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Analysis of Trends in Climate , Stream Flow, and Stream Temperature in North Coastal California Park Units

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Mary Ann Madej,
Alicia Torregrosa, and Andrea Woodward

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NPS Vital Signs Monitoring Networks

Monitoring:

Temperature
Precipitation
Stream Flow
Vegetation
Fish

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Possible Climate Impacts

- Change in seasonal and annual air temperature
- Change in seasonal and annual precipitation
- Change in timing and amount of runoff
  - (fish migration, estuary dynamics)
- Reduction of coastal fog
- Increase in stream temperature
- Increased frequency of extreme events
- Change in vegetation (and evapotranspiration)

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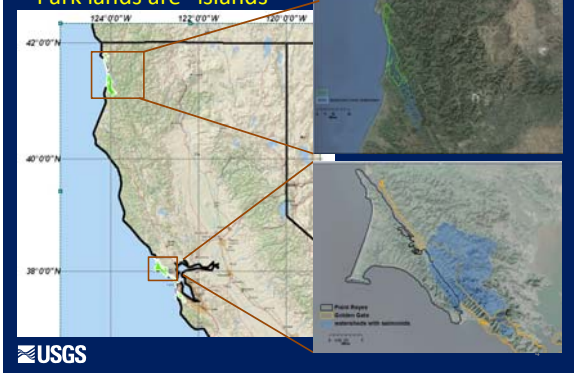
Challenges – Park lands are "islands"



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Focusing on Freshwater Phase

Fall First Flows

Adults return to spawn

Need to exceed minimum flows for migration

Winter Peak Flows

Eggs incubating in redds

- High flow scours redds
- Eggs/juveniles washed out
- Channel morphology changed
- Fine sediments flushed out

Summer Dry-down

Parr → 1 yr → 2 yr Smolt

-Enough winter & spring PPT to replenish groundwater?
-Adequate pools for rearing

Spring Run-off

Fry → Parr → Smolt

- If high flow & no side channels fry & parr wash out
- Fog/PPT trigger smolt to ocean?
- SUNNY → Algal blooms

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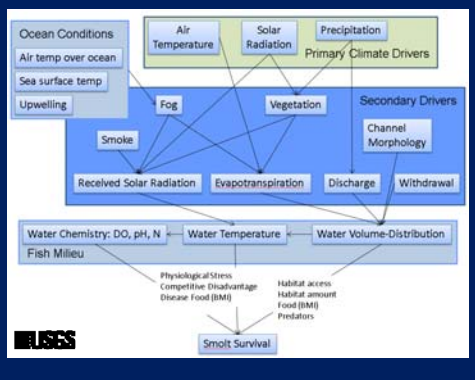
Summer Model



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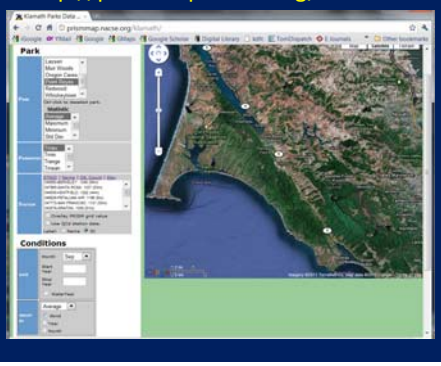
Step 1: Assess Trends in Climate

http://prismmap.nacse.org/klamath



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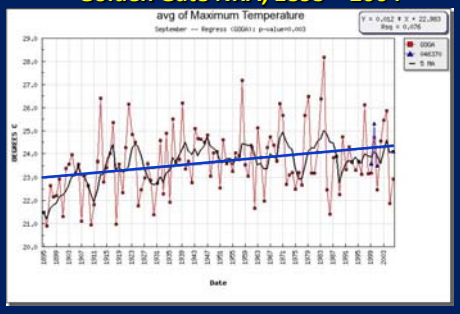
Average Maximum Air Temperature- September Golden Gate NRA, 1895 – 2004



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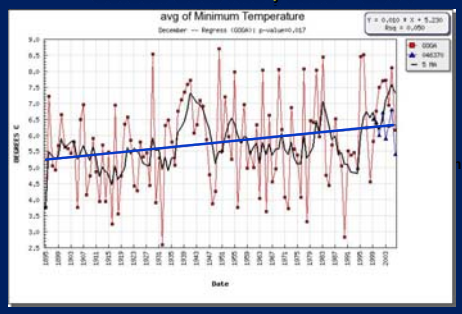
Average Minimum Air Temperature- December Golden Gate NRA, 1895 – 2004



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Summer fog is critical to redwood ecology

From National Geographic

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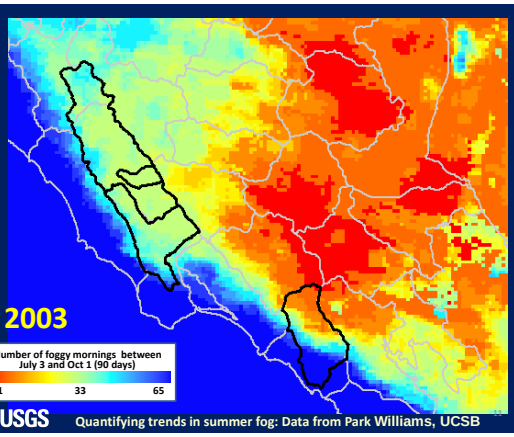

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Quantifying trends in summer fog: Data from Park Williams, UCSB

Average Daily Max Air Temperature By Month: 1895 – 2004

P values	REDW	GOGA	PORE	MUWO
Average Maximum Temperature	1895-2007	1895-2007	1895-2007	1895-2007
January	!	↑	↑	↑
Feburary		↑	↑	↑
March		↑	↑	↑
April	↓			!
May		↑	↑	↑
June				
July				
August		↑	↑	!
September		↑	↑	↑
October		↑	↑	↑
November	↓			
December		↑		

	decreasing trend	increasing trend
<0.01	↓	↑
0.011-0.05	↓	↑
0.051-0.10	!	!
not significant		

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Average Daily Min Air Temperature By Month: 1895 – 2004

P values	REDW	GOGA	PORE	MUWO
Average Min Temperature	1895-2007	1895-2007	1895-2007	1895-2007
January				↓
Feburary			↓	↑
March		↑	↑	↑
April		↓	↑	↑
May		↑	↑	↑
June		↑	↑	↑
July		↑	↑	↑
August	↓	↑	↑	↑
September		↑	↑	↑
October		↑	↑	↑
November		↑	↑	↑
December		↑	↑	↑

	decreasing trend	increasing trend
<0.01	↓	↑
0.011-0.05	↓	↑
0.051-0.10	↓	↓
not significant		

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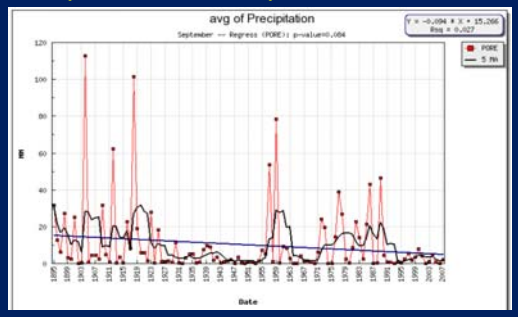
September Precipitation, PORE



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Average Monthly Precipitation 1895 – 2004

P values	REDW	GOGA	PORE	MUWO
Average Precipitation	1895-2007	1895-2007	1895-2007	1895-2007
January				↓
Feburary				
March				
April				
May				
June				
July				
August				↓
September	↓	↓	↓	↓
October				
November				
December				↓

	decreasing trend	increasing trend
<0.01	↓	↑
0.011-0.05	↓	↑
0.051-0.10	↓	↓
not significant		

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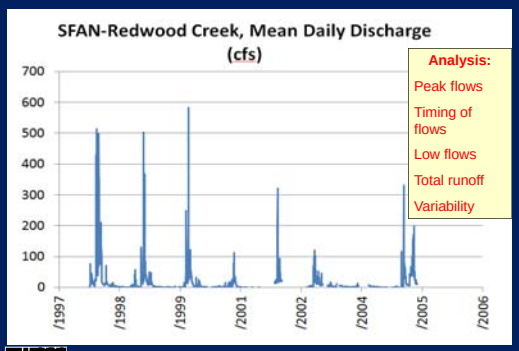
Step 2: Assess Trends in Runoff



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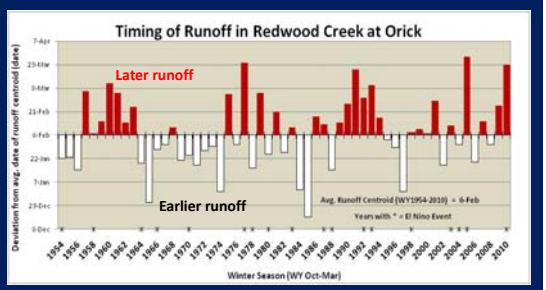

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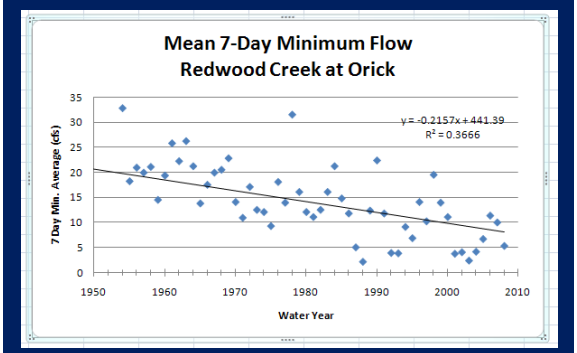

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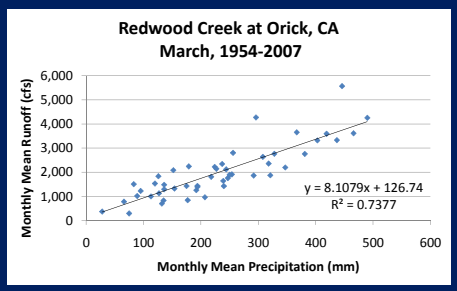
Step 3: Assess Relationships among Variables



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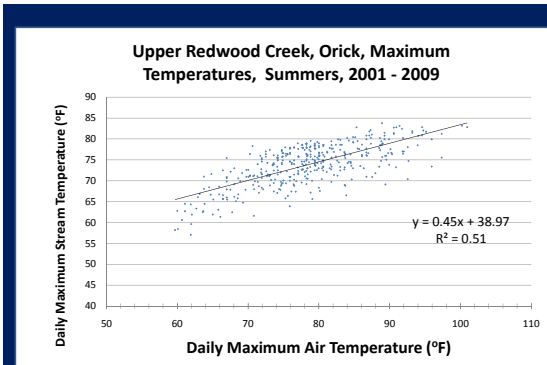

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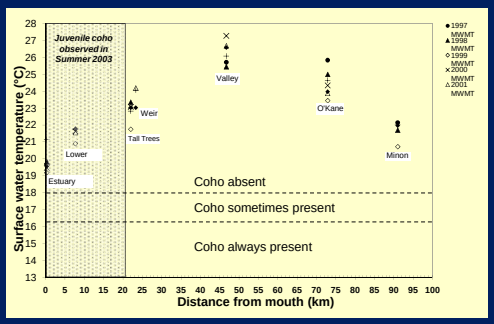
Stream temperatures in Redwood Creek no longer favorable for salmon



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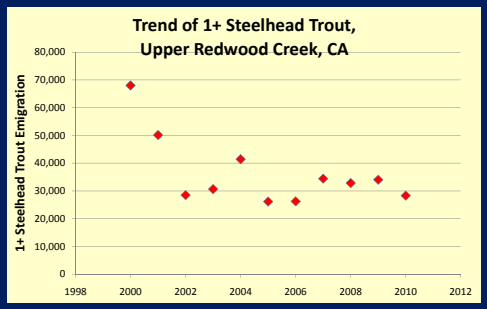
How do trends in climate, stream flow and stream temperature affect salmon populations?



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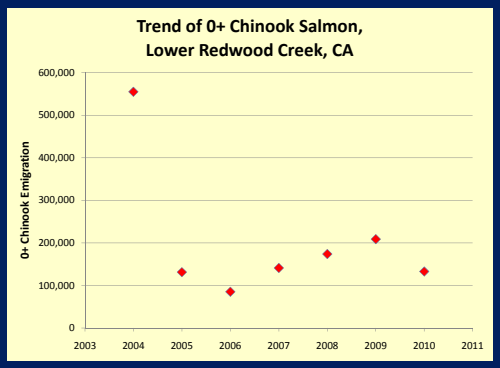
Data from CA Dept. of Fish and Game



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Data from CA Dept. of Fish and Game

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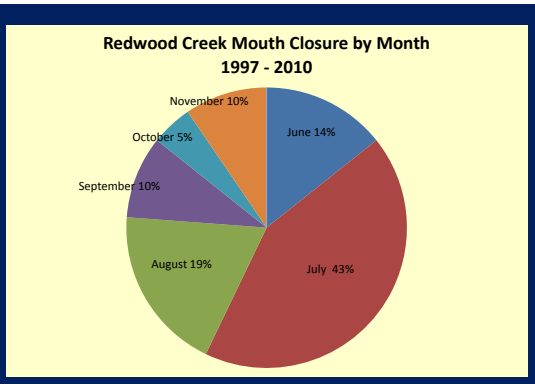

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Ultimate Goal

Synthesize monitoring data to understand the strength of relationships to better target management activities

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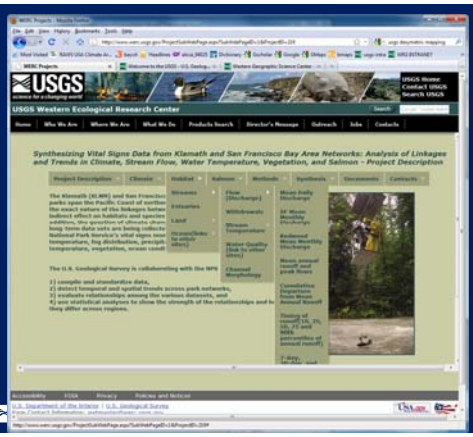

Take Home Messages

- The NPS Vital Signs Program protocols focus on rigorous monitoring of individual indicators
- However, ecosystems are complex with dynamic interacting components
- Synthesizing monitoring data leads to a deeper understanding of the relationships in this complex, multivariate system and consequently a stronger foundation for resource decisions

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