

Sierra Nevada Climate Change: Recreation Vulnerability Assessment



Patricia L. Winter PhD, &
José J. Sánchez PhD
With David Olson, MS
US Forest Service, PSWRS
September 14, 2018
Expert Elicitation Workshop



Overview



Current and Projected Impacts Overview


Recreation Uses in the Assessment Area

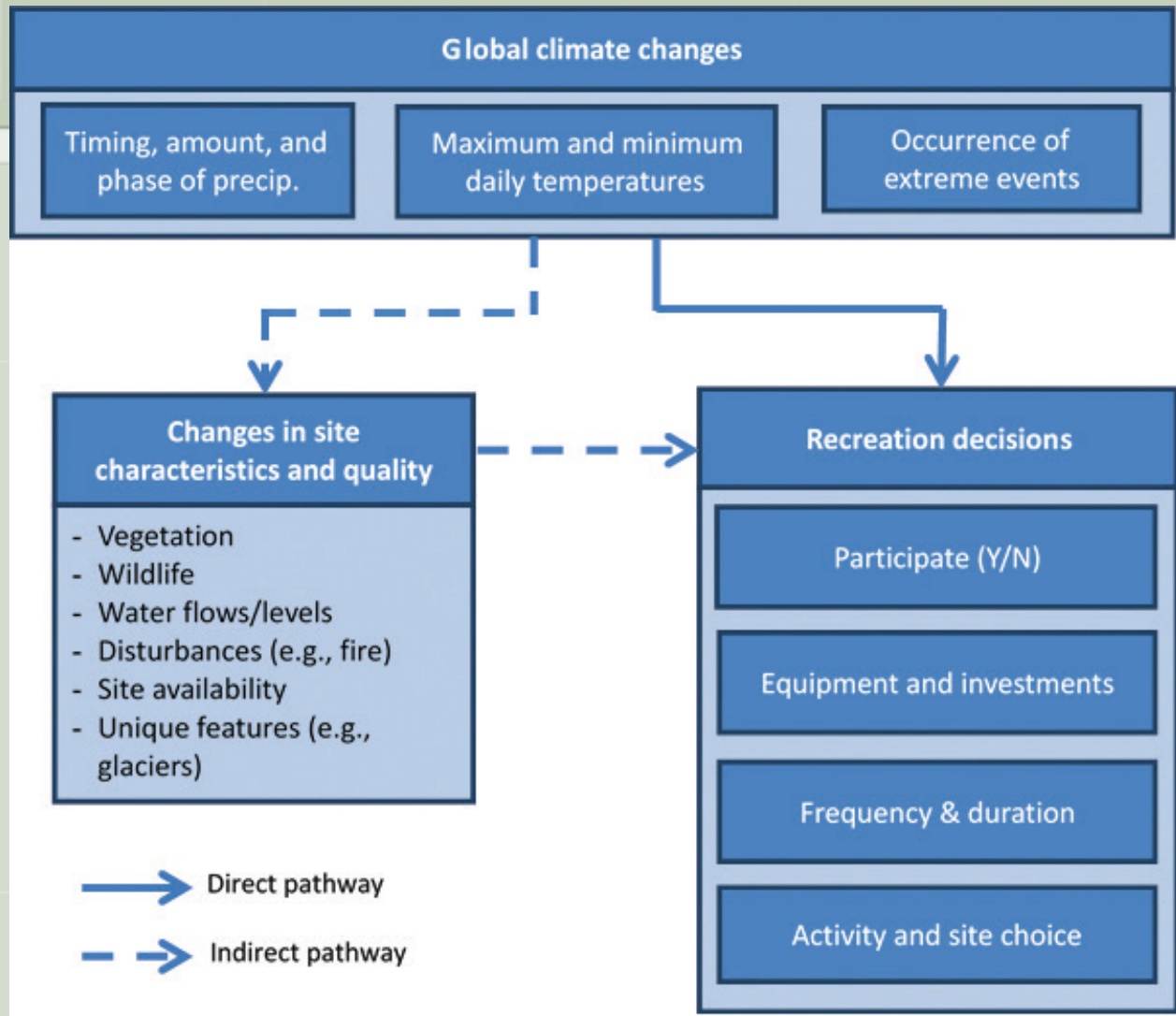
Vulnerability – Short & Long-Term





Overview of Climate-Related Changes


- Heat – Increased average temperatures
 - Precipitation – less variation, more extremes
 - More dry days
 - Storms of increased intensity
 - Possible lessened snowpack (more rain, less snow)
 - Reduced fuel moisture, longer fire seasons, increased fire severity
 - Decreased air quality/smoke
 - Heat + more dry days may increase ozone/poor air quality
- 

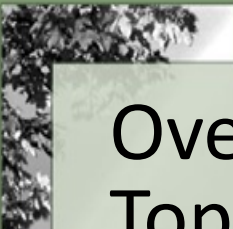


From Hand & Lawson (2018) RMRS-GTR-374, pg. 399



Myriad Benefits of Nature Based Recreation

- Improvements in self-esteem and total mood disturbance after green exercise – 10 case studies (*Pretty et al., 2007*)
 - Counteracting societal trend of sedentary lifestyles (*Kondo et al., 2015*)
 - Facilitate social interactions increasing social capital (*Bedimo-Rung et al., 2005*)
 - Parks and green spaces can remedy some income-associated inequalities in health outcomes (*Mitchell and Popham, 2008; South et al., 2018*)
 - Recreation serves as pathway to connect people with forests, fostering life-long relationship / stewardship
- 



Overall Participation in Outdoor Recreation – Topline Report 2017 – Outdoor Foundation


	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
African American/Black	8%	8%	8%	11%	7%	11%	11%	10%	8%	9%
Asian/Pacific Islander	4%	6%	5%	6%	6%	7%	7%	7%	7%	7%
Caucasian/ White, non- Hispanic	77%	75%	78%	71%	76%	71%	68%	70%	71%	70%
Hispanic	7%	7%	7%	9%	8%	8%	10%	10%	12%	12%



Participation in Outdoor Recreation Activities


Activity	Percent
General outdoor recreation/ relaxing	54.9
Viewing natural features, scenery, flowers, etc.	53.4
Hiking or walking	42.1
Downhill skiing	41.1
Viewing wildlife and birds	38.7
Driving for pleasure	27.1
Picnicking, family activity	13.3
Fishing	13.2
Other non-motorized activity	12.4
Nature or visitor centers	10.5
Visiting historic sites	10.1
Developed camping	9.8

Analyses based on 2010-2012 survey rounds, NVUM data.





What are the top recreation activities in the assessment area?

- How do these vary by forest/unit?
 - How do these vary by larger areas (north/central/south)?
 - Which are likely to be more/less susceptible to impacts?
 - Seasonal; specific to ecosystem features
 - Which involve iconic/niche contributors to area/forests & units?
 - Fishing in high Sierra lakes
 - The Pacific Crest Trail
 - Wilderness areas
 - Giant Sequoia Monument
- 



Largest Economic Values: Benefits Transfer ES Assessment

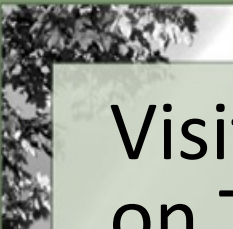
Activity Participation	All 10 NF
Activity	Total
Downhill Skiing	\$ 422,518,276
Hiking / Walking	\$ 185,863,072
Viewing Natural Features	\$ 168,335,296
Relaxing	\$ 121,120,091
Fishing	\$ 66,097,347
Developed Camping	\$ 37,282,053
Other Non-motorized	\$ 35,129,420
Bicycling	\$ 32,312,295
Driving for Pleasure	\$ 28,282,908
Non-motorized Water	\$ 21,688,620
Some Other Activity	\$ 15,428,729
Picnicking	\$ 14,719,539



Sample Variations by Forest/Unit

Activity Participation	Stanislaus
Activity	Total Value
Relaxing	\$ 13,675,627
Hiking / Walking	\$ 11,999,896
Fishing	\$ 7,779,242
Viewing Natural Features	\$ 7,708,124
Downhill Skiing	\$ 6,589,095
Non-motorized Water	\$ 6,351,375
Hunting	\$ 5,453,213
Other Non-motorized	\$ 3,759,883
Some Other Activity	\$ 2,971,837
Developed Camping	\$ 2,777,243
Picnicking	\$ 2,349,424
Driving for Pleasure	\$ 1,558,080

	LTBMU
Activity	Total Value
Downhill Skiing	\$ 265,864,055
Viewing Natural Features	\$ 100,696,305
Hiking / Walking	\$ 90,192,290
Relaxing	\$ 54,740,510
Other Non-motorized	\$ 22,452,497
Bicycling	\$ 14,616,678
Driving for Pleasure	\$ 9,888,888
Viewing Wildlife	\$ 5,902,327
Non-motorized Water	\$ 5,381,373
Nature Center Activities	\$ 5,354,356
Motorized Water Activities	\$ 5,283,441
Picnicking	\$ 5,212,724



Visitors from Outside 50 mile Radius Spend More on Trip

Total amount spent by recreating party within 50 miles of site

	\$
within 50 mile	107.68
outside 50 miles	704.76

Amount spent by recreating party on the entire trip away from home

	\$
within 50 mile	98.12
outside 50 miles	1124.33






Activities by Proximate/Distant Visitors

About one-fourth lived within a 50 mile radius

- Visitors outside 50 mile radius more frequently:
 - Viewed natural features, scenery, flowers (57.1 vs 40.0%)
 - Hiked or walked (50.0 vs 33.6%)
 - Downhill skiing (48.7 vs 32.5%)
 - Viewed wildlife or birds (45.7 vs 32.4%)
 - Visited nature or visitor centers (12.1 vs 8.4%)
 - Visited historic sites (12.0 vs 7.8%)





Infrequent Visitors Spend more Than Frequent

Total amount spent by recreating party within 50 miles of site

\$

infrequent 824.77

frequent 286.27

Amount spent by recreating party on the entire trip away from home

\$

infrequent 1423.42

frequent 306.80






Trends in National Forest Recreation Use

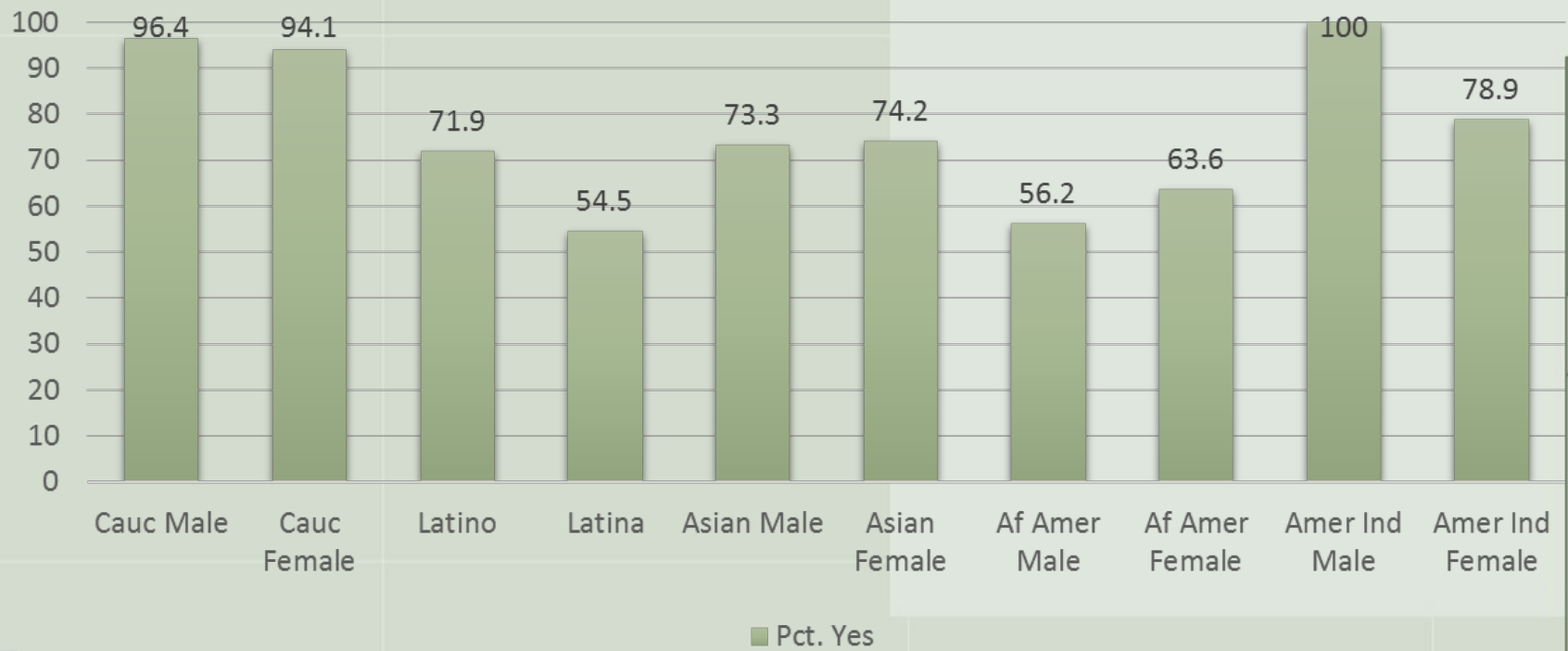
National recreation survey re: public forest lands (*Ghimire et al., 2016*) :

- Most likely are Caucasian and water-based rec. consumptive uses
- Least likely are elderly and ethno racial minorities
- National comparison of census data with forest visitor use data (w/i 50 miles of NF lands) *Flores et al., 2018* (p. 4) –

	Region 5	Overall
Census % minority	49.7 ± 6.47	35 ± 2.17
% minority use	21.5 ± 2.51	11.7 ± 0.79
Equity score	-28.2 ± 5.85	-23.8 ± 1.92

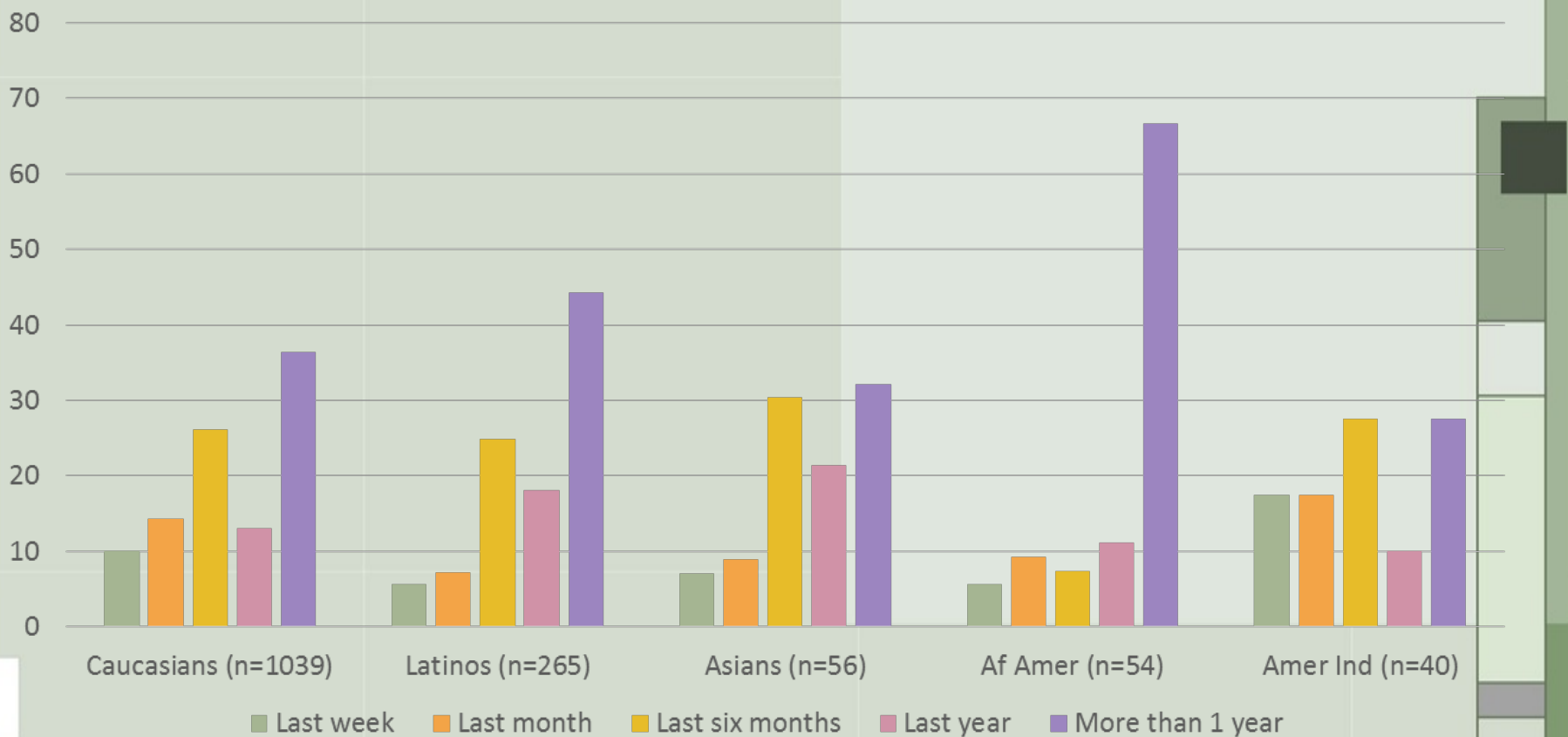


Have you ever visited a National Forest?




When was the last time you visited a National Forest? ($\chi^2 = 49.983$ (df=16))

Recency of Visit by Ethnoracial Categories

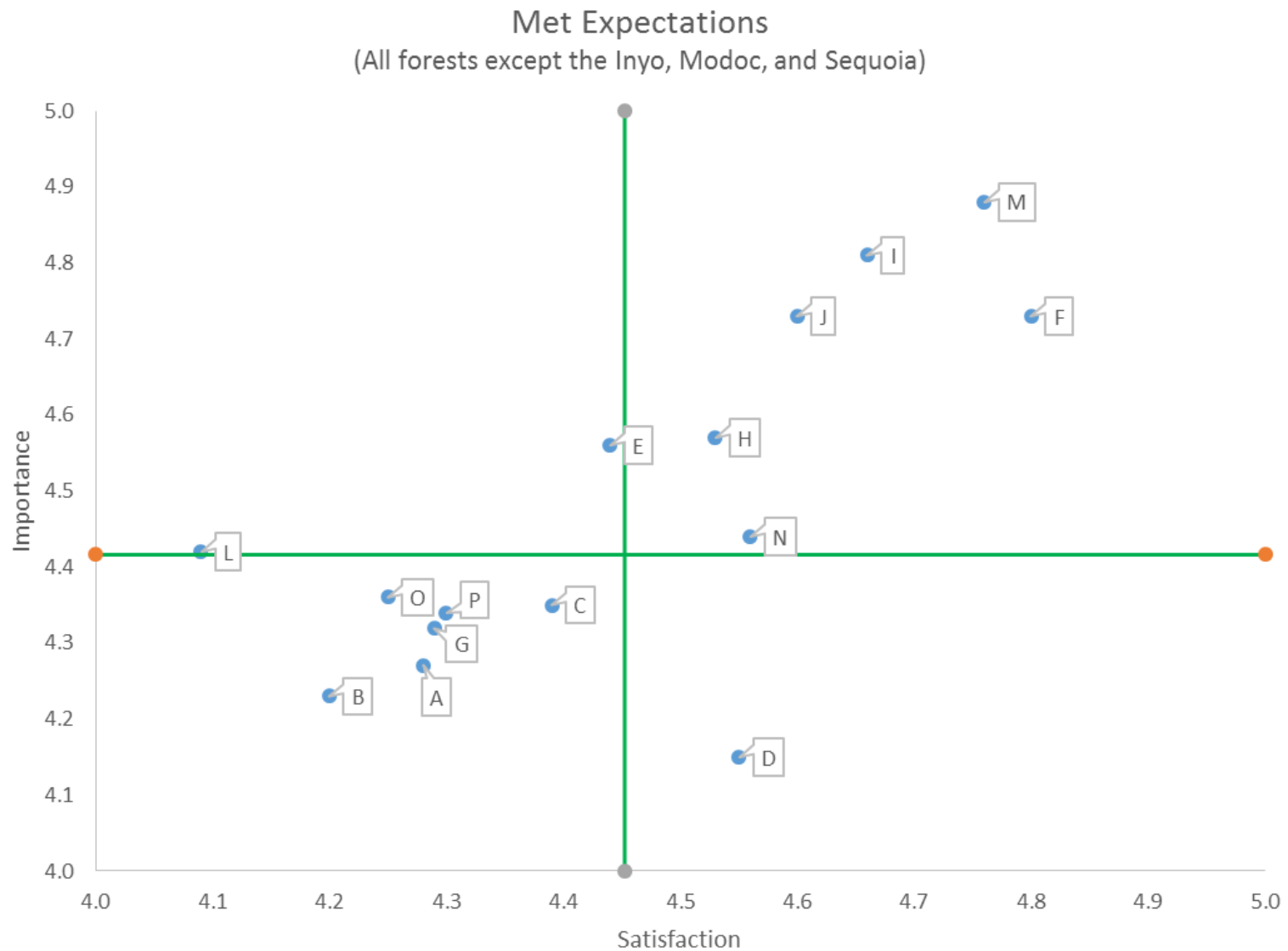




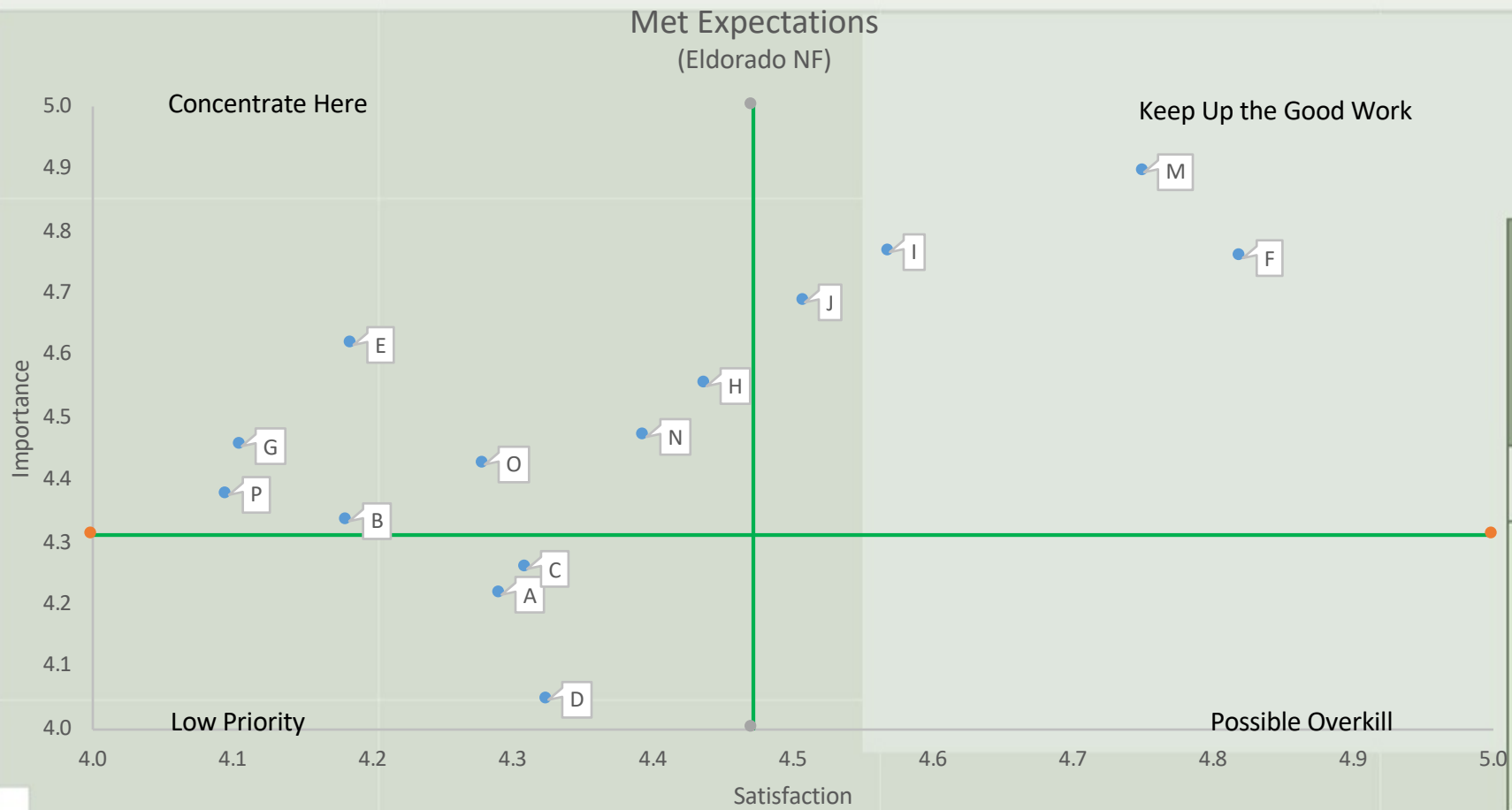
Activities where Minorities Have Higher Proportional Participation

- **Picnicking/family activity**
 - Asians 24.7%, Hispanics 24.2%, Whites 13.6%
 - **Developed camping**
 - Hispanics 26.1%, Asians 11.9%, Whites 10.0%
 - **Fishing**
 - Native Americans 34.6%, Blacks 25.2%, Whites 13.3%
 - **Downhill skiing**
 - Pacific Islanders 61.7%, Native Americans 59.4%, Whites 43.2%
- 

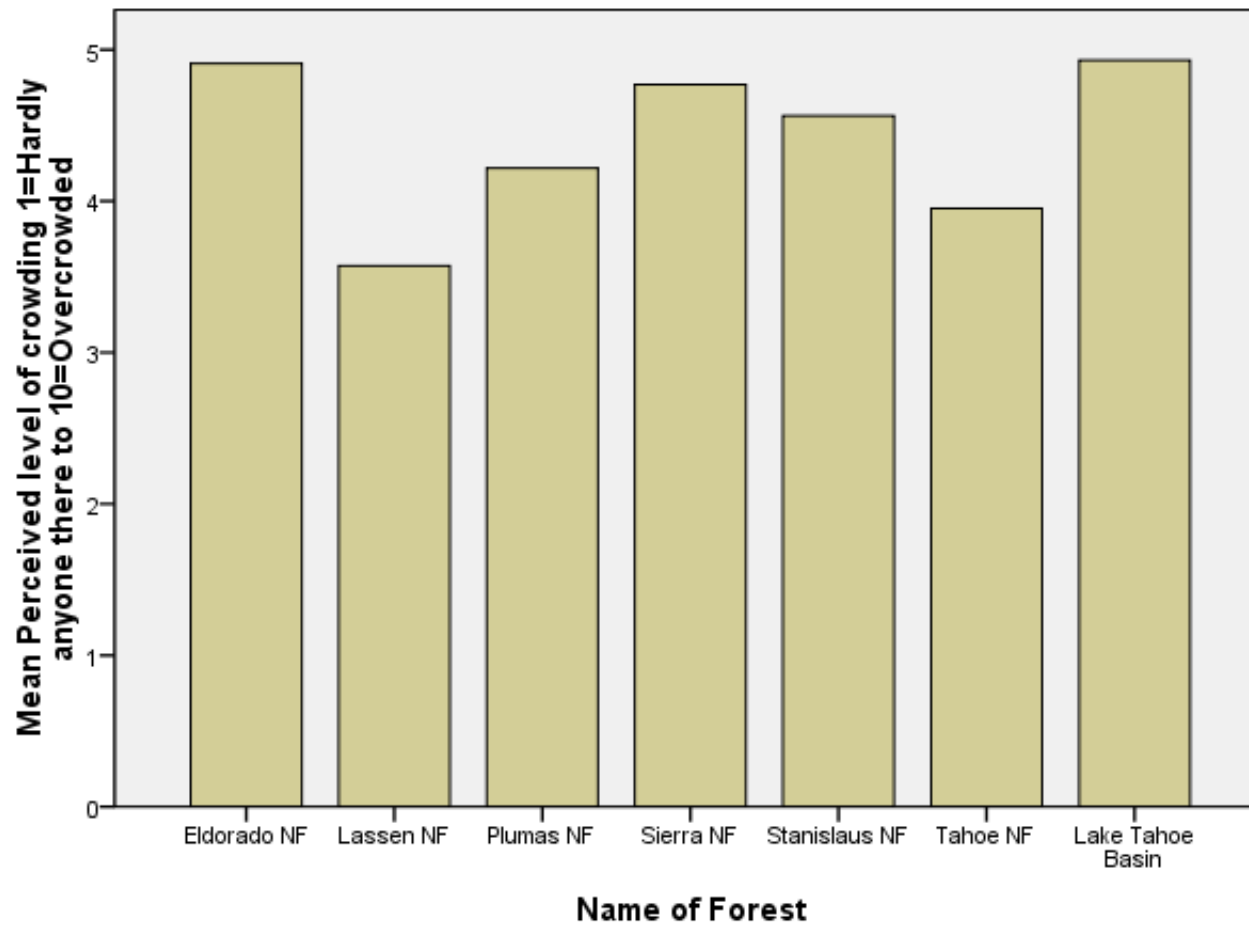
What is Experience Quality? (unweighted)



Monitor Experience Quality – Especially for Higher Sensitivity Dimensions (unweighted)



Perceived Level of Crowding





Cases weighted by Weight to expand individual cases to forest level population of National Forest visits; weight is reciprocal of sampling rate of NF visits in the stratum



Immediate & Extended Impacts

- Increased recreation season
- Increased access to higher elevation zones

Effect may be increased recreation use across larger areas....HOWEVER.....





Immediate & Extended Impacts

■ Heat

- Possible increase, to a point, in forest visitation
- Increased water temperature may affect fishing, water based activities
- Viewing of wildlife, flowers, etc. may be affected

■ Wildfire – More difficult to redirect activities to other areas

(Long et al 2014)

■ In advance:

- Closures for high fire danger
- Limits on some uses

■ During


- \$ for surrounding communities, e.g.. Ferguson fire
- Smoke/impaired scenery and air quality e.g.. July 2018 diminished air quality

■ After

- Example from Station fire on Angeles National Forest
- 



Immediate & Extended Impacts

- Erratic storms
 - Risk of flooding
 - Loss of trails/water courses altered/structures damaged
 - Impacts to ecosystem from some uses increase
 - Need to protect 'stressed' system from further disturbances
 - Decreased health related benefits of participation
 - Decreased experience quality
 - Loss of desired experience/amenity
 - Loss of place
 - Increased crowding/decreased access
- 



Key Discussion Questions

- Over the past 5- 10 years what recreation sites have closed owing to effects related to climate change (fire, flooding, felled trees, hazard trees, landslides post fire then rain etc.)?
- What is estimate of return of asset (rehabilitated and reopened) and what remains closed?
 - Assets represent unique contributions yet recovery dollars/capacity may not permit, or there may be additional reasons for leaving an area closed (e.g.. allowing a species to recovery)
- What are barriers to return/restoration of assets?
- Tools needed moving into future scenario of elevated effects
 - Monitoring Communication Resources Partnerships