United States Department of Agriculture

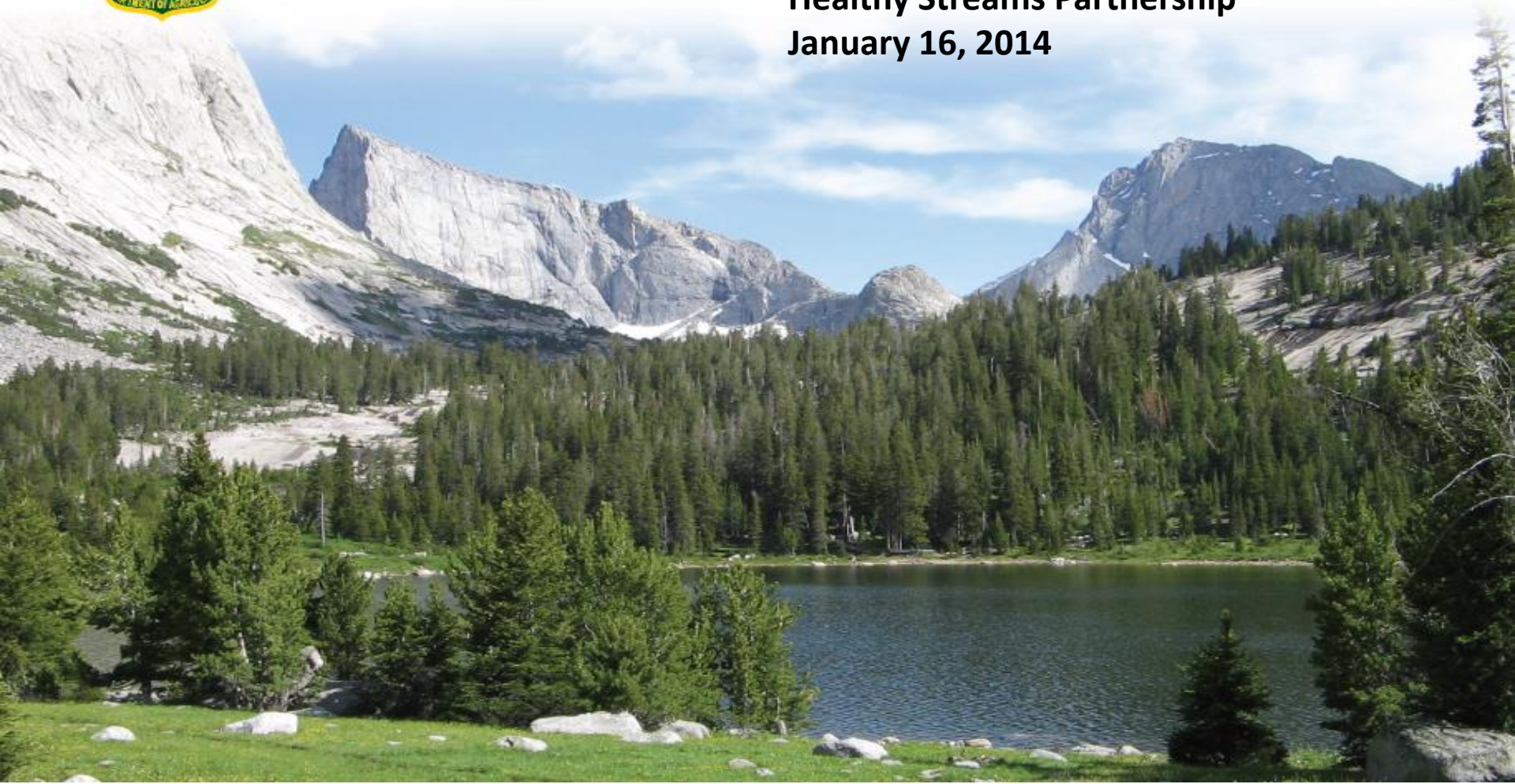
Forest Service

FS-977

May 2011

Watershed Condition Framework

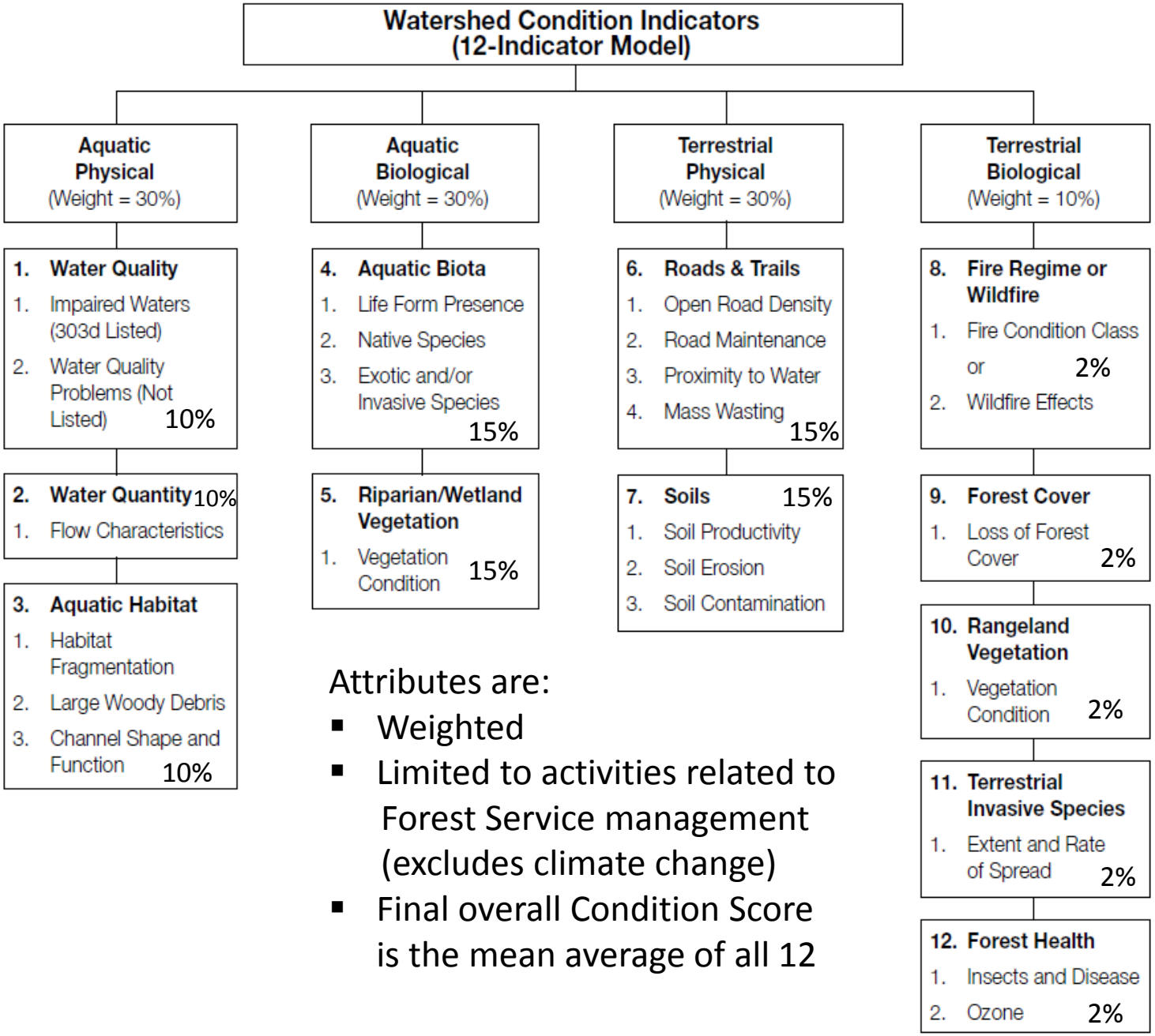
Joseph Furnish, Regional Aquatic Ecologist
USFS Pacific Southwest Region
Healthy Streams Partnership
January 16, 2014



Elements of Presentation

- **Background: 1999 Clean Water Action Plan**
  - **Priority Watersheds, PSW Regional direction to spend 80% of restoration funds in priority watersheds, Annual Accomplishment reports were sent to Washington, D.C.**
- **Broad-scale assessments**
  - **1994 Klamath-Sierra logging cumulative effects study (Hawkins et al. 2000 1st CA RIVPACS), EPA-EMAP/NARS, 2013 BLM-EPA WRSA, BLM Conservation Success Index, TNC-TU Below the Surface**
- **2011 USFS Watershed Condition Assessment (WCA)**
  - **2006 OMB Report suggested the Forest Service needed a national standard for assessment to prioritize watershed restoration, WCA was a response to this report**
  - **Attributes, compare-contrast with HSA, results for National Forest watersheds**
- **NWFP AREMP (Aquatic Riparian Effectiveness Monitoring Program)**
  - **Range of attributes, scale of analysis, probabilistic design**
  - **How may we measure whether 15 years of restoration efforts have been successful?**
- **Aquatic Management Indicator Species (MIS)**
  - **Combined CA Perennial Stream Assessment & aquatic MIS – benthic invertebrates**
  - **What is the condition of perennial streams, rivers and lakes in Sierra Nevada national forest watersheds?**
- **Aquatic Ecological Integrity**
  - **Definitions, Assessment & mapping in the Sierra Nevada Bioregion to support forest plan revisions under the new Planning Rule, determination of where to place Critical Aquatic Reserves (CARs) for conservation of native species and aquatic ecosystem structure and function**

U.S. Forest Service



Attributes are:

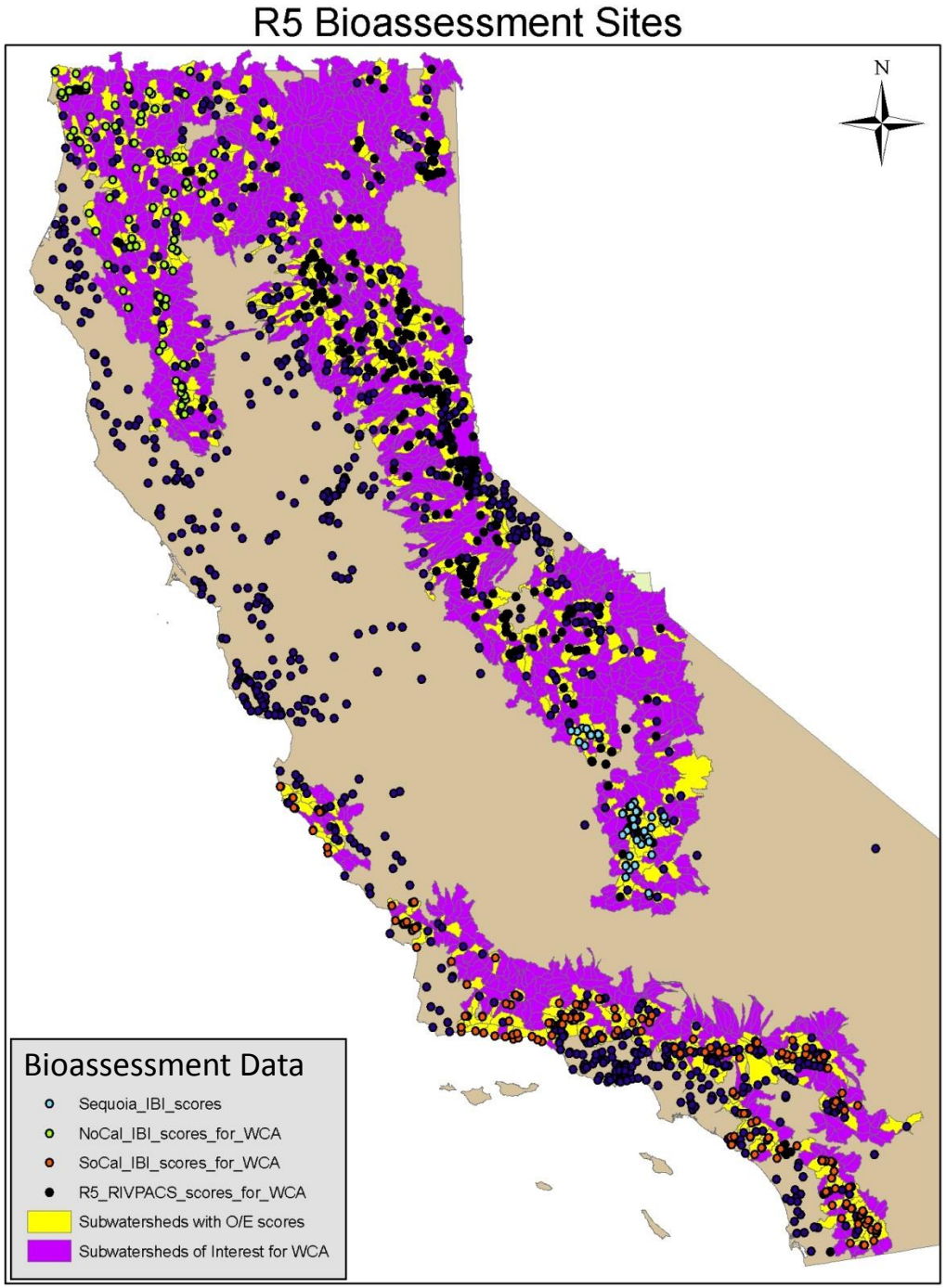
- Weighted
- Limited to activities related to Forest Service management (excludes climate change)
- Final overall Condition Score is the mean average of all 12

WCA Attributes

AQUATIC PHYSICAL INDICATORS	
1. Water Quality	Alteration of physical, chemical, and biological components of water quality.
2. Water Quantity	Changes to the natural flow regime - magnitude, duration, or timing of the natural stream flow hydrograph.
3. Aquatic Habitat	Aquatic habitat condition - habitat fragmentation, large woody debris, and channel shape and function.
AQUATIC BIOLOGICAL INDICATORS	
4. Aquatic Biota	Distribution, structure, and density of native and introduced aquatic fauna.
5. Riparian/Wetland Vegetation	Function and condition of riparian vegetation along streams, water bodies, and wetlands.
TERRESTRIAL PHYSICAL INDICATORS	
6. Roads and Trails	Changes to the hydrologic and sediment regimes due to the density, location, distribution, and maintenance of the road and trail network.
7. Soils	Alteration to natural soil condition, including productivity, erosion, and chemical contamination.
TERRESTRIAL BIOLOGICAL INDICATORS	
8. Fire Regime or Wildfire	Potential for altered hydrologic and sediment regimes due to departures from historical ranges of variability in vegetation, and fire behavior.
9. Forest Cover	Potential for altered hydrologic and sediment regimes due to the loss of forest cover on forest lands.
10 Rangeland Vegetation	Impacts to soil and water relative to the vegetative health of rangelands.
11. Terrestrial Invasive Species	Potential impacts to soil, vegetation, and water resources due to terrestrial invasive species (including vertebrates, invertebrates, and plants).
12. Forest Health	Forest mortality impacts to hydrologic and soil function due to major invasive and native forest pest insect and disease outbreaks and air pollution.

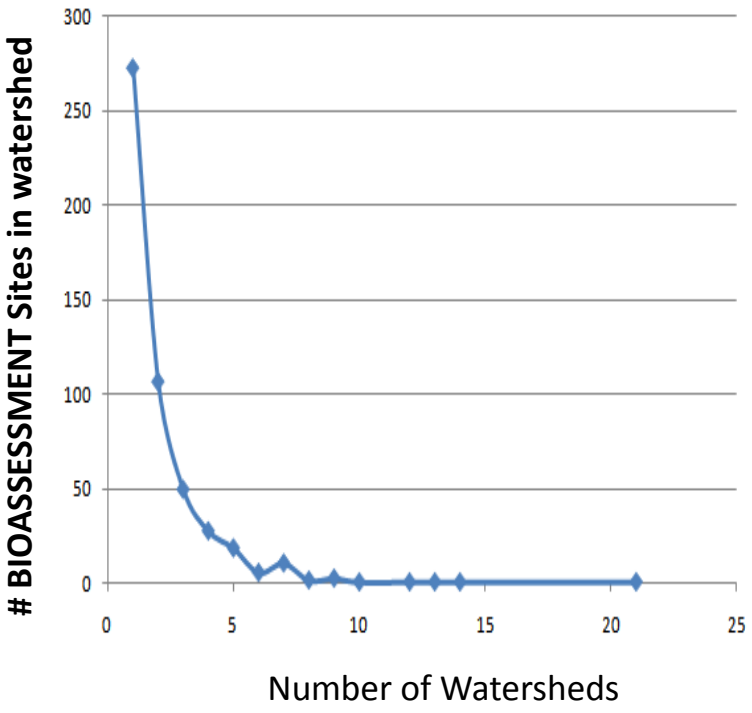
Comparison between USFS WCA & EPA-CA Healthy Streams Assessment

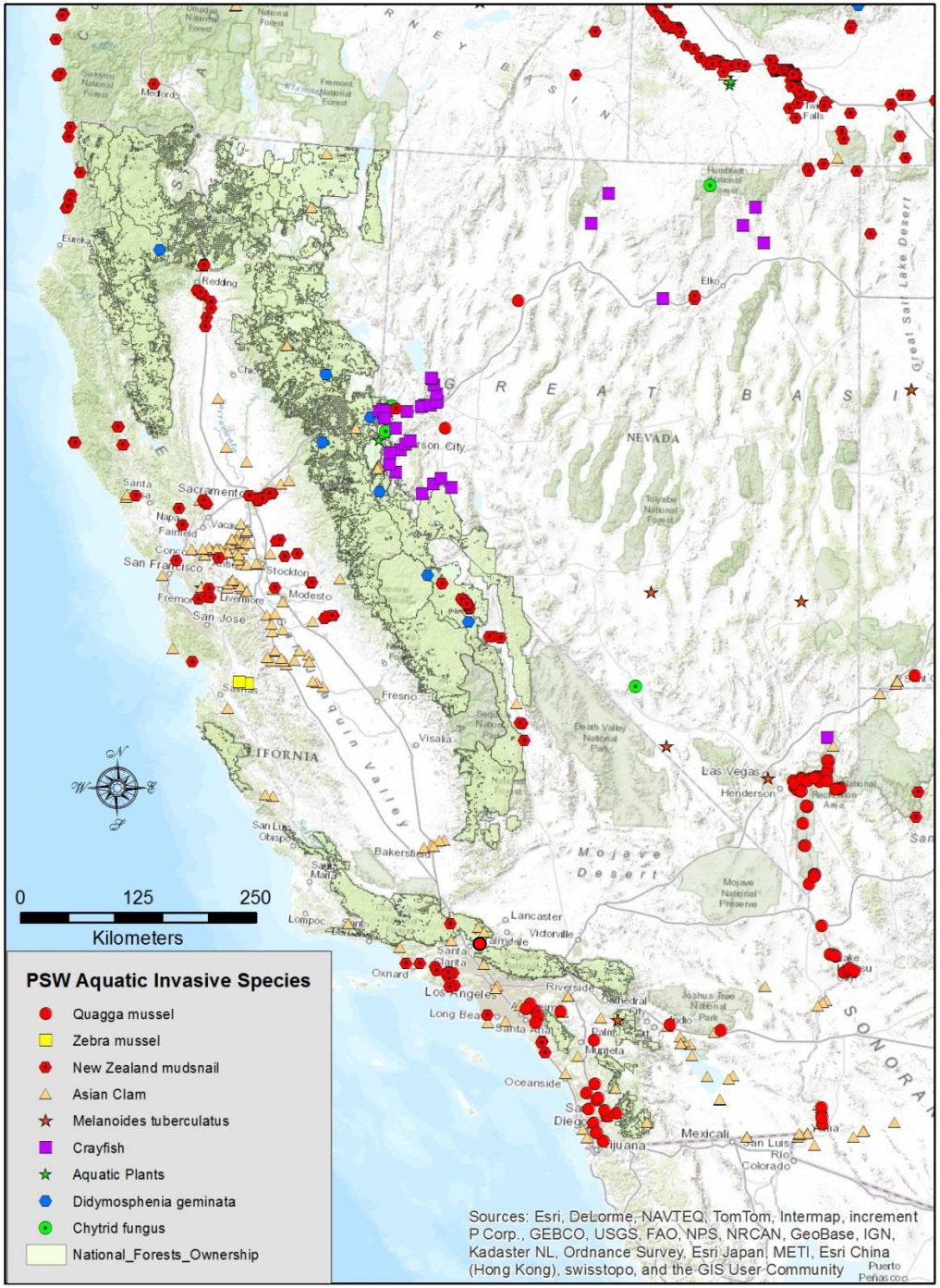
Attribute	USFS WCA	EPA HSA
Spatial Scale of Watersheds	12-unit HUCs, mean average of 23,000 acres (36 mi^2), Range 8,000 to ~40,000 acres	Mean < 800 acres or 1.2 mi^2
Number of Watersheds	15,066	135,255
Treatment of Public vs. Private lands	All watersheds with at least 5% USFS ownership	All lands, depending on position of site
Weighing of Attributes	YES	NO?
Objectives	Forest-, Region- and nation-wide standard for assessment, priorities for watershed restoration and protection	Identification of which watersheds are in best condition and should be protected
Origin of Attributes	Numeric, GIS-derived and best professional judgment	Numeric, GIS-derived
Climate Change	Not included, only related to USFS management activities	Extensively evaluated for several variables



Data Quality - GOOD

Number of Watersheds Analyzed	~1748
Number of bioassessment sites in Watersheds of interest	1070
Number of watersheds with at least one bioassessment site	504

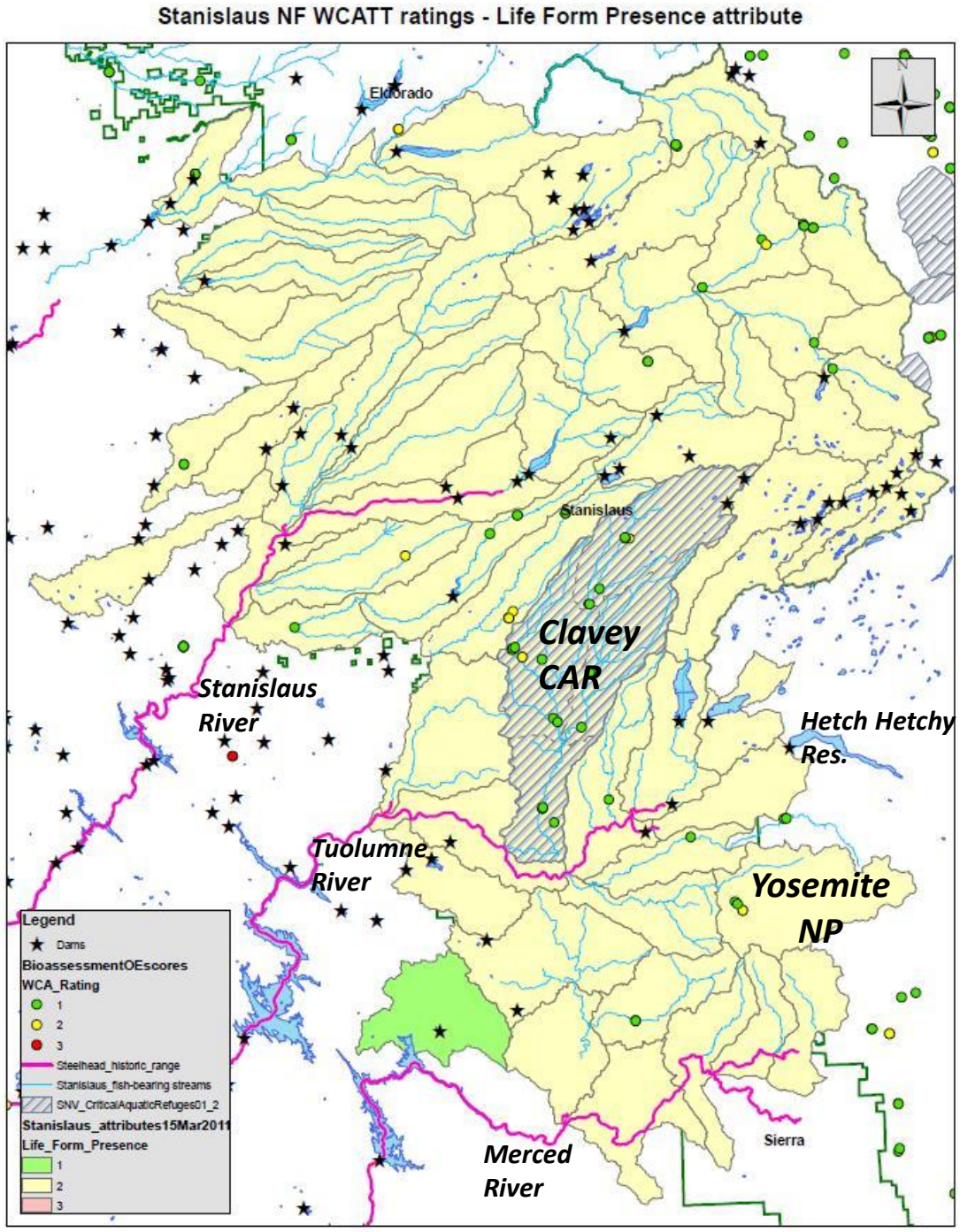




Data Quality – Major gaps

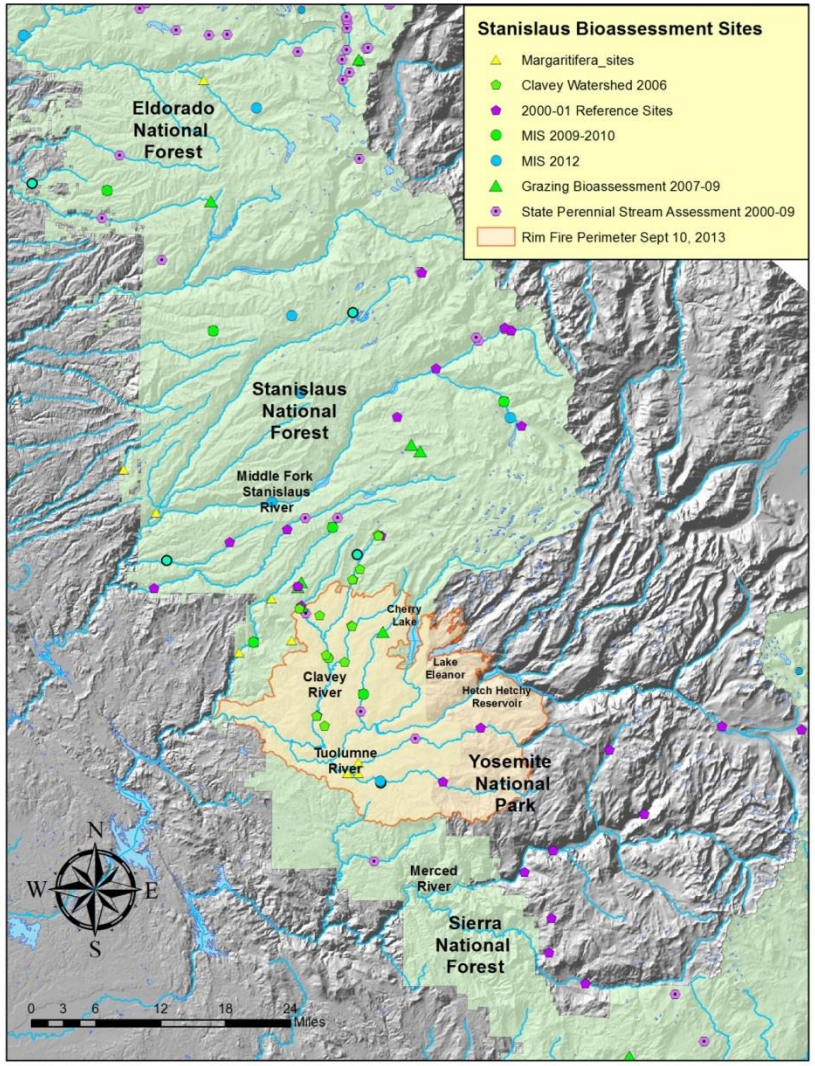
Aquatic Invasive Species

- Quagga mussel
  (*Dreissena rostriformis bugensis)*
- Zebra Mussel
  (*Dreissena polymorpha)*
- New Zealand mudsnail
  (*Potamopyrgus antipodarum)*
- Asian clam
  (*Corbicula fluminea*)
- Red-rimmed melania snail
  (*Melanoides tuberculatus*)
- Crayfish (*Pacifastacus leniusculus*,
  Orconectes virilis)
- Aquatic plants
  Eurasian water milfoil
  (*Myriophyllum spicatum*),
  Hydrilla (*Hydrilla verticillata*),
- *Didymosphenia geminata* - diatom
- Chytrid fungus
  (*Batrachochytrium dendrobatidis*)

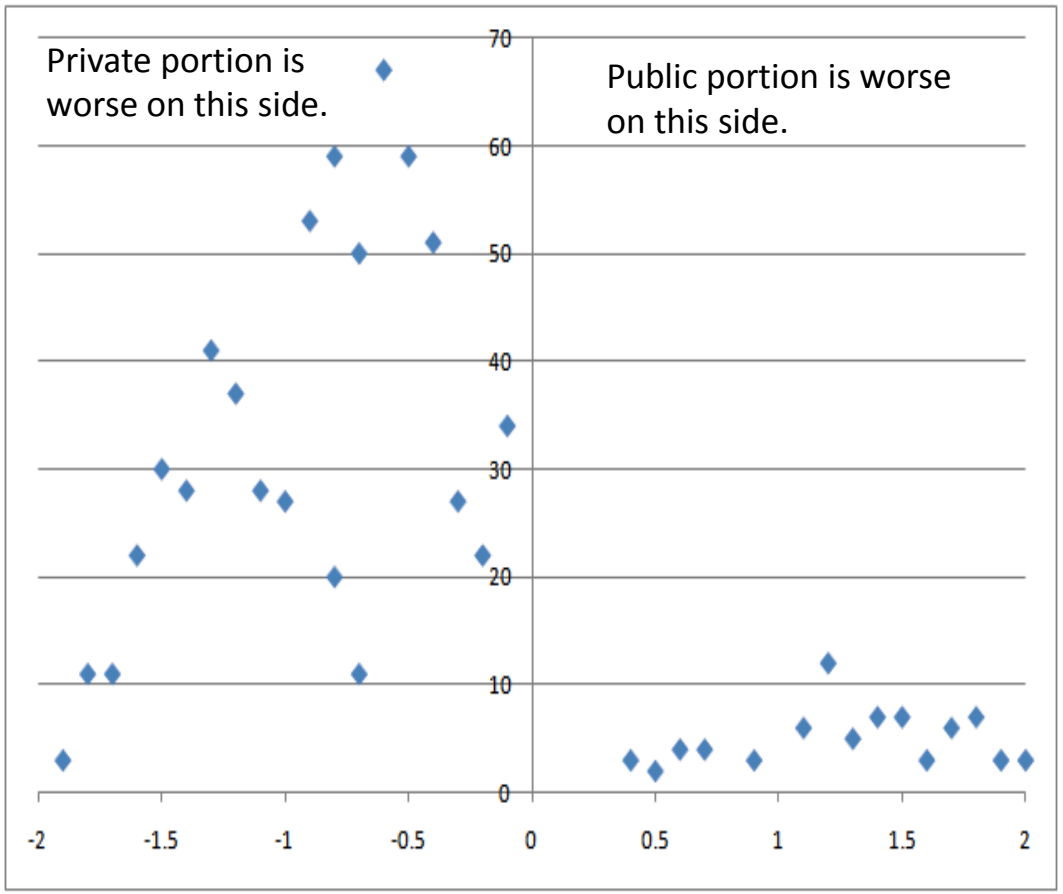


Stanislaus National Forest Example- Life Form Presence

- Fish-bearing
- Steelhead historic range
- Bioassessment Scores



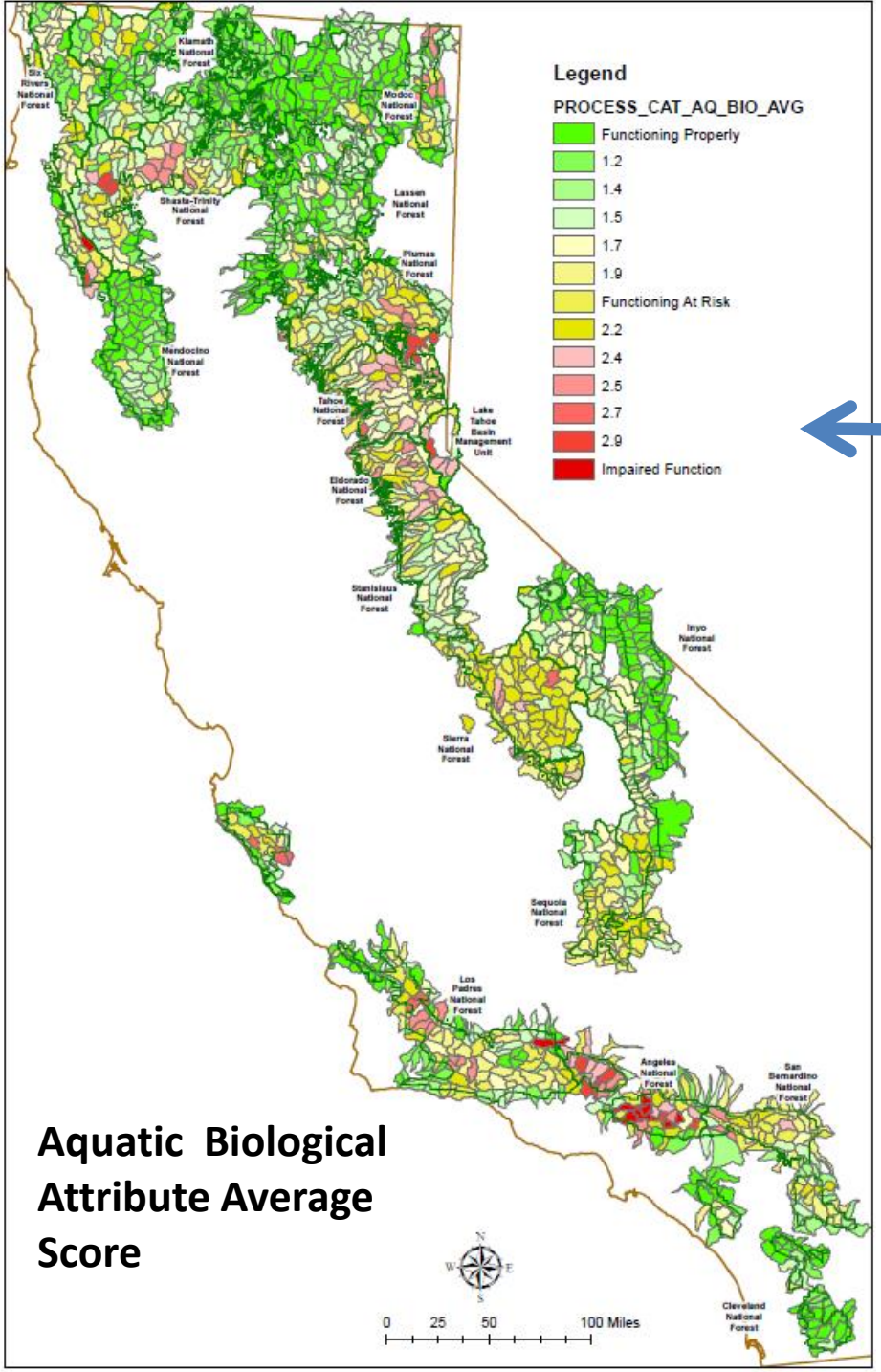
Influence of Private Lands: For any given 6th-field HUC watershed, how do scores on the national forest vs. private portions compare? (Public-Pvt)

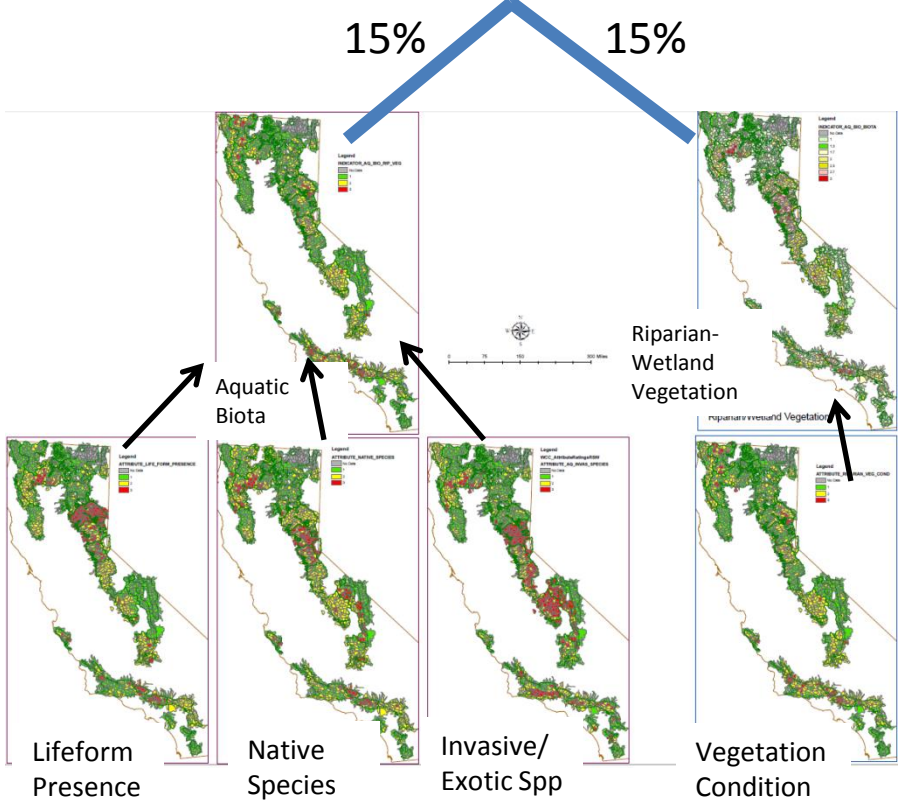


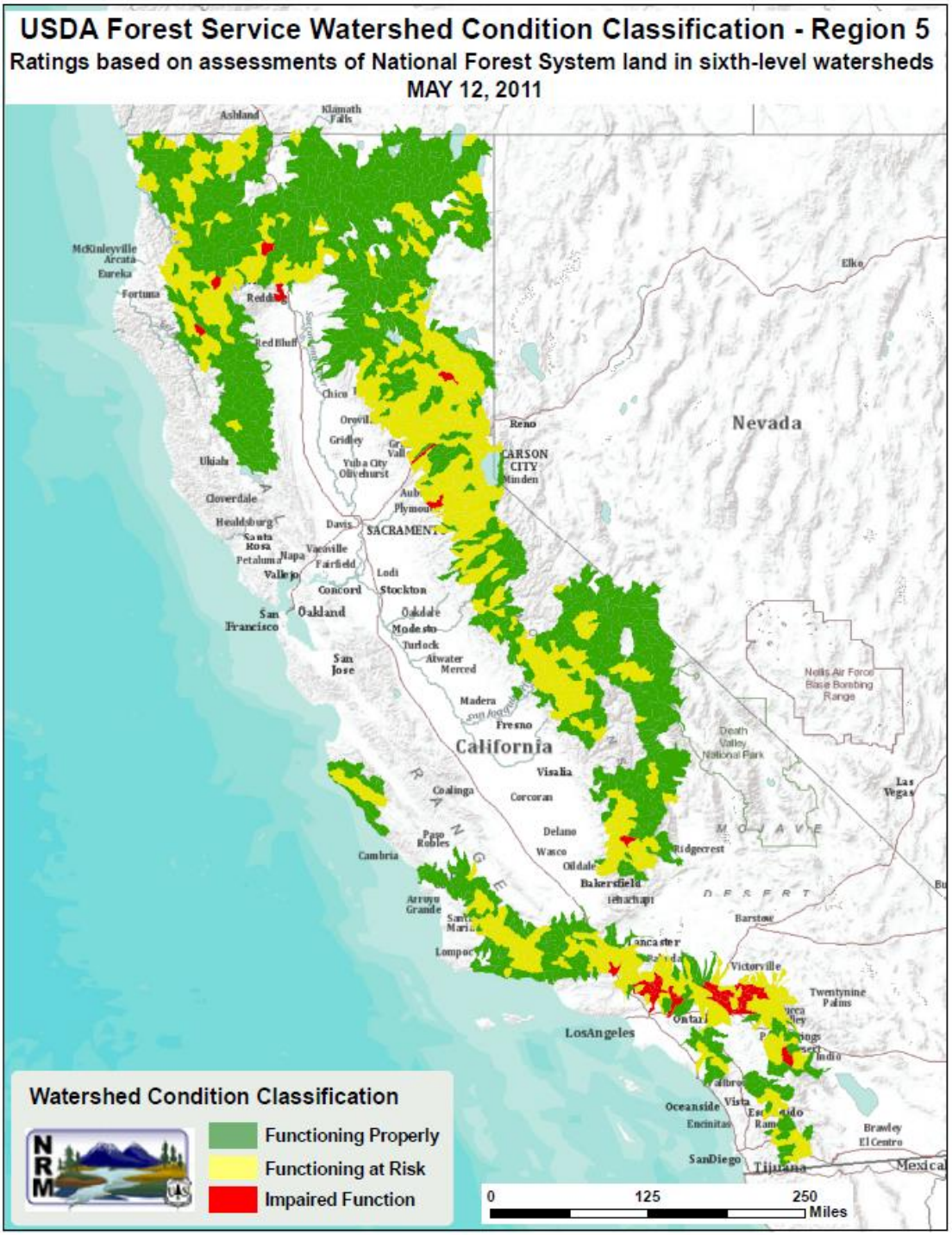
For Example, let the Public WS Score = 1
Private WS Score = 2;
Sum = -1 because Pvt was worse than Public portion.

Conclusion : While there was no difference for the majority of watersheds, when there were differences in score, the Private Portion of mixed ownership watersheds was usually assessed to be in worse condition than the public portion of the watershed.

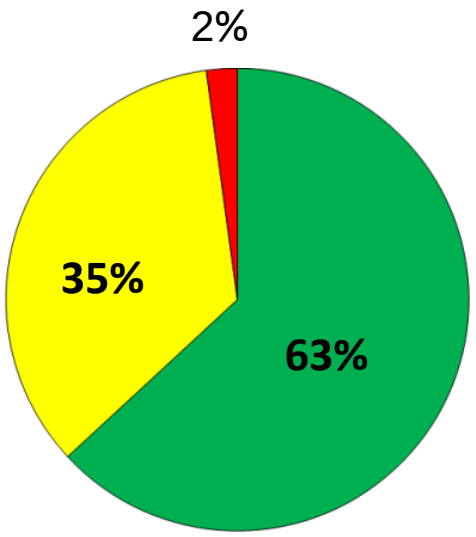
Maps were produced to depict composite, mean average scores for all attributes: Example for the Aquatic Biological Attribute





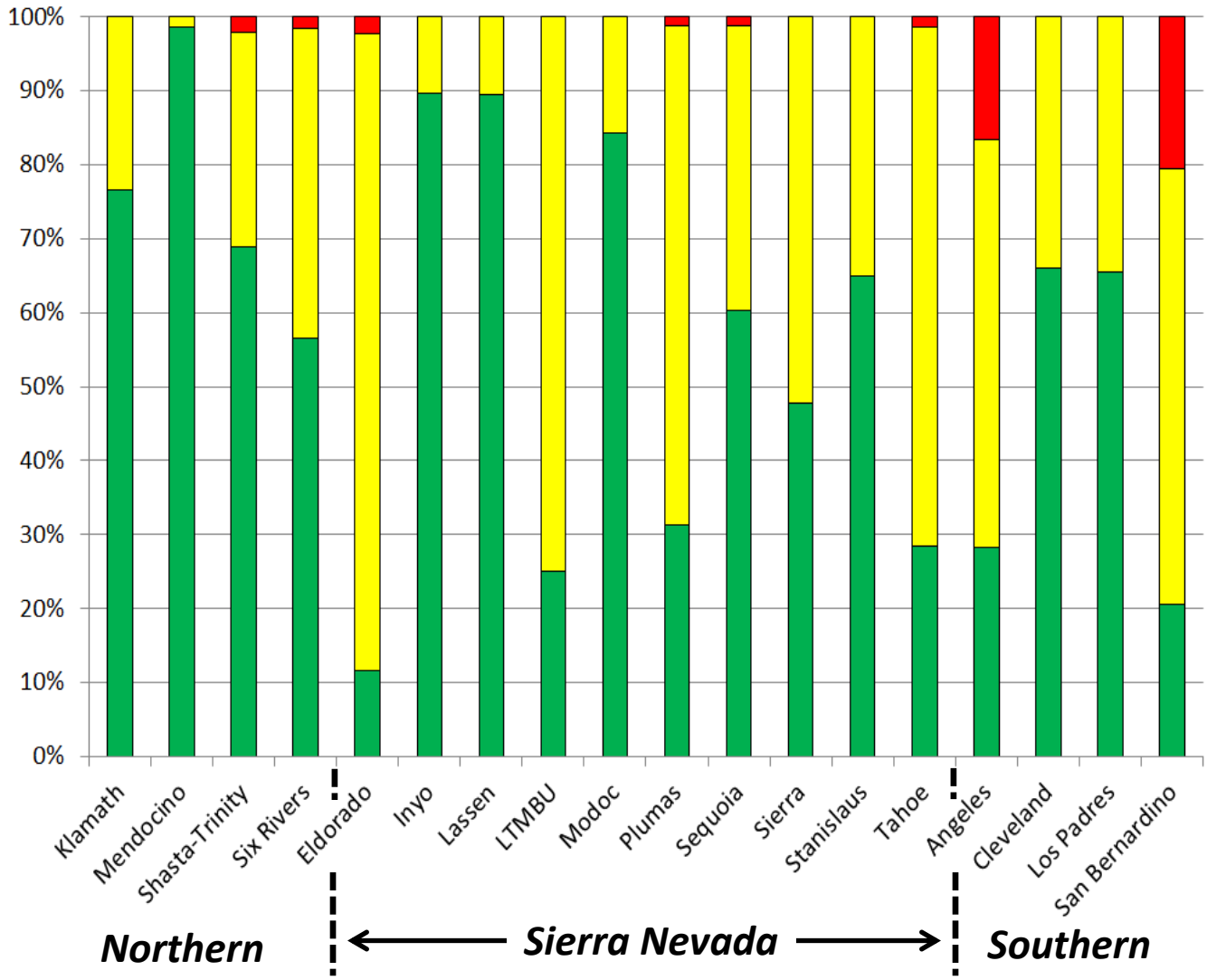


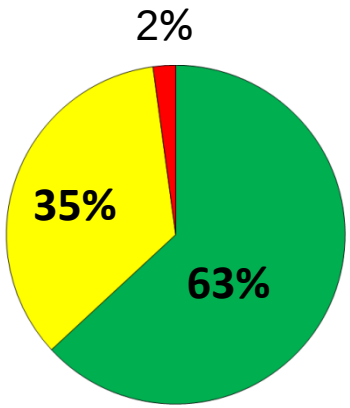
Regional Results



Impaired watersheds are concentrated on the southern, urban national forests & mother load region

Distribution of watershed condition scores for 1,490 6th- field HUC watersheds by forest





Impaired Function

Functioning at Risk

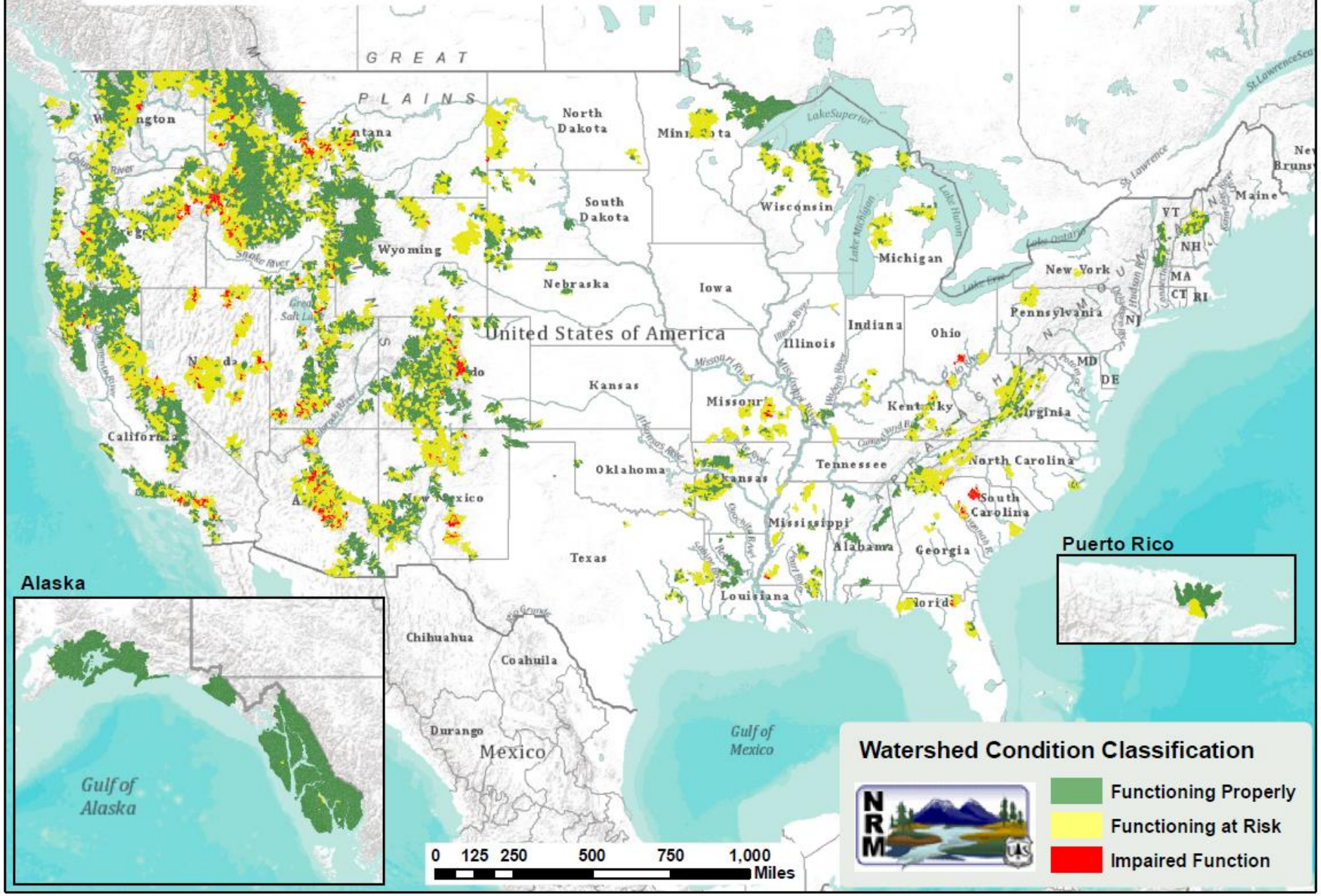
Functioning Properly

Pacific Southwest Region National Forest

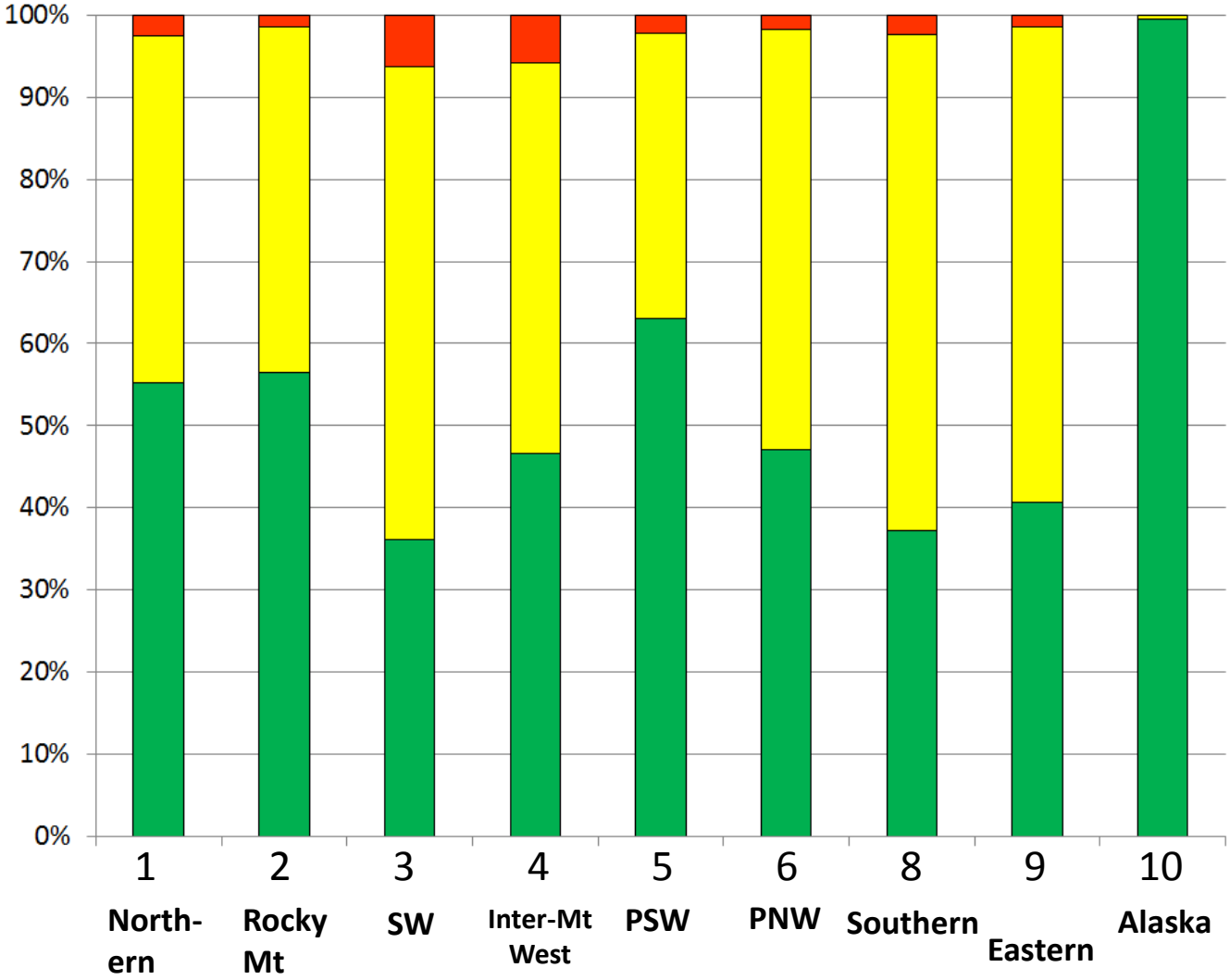
USDA Forest Service Watershed Condition Classification

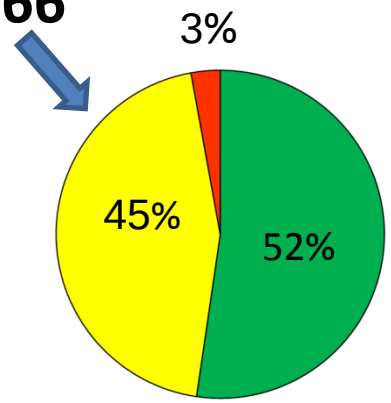
Ratings based on assessments of National Forest System land in sixth-level watersheds

MAY 12, 2011



Distribution of watershed condition scores for 15,066 6th- field HUC watersheds by Forest Service Region





Impaired Function

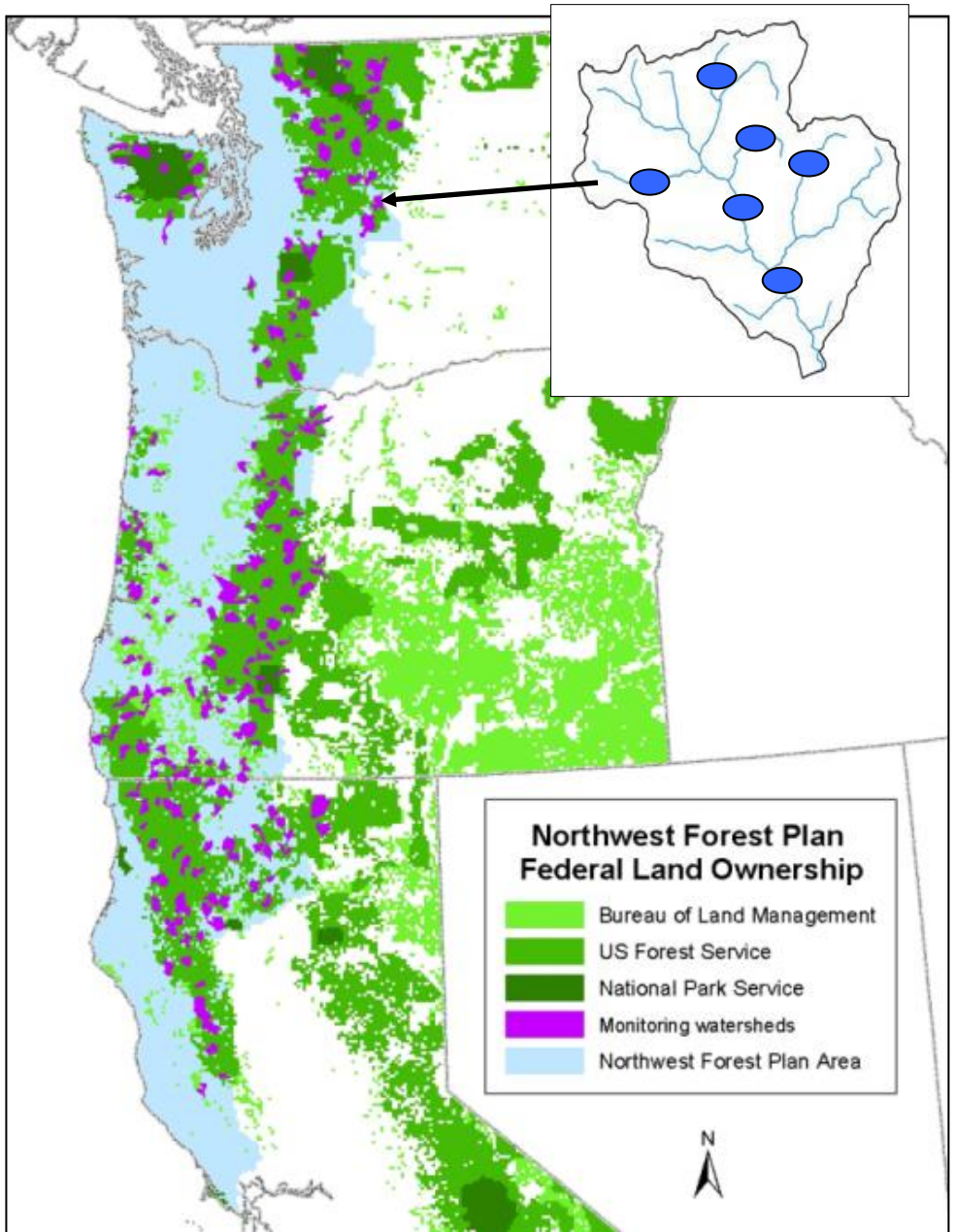
Functioning at Risk

Functioning Properly

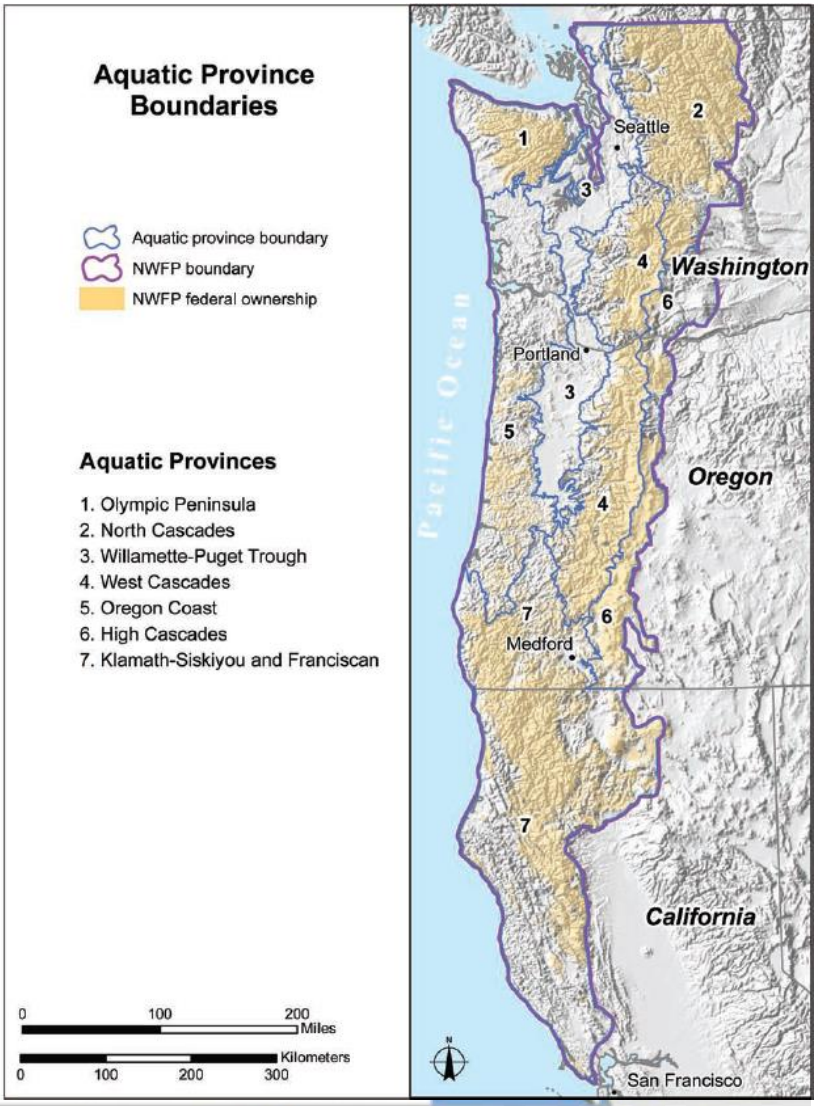
NWFP – Aquatic Riparian Effectiveness Monitoring Program (AREMP)

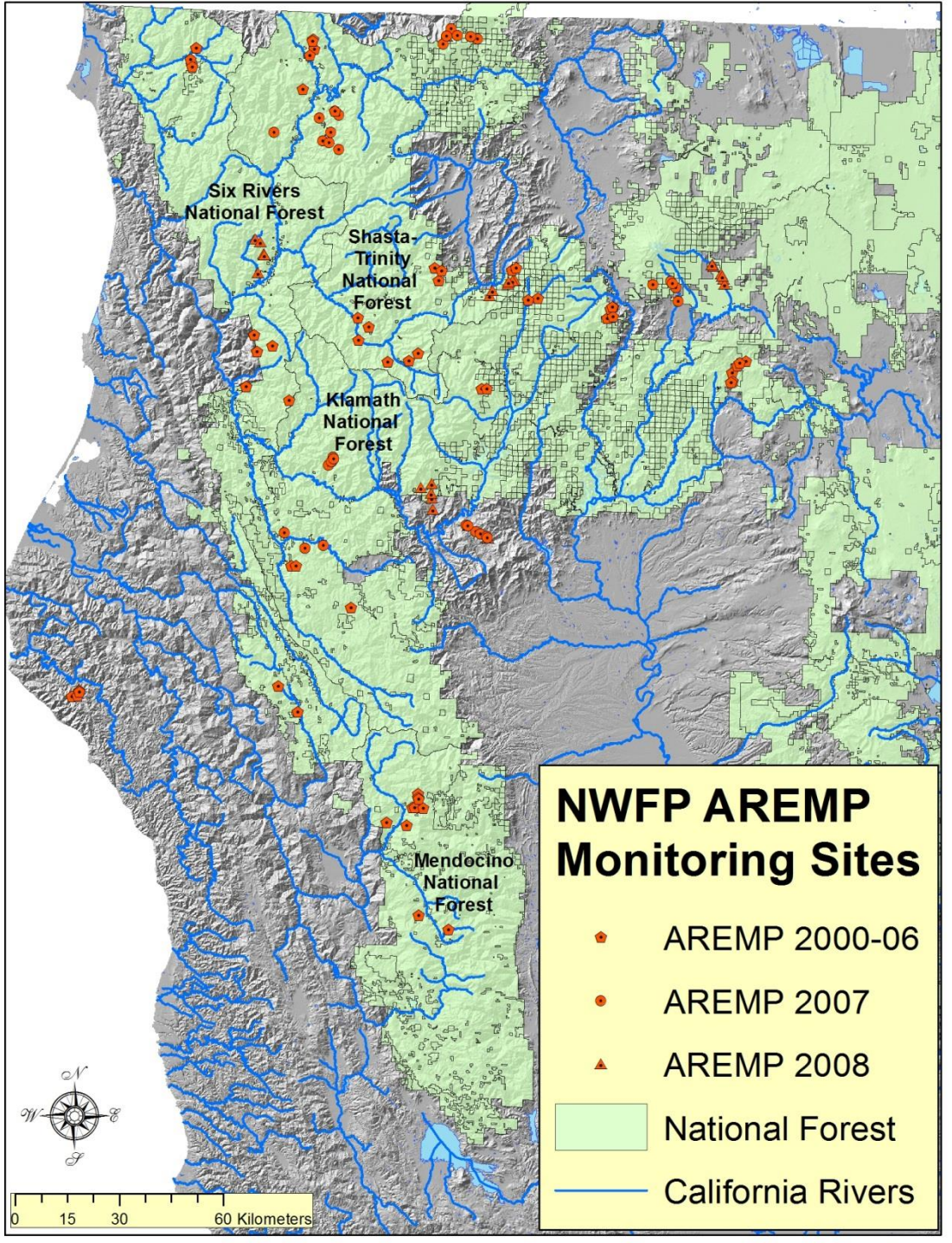
Sample design

- Minimum of 25 % federal ownership
- 250 randomly selected watersheds
- 28 watersheds sampled per year on an 8-year rotation
- Duration 1994 to present



Location of AREMP sites in the Klamath- Siskiyou & Franciscan Aquatic Province





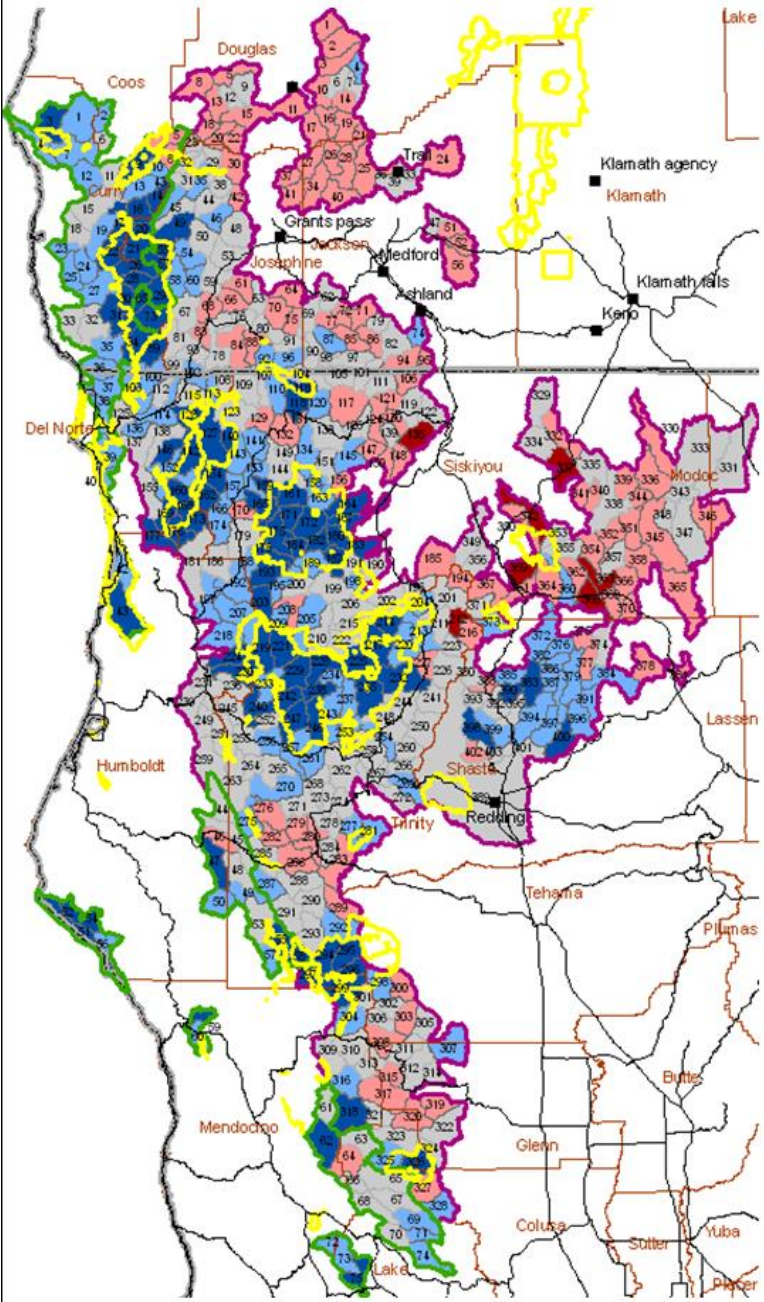
AREMP Watershed Assessment

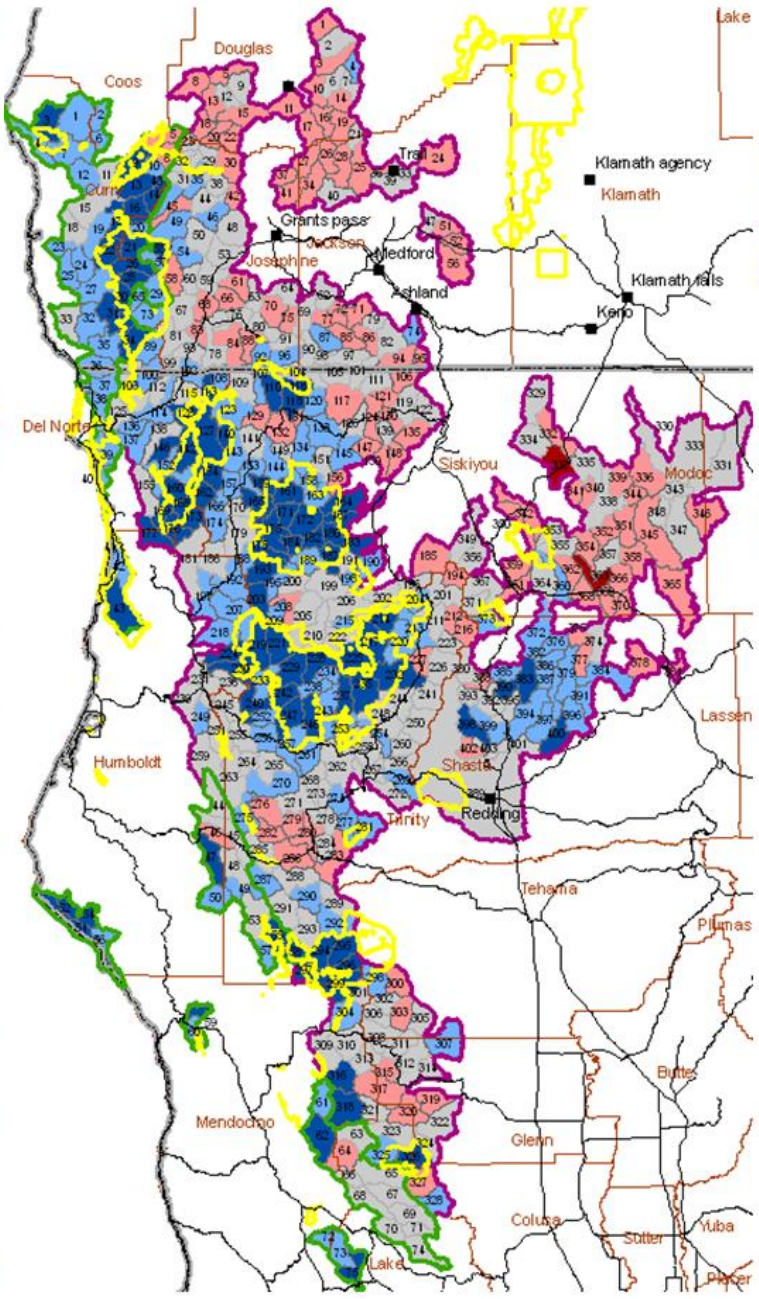
Klamath/Siskiyou & Franciscan

Dataset 05-21-2010

WatershedScore 1994

WatershedScore 2009





Franciscan Province

Klamath/Siskiyou Provinc

Reserved areas

Status Scores

Color	Score	Description
	+0.61 to +1	Very High
	+0.21 to +0.6	High
	-0.2 to +0.2	Moderate
	-0.21 to -0.6	Low
	-0.61 to -1	Very low

ATTRIBUTES

Scale 7th field HUCs
Vegetative cover
Riparian cover
Road Crossings
Road Density
Landslide Risk

How can we measure success? An example from AREMP tracking 15 years of restoration efforts to determine whether watershed condition is improving.

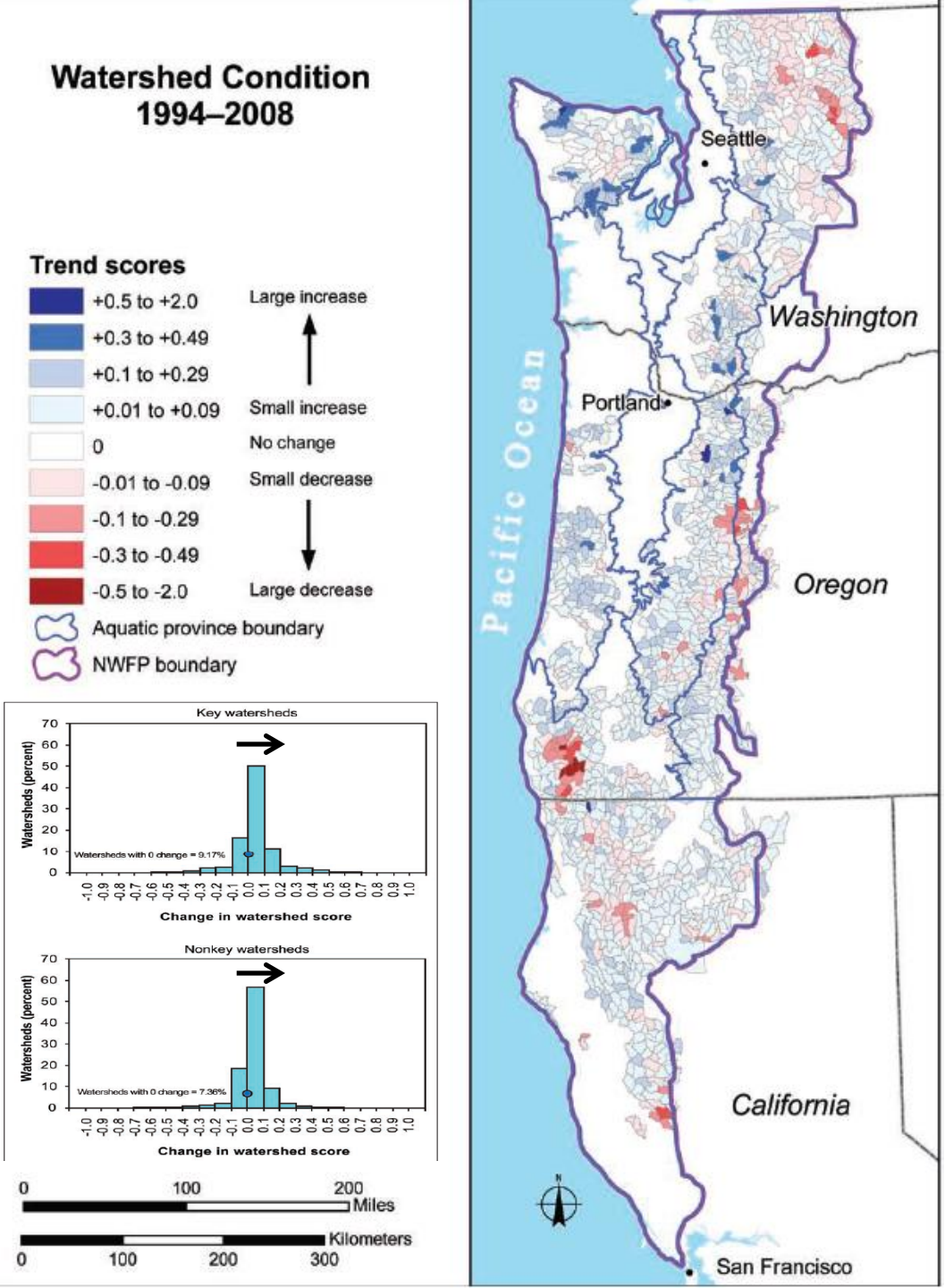
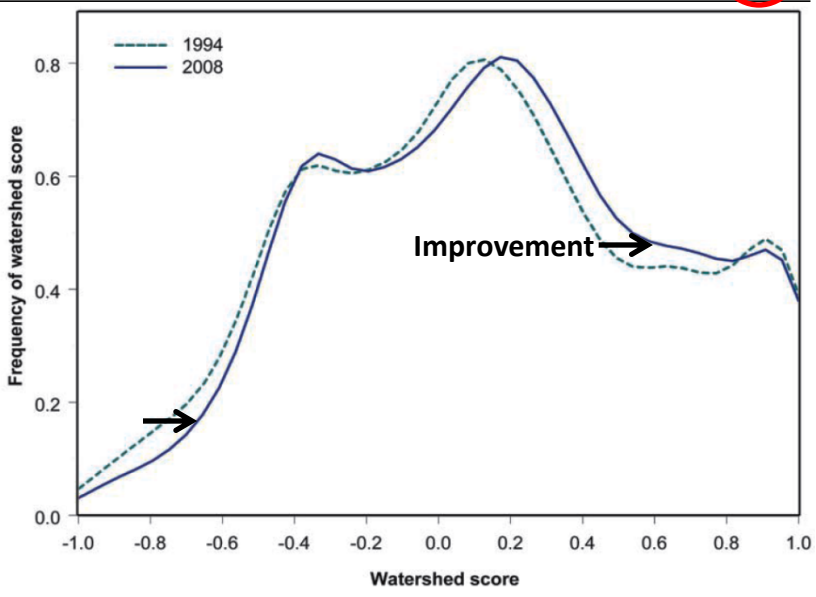
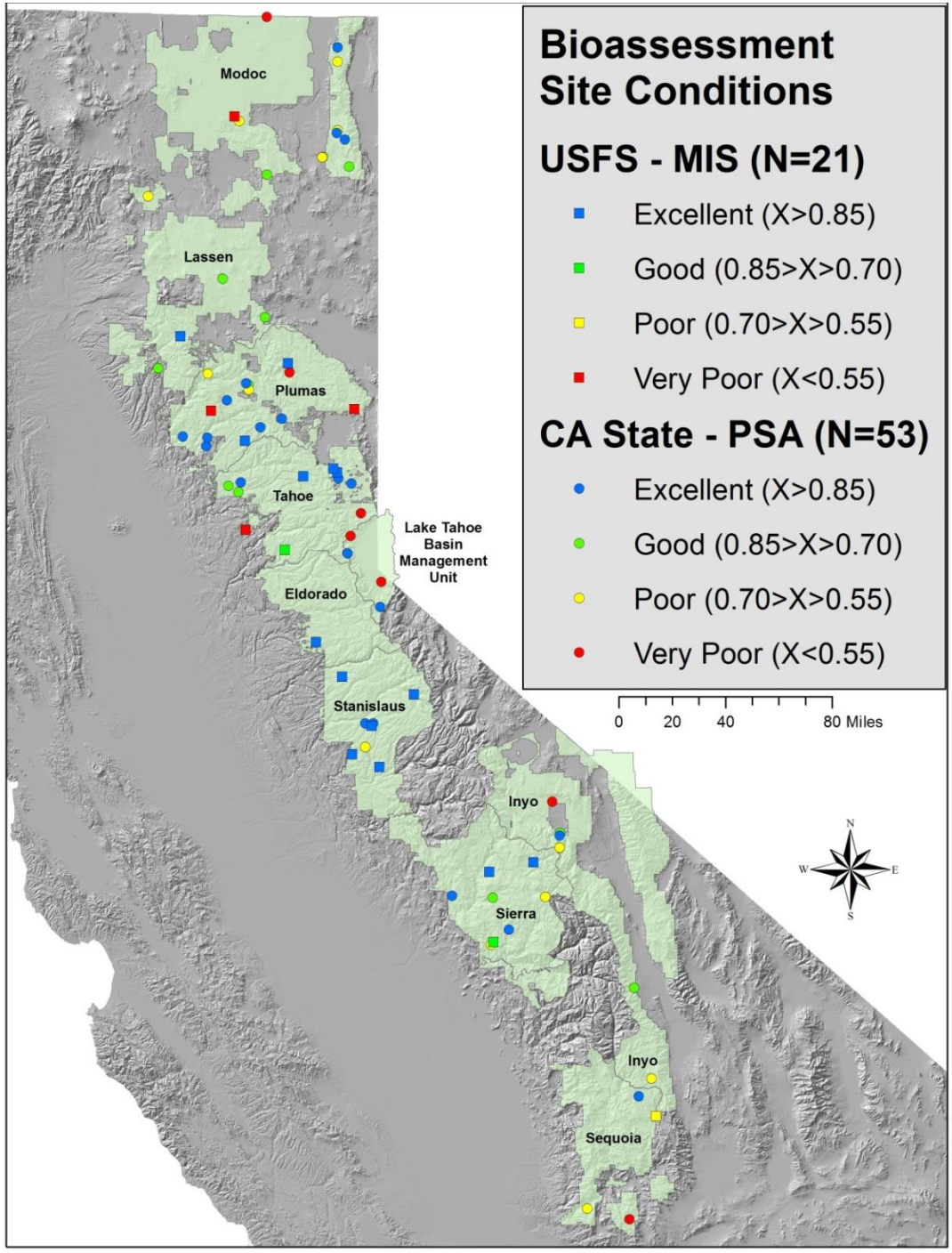


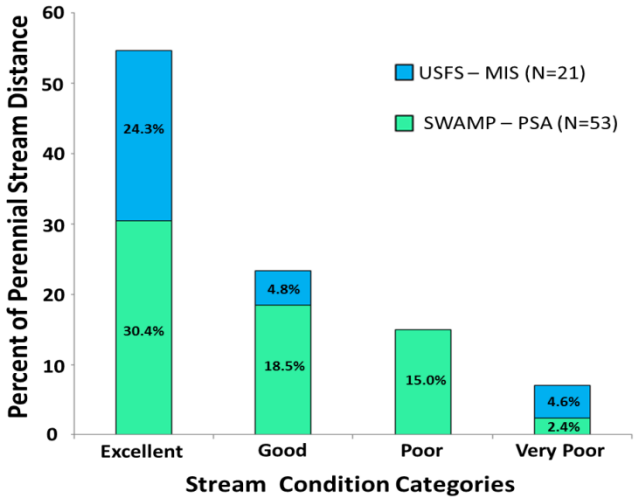
Table 6—Watersheds (n = 1,379) that decreased, increased, or had no change in watershed scores between 1994 and 2008

	Decrease	No change	Increase
		Percent	
All watersheds			
No min. threshold [a]	23	8	69
± 0.1 min. threshold[b]	4	86	10
Congressional reserve[c]	38	19	43
Late-successional reserve	17	3	80
Matrix	16	3	81
Key	23	9	68
Nonkey	23	7	70

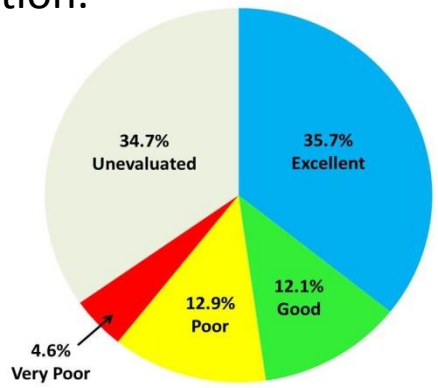




Aquatic MIS Results

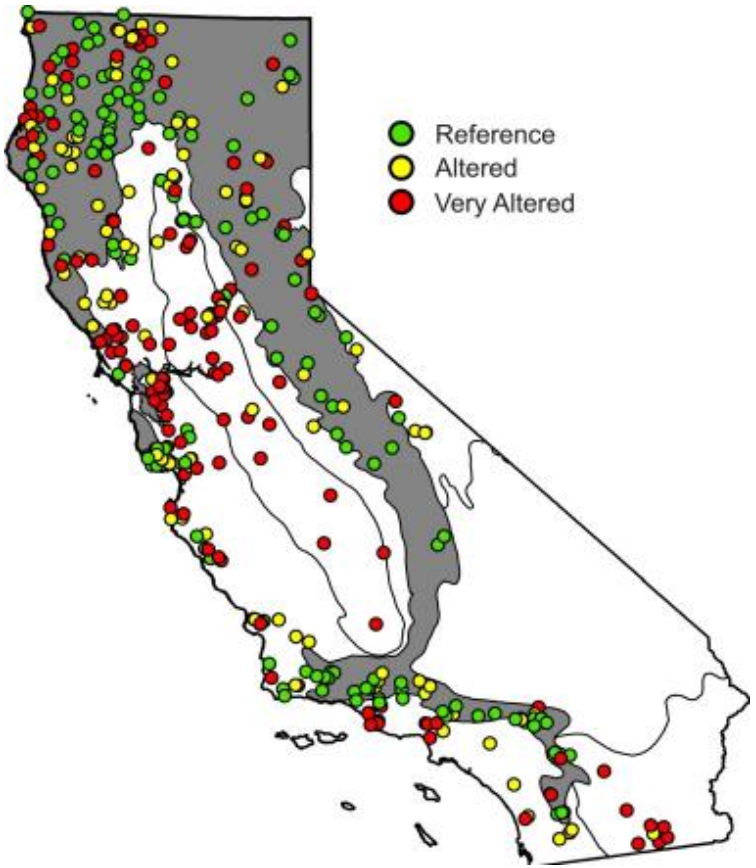


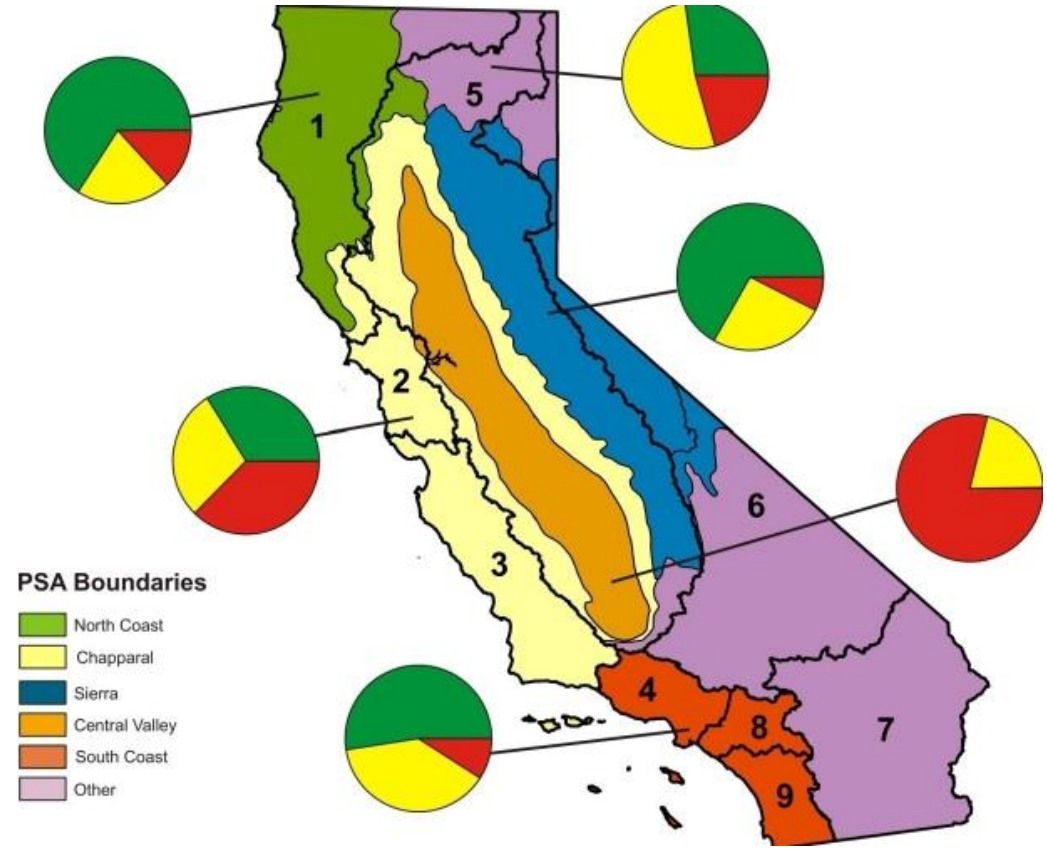
RIVPACS-IBI hybrid USFS & CDFW combined indicate that 78% of perennial stream miles on Sierra Nevada national forests are in reference condition.



Condition Assessments by Region (8 Years)

Thanks to Tom Kincaid and Tony Olsen, EPA, Corvallis





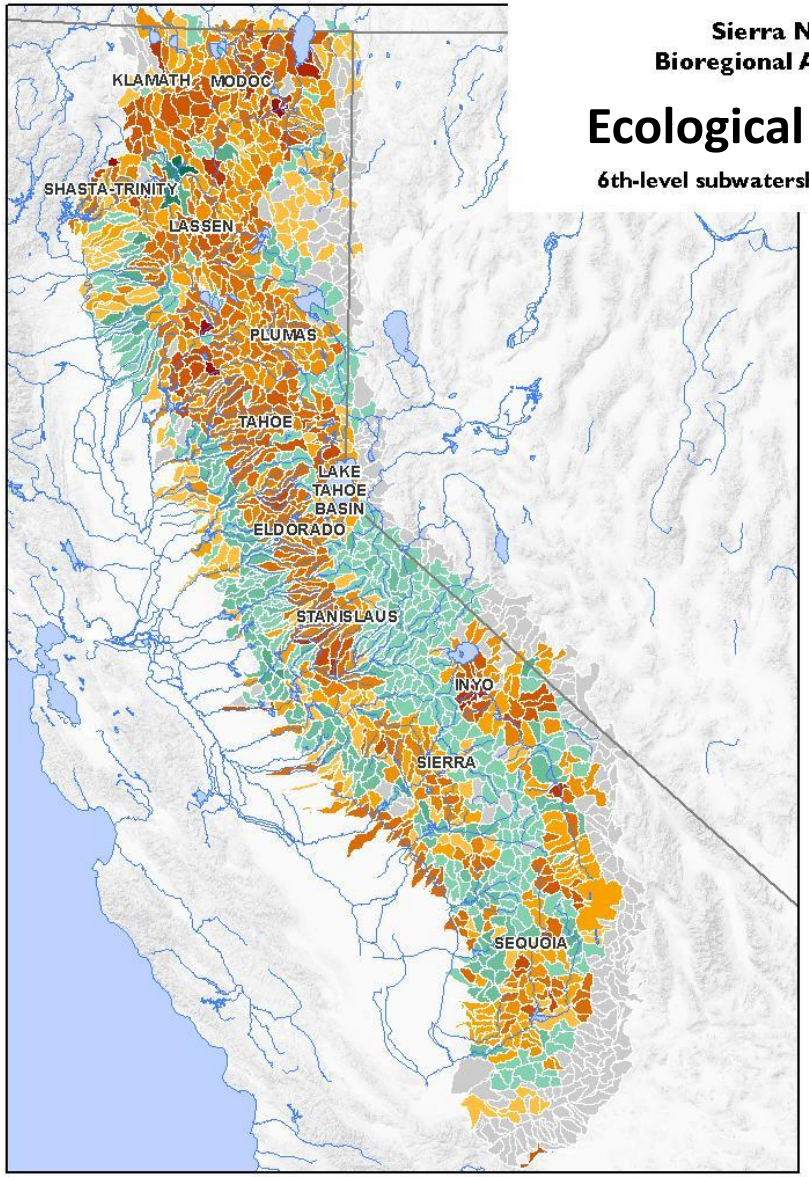
Statewide: ~50% of stream length has impaired biology

~22% of stream length has very impaired biology

Slide from Pete Ode, CDFW

Mapping Aquatic Ecological Integrity-

From Michael Kellett, USFS, Regional Fisheries Biologist



Sierra Nevada Bioregional Assessment

Ecological Integrity

6th-level subwatershed unit (HUC12)

Percent*

INCREASING AQUATIC BIODIVERSITY

- 61 to 70
- 51 to 60
- 41 to 50
- 31 to 40
- 21 to 30
- 11 to 20
- 1 to 10
- 0
- -9 to -1
- -19 to -10
- -29 to -20
- -39 to -30
- -49 to -40
- -59 to -50
- -69 to -60
- -79 to -70
- -89 to -80
- -100 to -90

***Methodology of aquatic biodiversity index calculation displayed on this map**

Data were gathered and classified according to 6th level subwatershed units (HUC12). Values for each factor (see table below) within the subwatersheds were normalized to a range from -10 to +10 based on either the number of occurrences within a HUC, determined condition for the HUC, or change within the HUC. Scores from each factor were summed for each subwatershed. Finally, a percent of absolute maximum value (wherever the summed area is the greatest difference from zero) was calculated.

Inputs for Aquatic Ecological Integrity

Fish, Invertebrates, Herptiles	Positive factor
Invasive/non-native species	Negative factor
Water development	Negative factor
Road density	Conditional factor
Range contraction	Negative factor