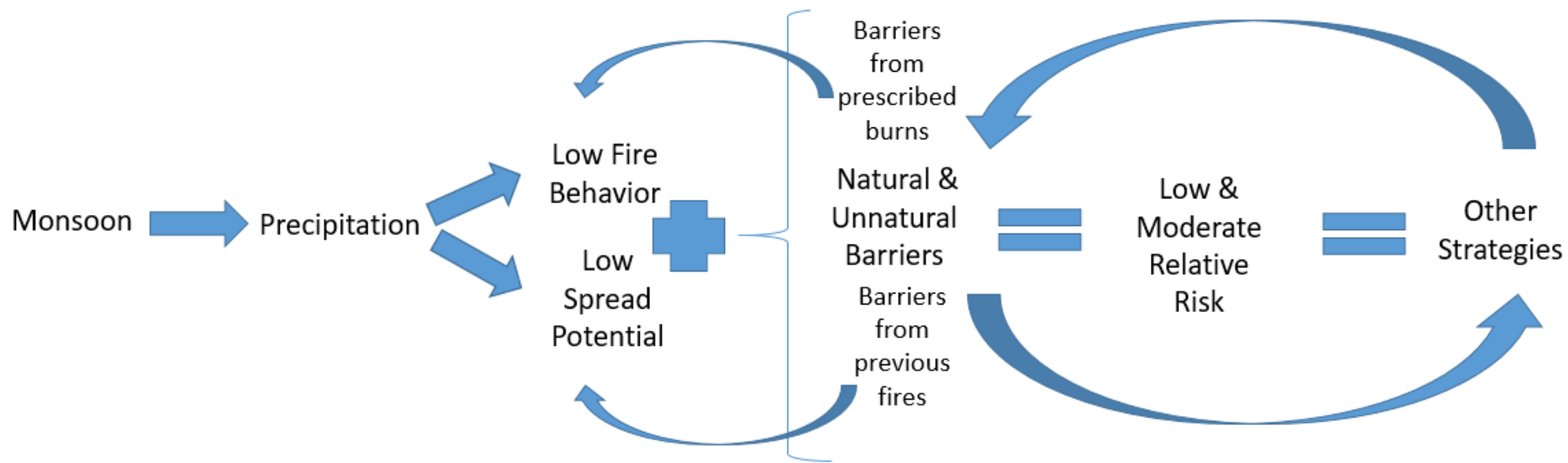


Fig X. Conceptual proposed model that summarizes the factors that allow for low and moderate relative risk and Other Strategies in the Southwest.

Conclusion

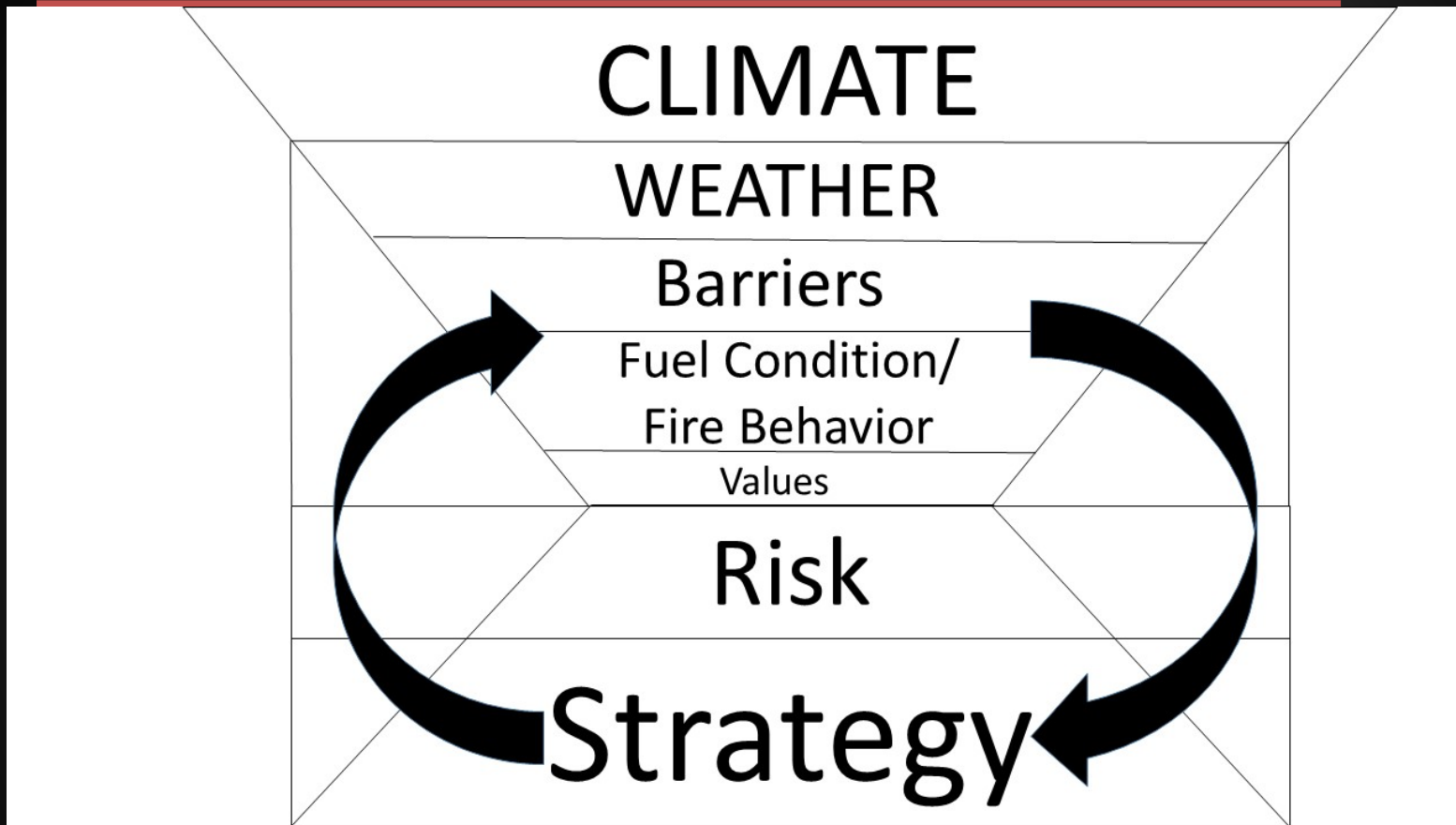
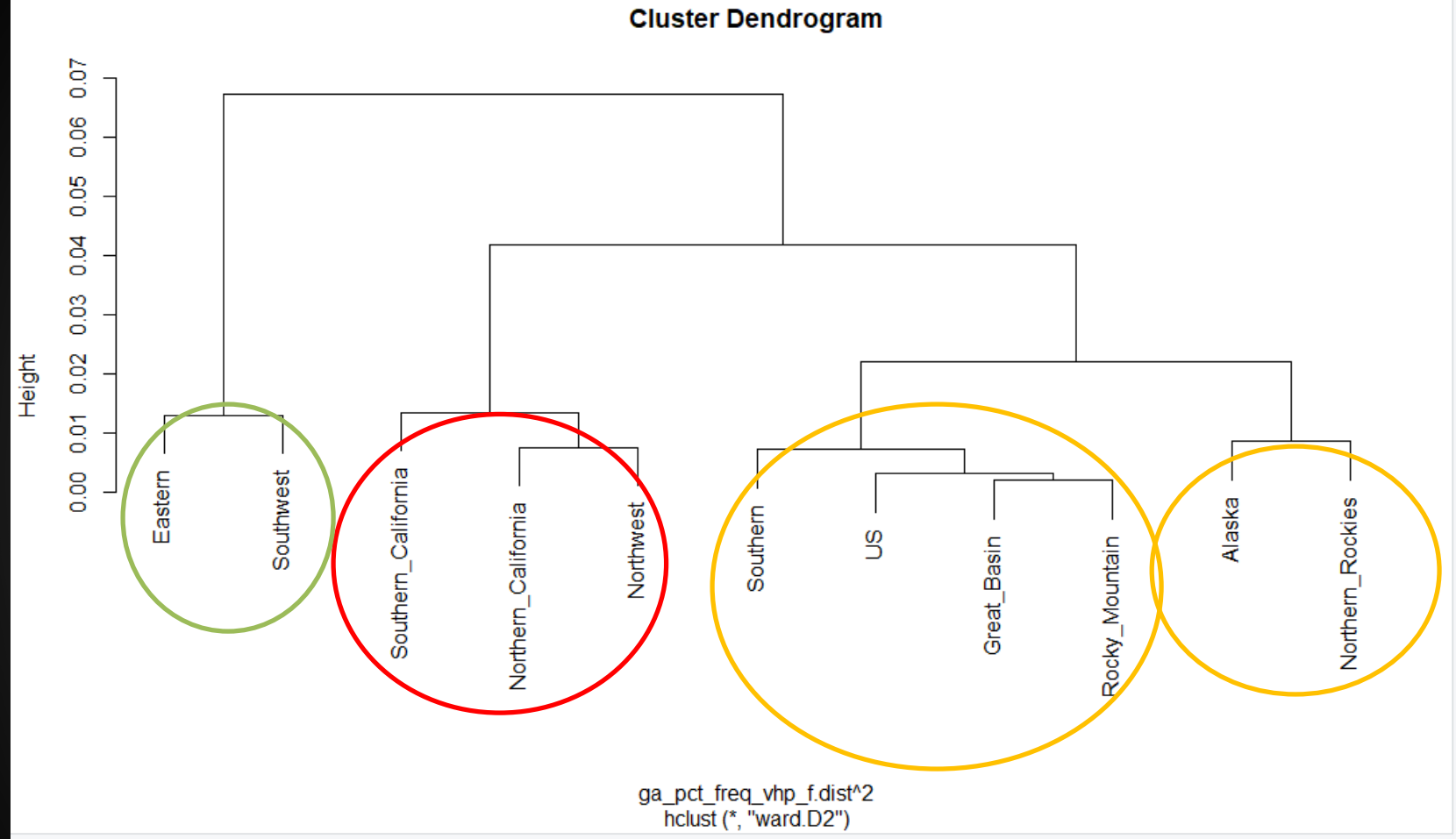


Fig X. Conceptual proposed model that summarizes how elements of risk influence the chosen strategy; and how strategy influences elements of risk

Cluster Analysis

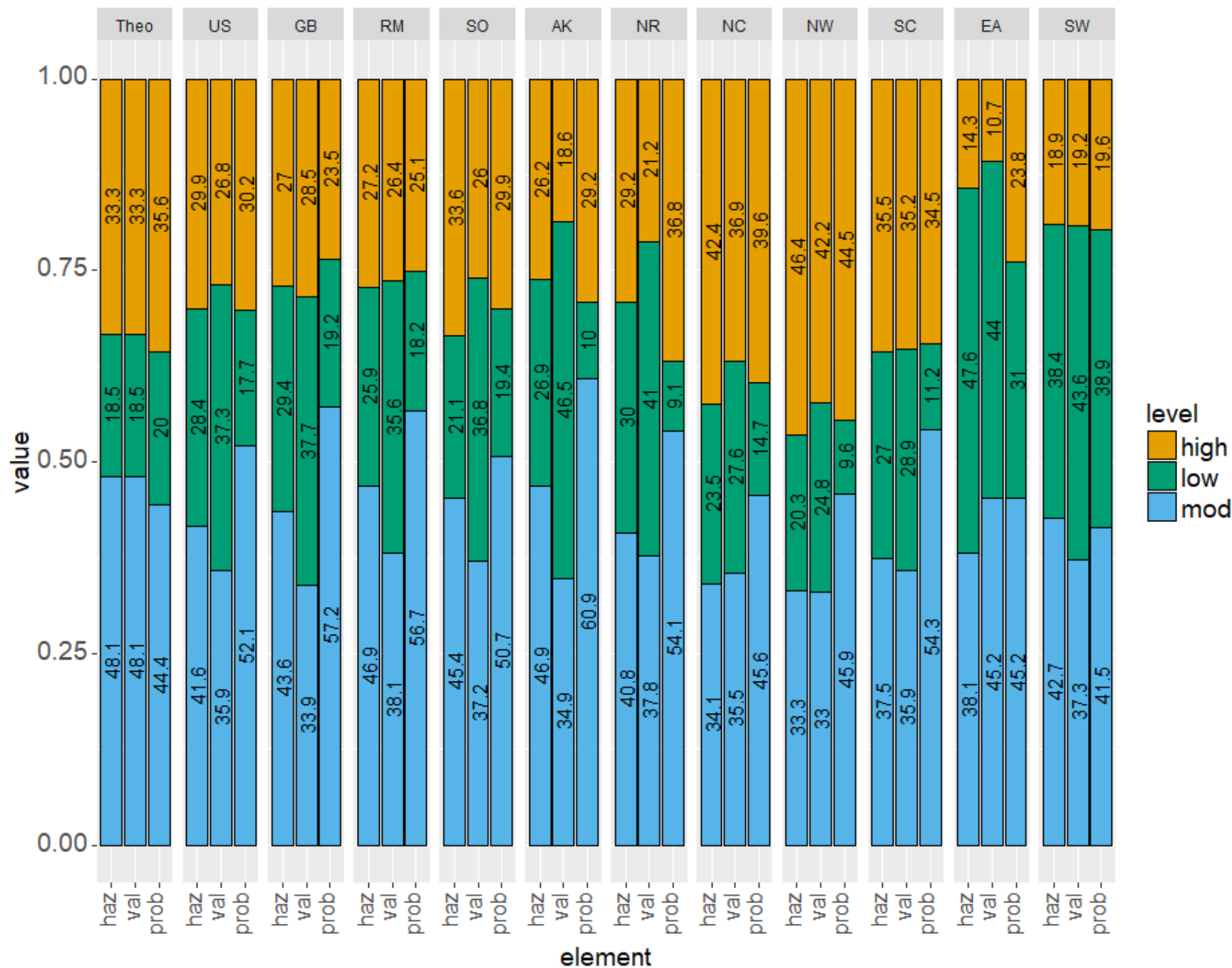
Percent Frequencies used for the Cluster Analysis
Red = high percentages, Blue = low percentages

Rel risk	Values, Hazard, Prob	val	haz	prob	US	Great Basin	Rocky Mountain	Southern	Alaska	Northern Rockies	Northern California	Northwest	Southern California	Eastern	Southwest
H	HHH	H	H	H	0.129	0.117	0.115	0.112	0.077	0.132	0.184	0.227	0.181	0.048	0.082
H	MHH	M	H	H	0.057	0.034	0.044	0.069	0.063	0.074	0.088	0.106	0.049	0.024	0.021
H	HHL	H	H	L	0.004	0.003	0.002	0.01	0	0.001	0.014	0.005	0.003	0	0.005
H	HHM	H	H	M	0.044	0.057	0.054	0.046	0.024	0.017	0.06	0.068	0.066	0	0.033
H	MHM	M	H	M	0.033	0.028	0.025	0.056	0.037	0.04	0.028	0.031	0.043	0.024	0.023
H	HLH	H	L	H	0.001	0	0	0	0.002	0.001	0	0.002	0	0	0.001
H	HMH	H	M	H	0.024	0.023	0.017	0.036	0.028	0.021	0.046	0.034	0.03	0	0.014
H	MMH	M	M	H	0.04	0.025	0.042	0.023	0.063	0.064	0.037	0.032	0.033	0.06	0.03
H	HMM	H	M	M	0.045	0.066	0.054	0.039	0.03	0.022	0.028	0.066	0.059	0.048	0.03
L	HLL	H	L	L	0.004	0.002	0.002	0.007	0.004	0.001	0.009	0.006	0.003	0.012	0.007
L	LLL	L	L	L	0.083	0.099	0.09	0.063	0.054	0.05	0.078	0.049	0.036	0.155	0.164
L	MLL	M	L	L	0.028	0.026	0.029	0.03	0.011	0.012	0.014	0.011	0.026	0.071	0.071
L	LLM	L	L	M	0.101	0.097	0.077	0.076	0.135	0.155	0.074	0.072	0.138	0.083	0.071
L	LML	L	M	L	0.028	0.035	0.021	0.039	0.017	0.01	0	0.014	0.013	0.048	0.07
M	LHH	L	H	H	0.015	0.012	0.008	0.016	0.028	0.014	0.032	0.015	0.003	0.036	0.01
M	LHL	L	H	L	0.001	0	0.002	0.003	0.002	0	0.005	0	0	0.012	0.001
M	MHL	M	H	L	0.004	0.006	0.006	0.003	0.002	0.001	0.005	0	0.003	0	0.007
M	LHM	L	H	M	0.014	0.013	0.015	0.02	0.03	0.012	0.009	0.012	0.007	0	0.007
M	LLH	L	L	H	0.009	0.005	0.004	0.01	0.004	0.02	0	0.006	0.01	0.024	0.011
M	MLH	M	L	H	0.006	0.003	0.002	0.007	0.004	0.006	0.009	0.003	0.02	0.024	0.007
M	HLM	H	L	M	0.011	0.011	0.008	0.003	0.018	0.012	0.014	0.014	0.003	0	0.01
M	MLM	M	L	M	0.042	0.05	0.046	0.016	0.039	0.042	0.037	0.04	0.033	0.107	0.041
M	LMH	L	M	H	0.022	0.017	0.019	0.026	0.024	0.036	0	0.02	0.02	0.024	0.021
M	HML	H	M	L	0.006	0.006	0.01	0.007	0.004	0.002	0.014	0.002	0.007	0	0.01
M	MML	M	M	L	0.02	0.015	0.019	0.033	0.007	0.012	0.009	0.009	0.02	0.012	0.053
M	LMM	L	M	M	0.1	0.097	0.119	0.115	0.173	0.113	0.078	0.059	0.063	0.06	0.081
M	MMM	M	M	M	0.131	0.153	0.167	0.135	0.124	0.126	0.129	0.097	0.132	0.131	0.119

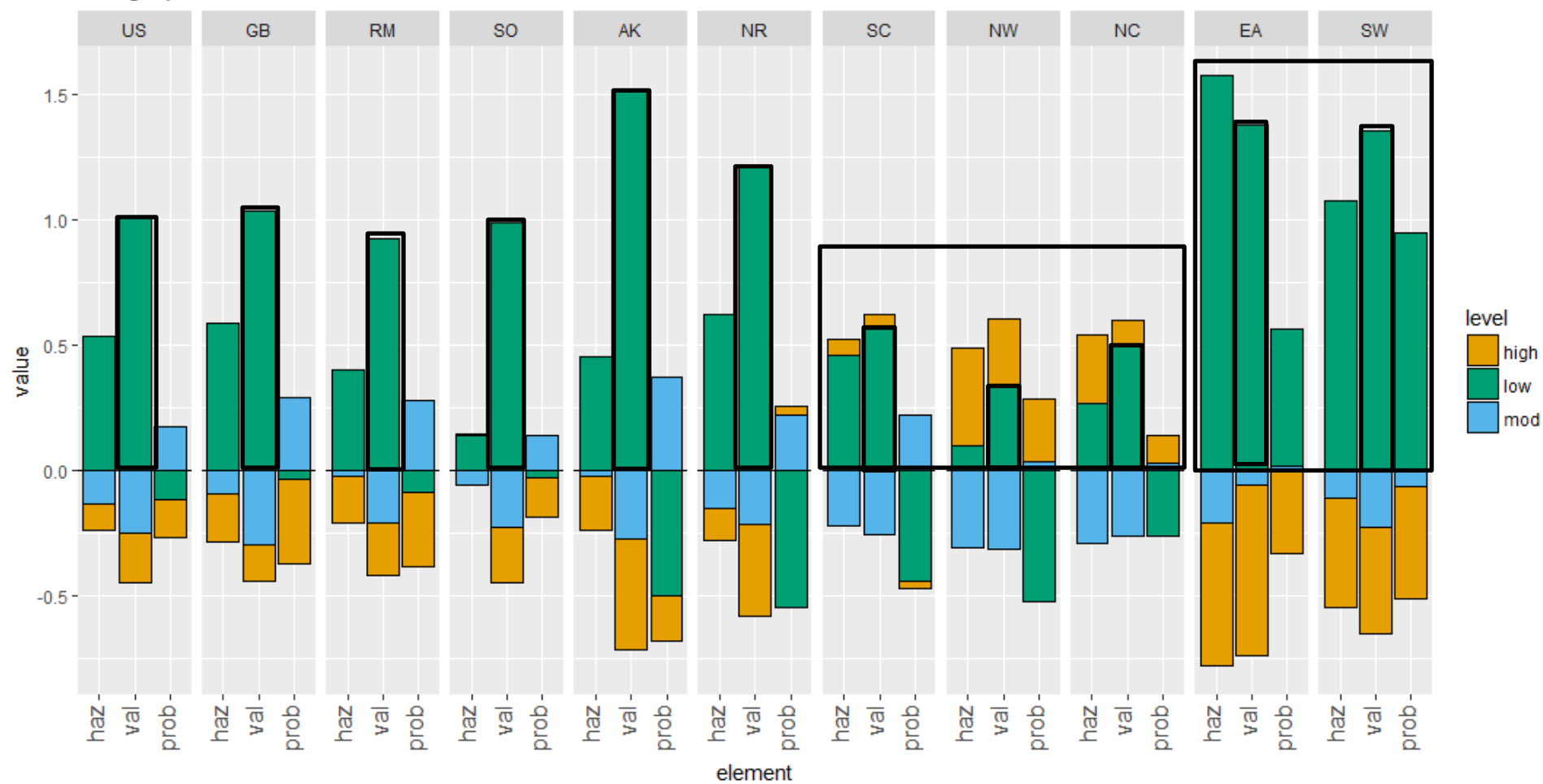


Cluster Analysis using squared Euclidean distance with Ward's method

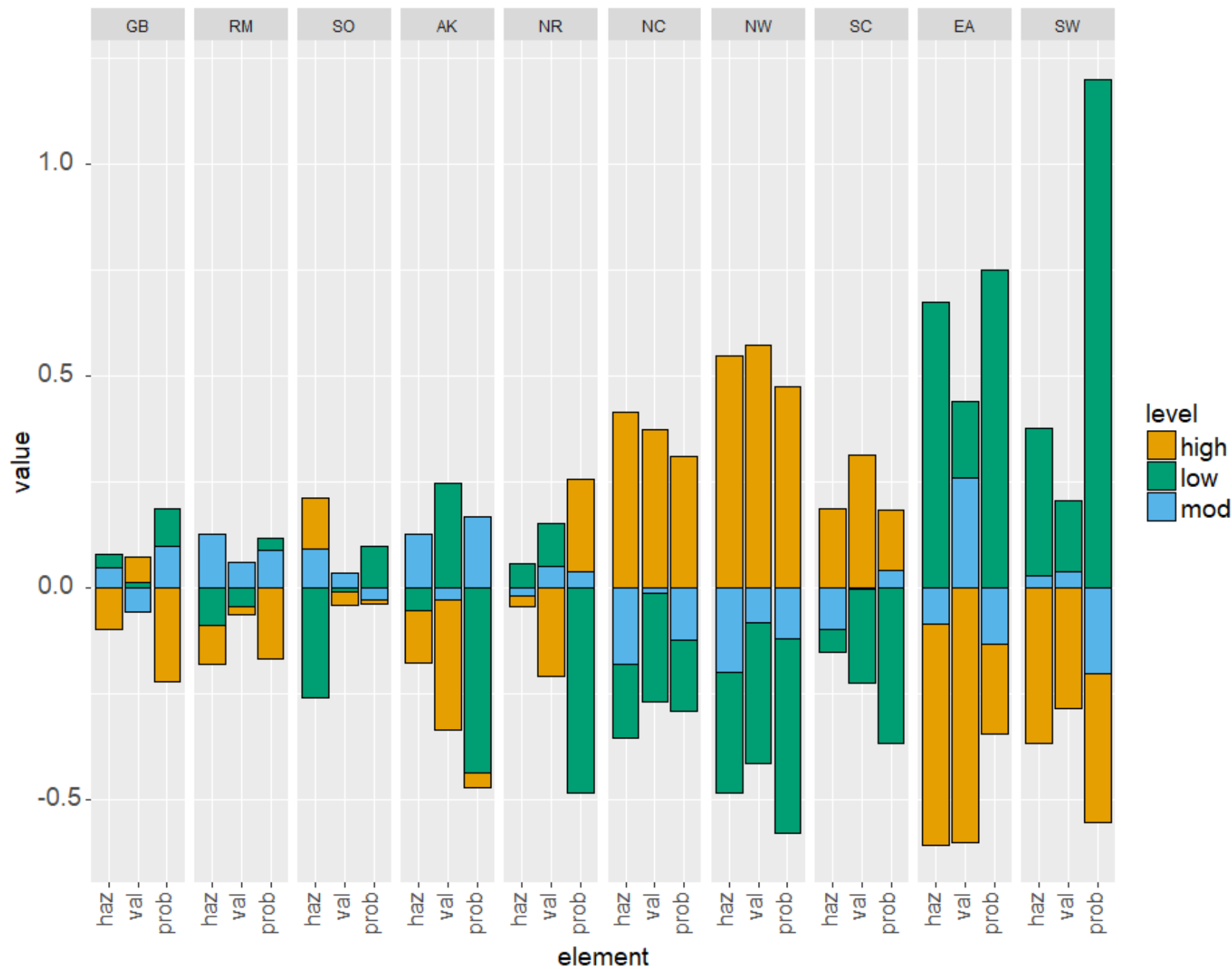
Geographic Area Frequencies: Main Elements



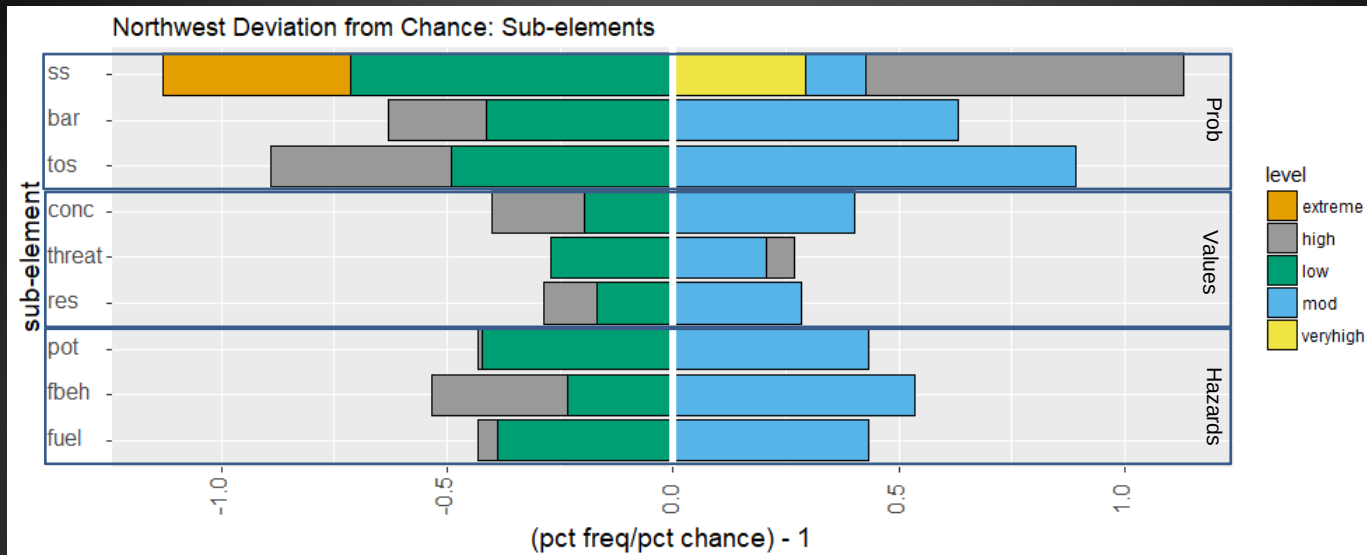
Geographic Area Deviation from Chance: Main Elements



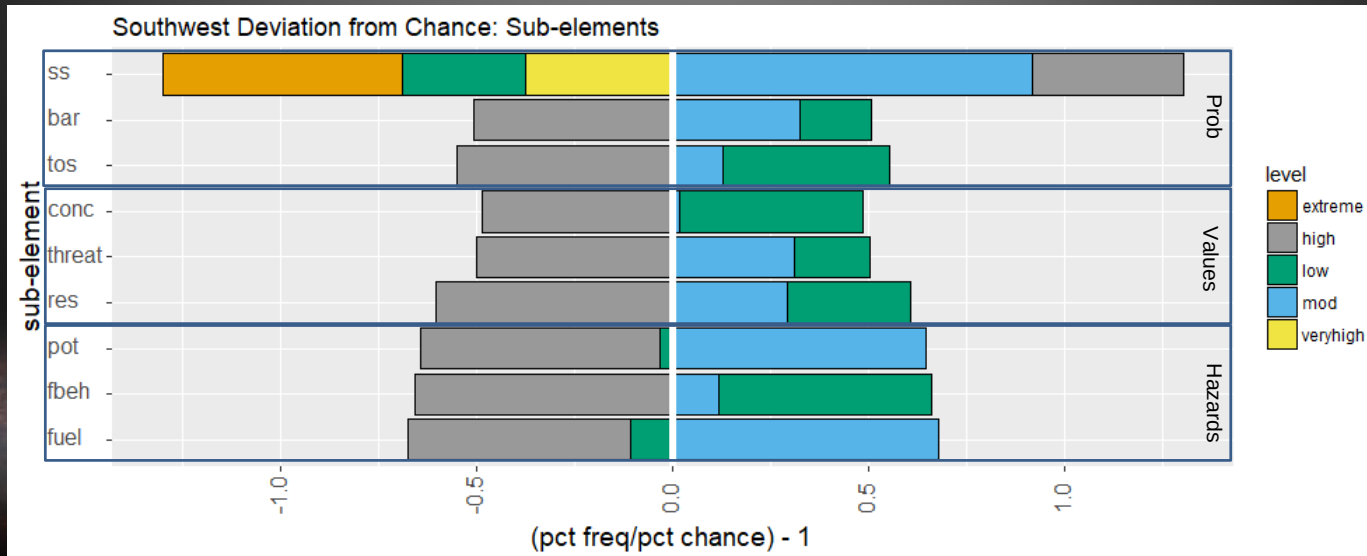
Geographic Area Deviation from the U.S.: Main Elements

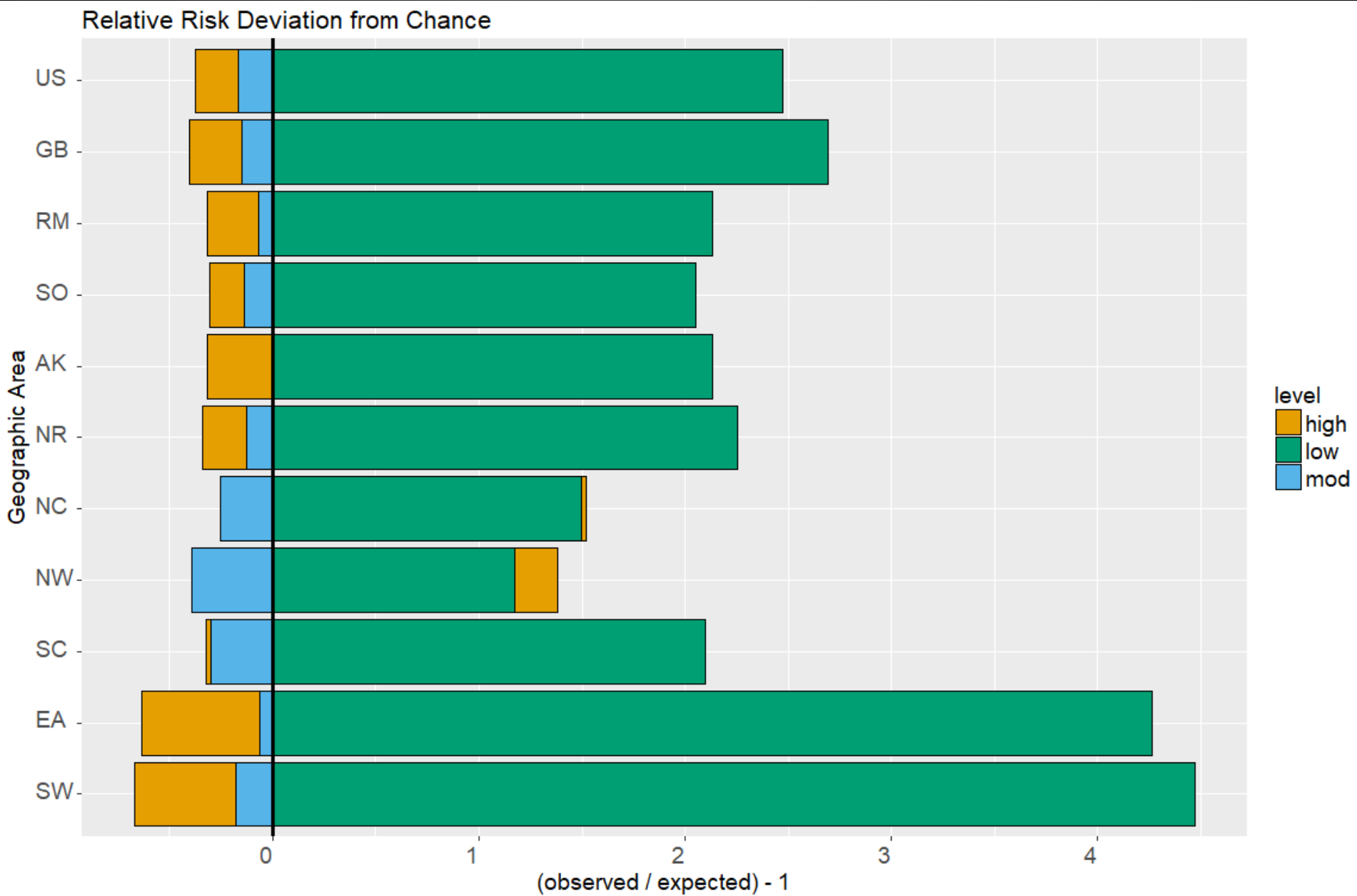


Deviation from Chance: Sub-elements



ss = seasonal severity, bar = barriers, tos = time of season; conc = concern, threat, res = resources; pot = potential, fbeh = fire behavior, fuel = fuel condition





Methods

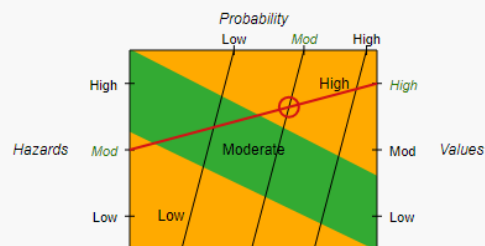
1. Tabulate Observed Raw & Percent Frequencies
2. Tabulate Expected
3. Compute Preference Metric

$$Preference\ metric = \left(\frac{\% \text{ observed}}{\% \text{ expected}} \right) - 1$$

4. Compute Cluster Analysis using Ward Linkage



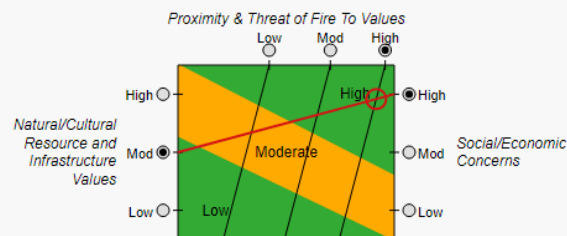
Relative Risk (Draft)



Select the appropriate radio buttons for Hazards, Values, and Probability to calculate the Relative Risk.

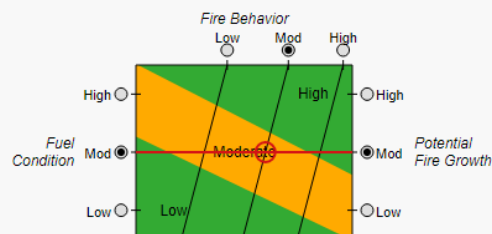
Use 'Continue' to complete your Relative Risk Assessment

Values



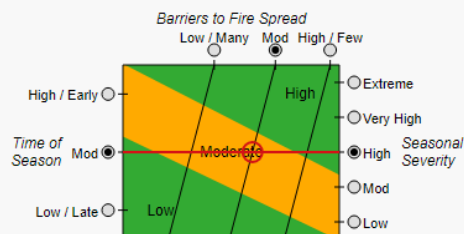
$3 \times 3 \times 3 = 27$
combinations to
get Values

Hazards



$3 \times 3 \times 3 = 27$
combinations to
get Hazards

Probability



$3 \times 3 \times 5 = 45$
combinations to
get Probability

Expected Frequencies (Chance)

	Chance
High Relative Risk	47.2%
Moderate Relative Risk	45.8%
Low Relative Risk	7.0%
High Values	33.3%
Mod Values	48.1%
Low Values	18.5%
High Hazard	33.3%
Mod Hazard	48.1%
Low Hazard	18.5%
High Probability	35.6%
Mod Probability	44.4%
Low Probability	20.0%

Each sub-element has a 33% chance of being selected except for Seasonal Severity which has a 20% chance of being selected.

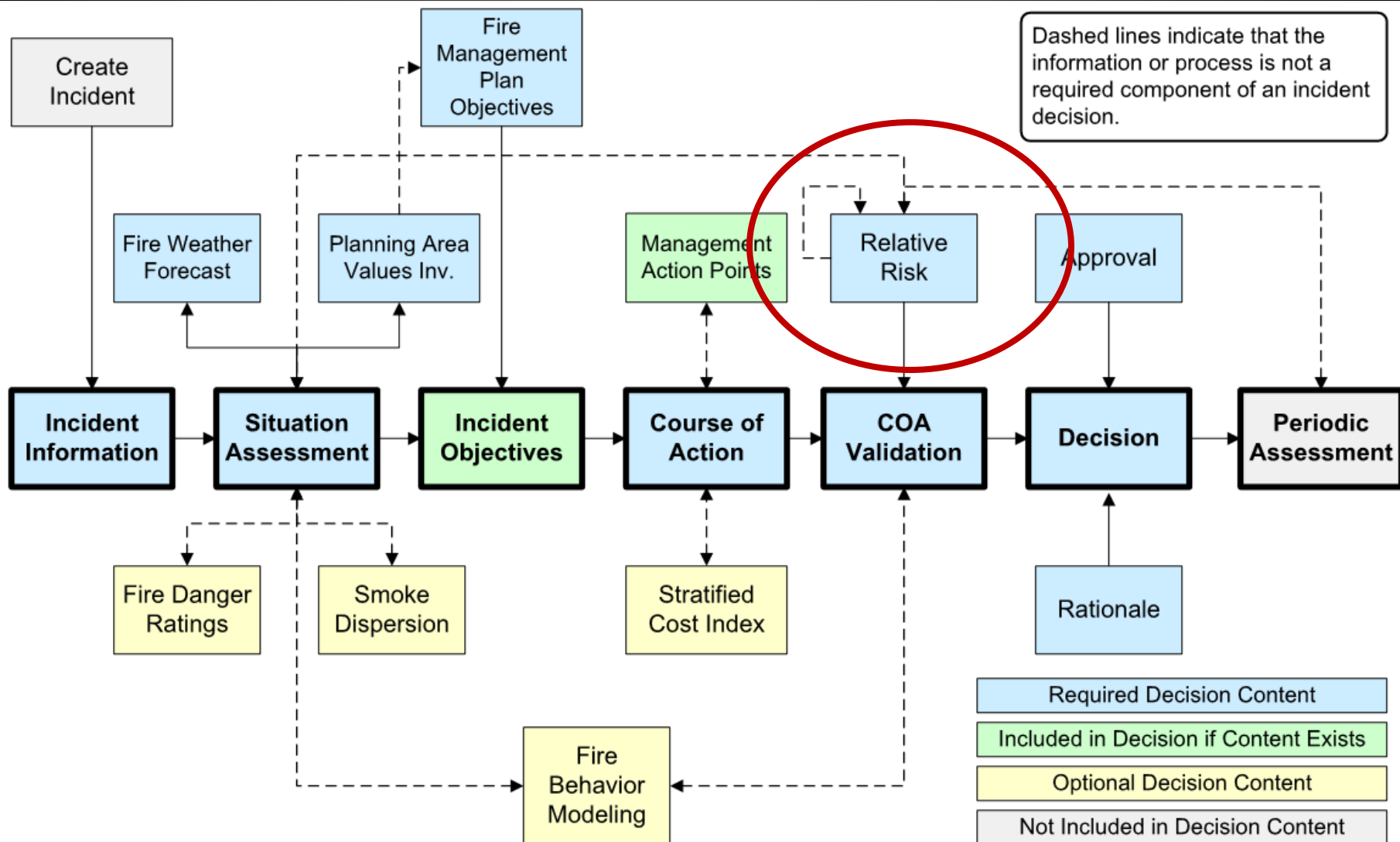
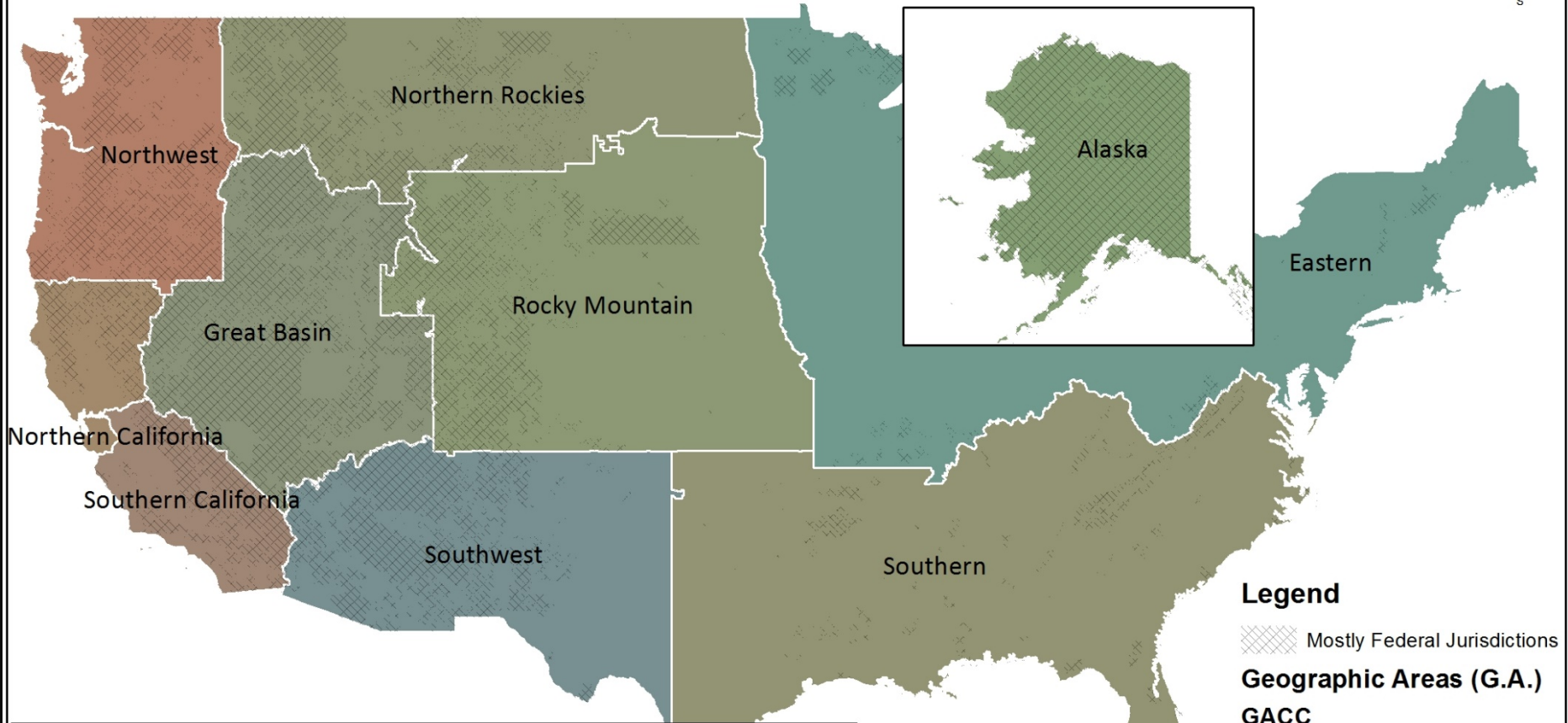
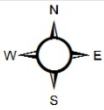


Figure by Hans Fieldler, IBM & R. Seli, Retired USFS, from Noonan-Wright, E., Opperman, T.S. et al. 2011
Developing the US Wildland Fire Decision Support System, Journal of Combustion, Vol 2011.

Geographic Area Comparison of High, Moderate and Low Relative Risk



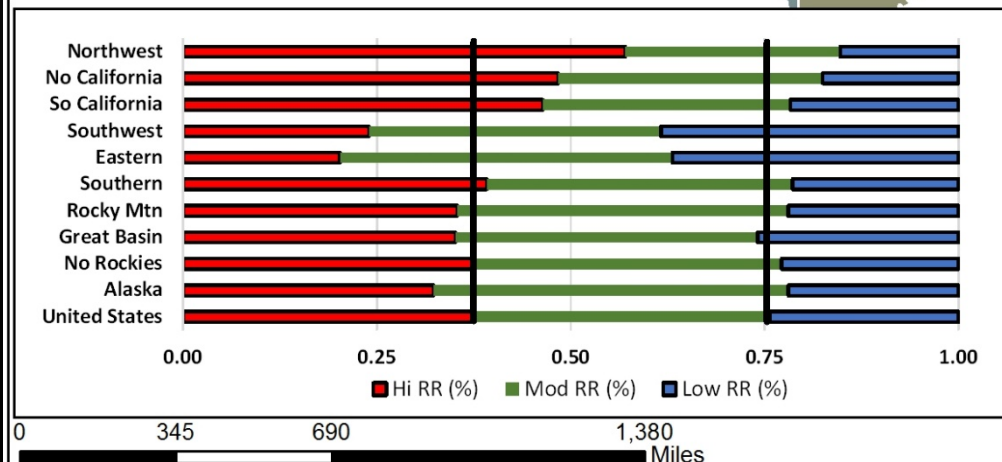
Legend

Mostly Federal Jurisdictions

Geographic Areas (G.A.)

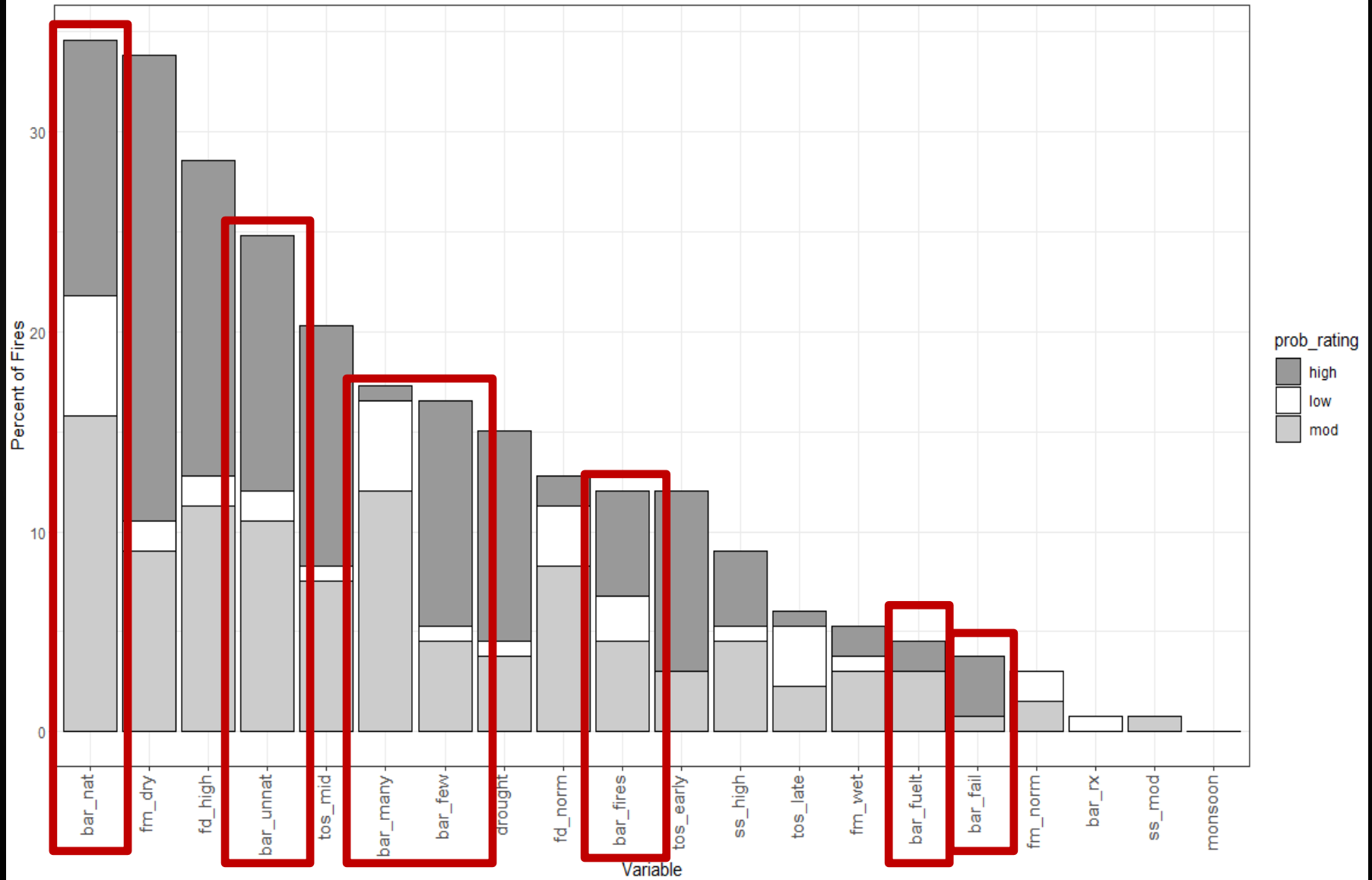
GACC

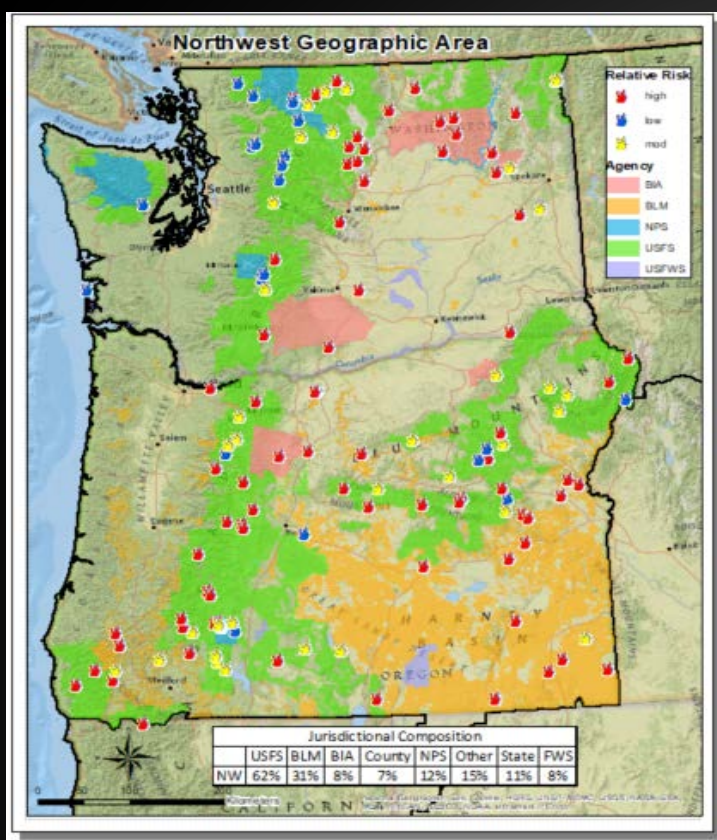
- Alaska, n = 548
- Eastern, n = 84
- Great Basin, n = 977
- Northern California, n = 217
- Northern Rockies, n = 802
- Northwest, n = 649
- Rocky Mountain, n = 478
- Southern, n = 304
- Southern California, n = 304
- Southwest, n = 730



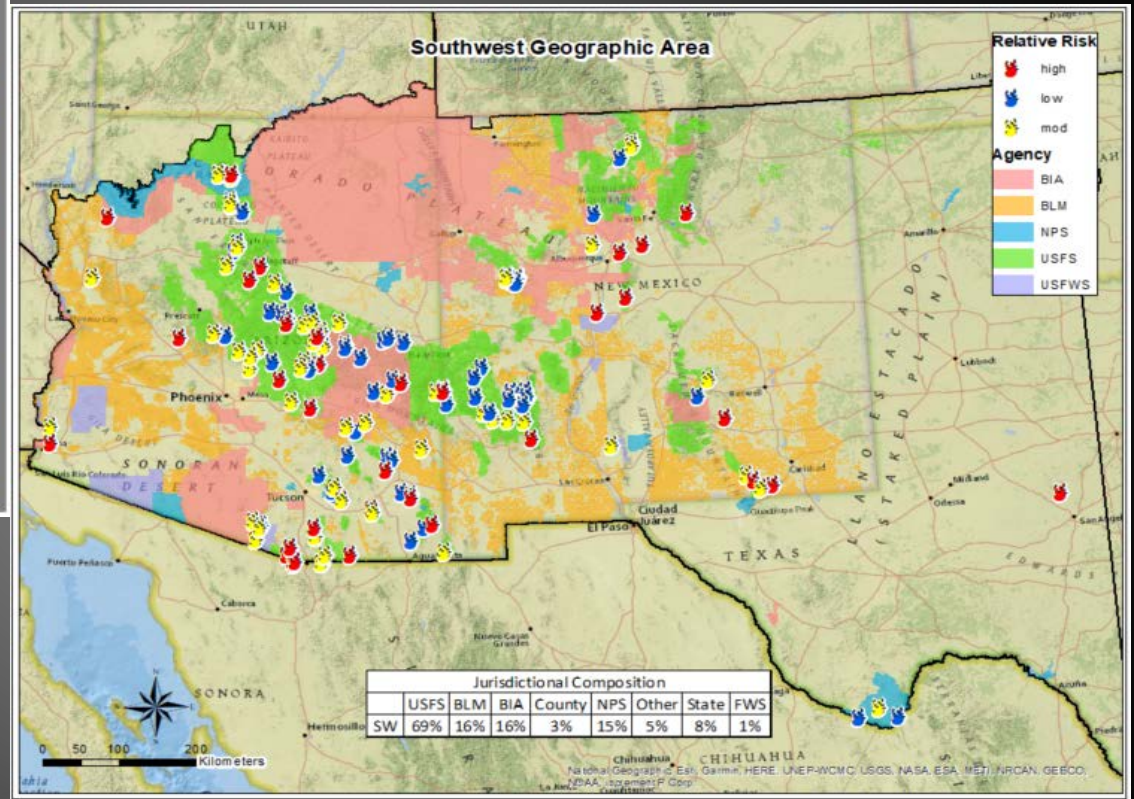
Barriers are mentioned often in the Northwest Notes

Percent Frequency of Codes by Probability Rating, Northwest Geographic Area





Sample = 149 fires



Sample = 133 fires