MONITORING THE RECOVERY OF STREAMS IN THE SAN GABRIEL MOUNTAINS (CA) FOLLOWING THE LARGEST WILDFIRE IN LOS ANGELES COUNTY HISTORY: STATION FIRE - 2009

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Acknowledgements

• Eric Stein, SCCWRP
• David Young, USFS
• Ken Franklin, City of LA
• Wendy Willis, Aquatic Bioassay
• Aquatic Bioassay Field Sampling Crews
• Council for Watershed Health
• The majority of the SGRRMP monitoring funding was provided by Los Angeles County Sanitation District
• The majority of the LARWMP monitoring funding was provided by the City of Los Angeles
Watershed-wide monitoring program established in 2005 and 2008

Multiple Stakeholders including LA County Sanitation District, the Cities of LA and Burbank, LADPW, OCPW, LARWCB, and others

Programs are designed to complement and/or coordinate with the State Water Resource Control Board Monitoring Programs
San Gabriel and Los Angeles River Watersheds

- **SGR Watershed**
  - 689 mi$^2$
  - ~2 million people
  - 54% undeveloped, mostly in the Upper Watershed

- **LAR Watershed**
  - 801 mi$^2$
  - ~4.5 million people
  - 45% undeveloped, mostly in the Upper Watershed
Los Angeles River Watershed

Upper Watershed

Lower Watershed

Los Angeles River
San Gabriel River Watershed

Upper Watershed

Lower Watershed

San Gabriel River
1. What is the health of streams?
2. Conditions at areas of unique importance?
3. Are regulated discharges meeting WQ objectives?
4. Is it safe to swim?
5. Is it safe to eat fish?

State of the Watershed
Angeles National Forest

- Lies between the Los Angeles Basin and Mojave Desert
- Comprised of 650,000 acres of land
- Elevations Range from 1,200 to 10,064 ft.
- Habitat includes dense chaparral with oak woodlands, and pine and fir forest in higher elevations

“Not even in the Sierra have I ever made the acquaintance of mountains more rigidly inaccessible” John Muir
2009 Station Fire

- Fire started on August 29th, 2009
- 100% contained on October 16th, 2009
- 161,189 acres (~252 sq mi.) burned
- Four major watershed impacted
  - Los Angeles, San Gabriel, Santa Clara & Mojave
2009 Station Fire
2009 Station Fire

- Infrastructure destroyed or damaged
  - $4 million fire station
  - Historic Vetter Mountain fire lookout tower
  - 320 mi. of service roads and 225 mi of trails

- Resources Damaged
  - 37,000 acres forests, including pine, fir, oak
    - 11,000 acres will not return w/o human intervention
  - Wildlife Resources
    - California condor, mountain yellow-legged frog, Santa Ana sucker

The estimated cost to fully contain the Station Fire was $95,300,000
### 2009-2010 Rainfall

<table>
<thead>
<tr>
<th>Date</th>
<th>Storm Total (in.)</th>
<th>Hydrologic Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct. 13-14, 2009</td>
<td>2.3 to 2.5</td>
<td>Negligible</td>
</tr>
<tr>
<td>Nov. 12, 2009</td>
<td>0.75 to 1.1</td>
<td>Localized damaging debris flows and flooding</td>
</tr>
<tr>
<td>Dec 7, 2009</td>
<td>0.8 to 1.4</td>
<td>Widespread damaging debris flows and flooding</td>
</tr>
<tr>
<td>Dec. 11-13, 2009</td>
<td>1.9 to 5.8</td>
<td></td>
</tr>
<tr>
<td>Jan. 18, 2010</td>
<td>2.1 to 4.3</td>
<td></td>
</tr>
<tr>
<td>Jan. 19, 2010</td>
<td>0.4 to 0.7</td>
<td></td>
</tr>
<tr>
<td>Jan. 20, 2010</td>
<td>1.0 to 1.8</td>
<td></td>
</tr>
<tr>
<td>Feb. 6, 2010</td>
<td>3.1 to 4.4</td>
<td></td>
</tr>
<tr>
<td>Feb 9, 2010</td>
<td>0.4 to 0.9</td>
<td></td>
</tr>
<tr>
<td>April 11, 2010</td>
<td>0.9 to 1.3</td>
<td></td>
</tr>
</tbody>
</table>

USFS, 2010. Station Fire BAER Revisit
SGRRMP & LARWMP Ambient Monitoring Programs

- Ambient monitoring program provided established pre-fire sites with a suite of indicators
- Workgroup moved quickly to provide post fire monitoring resources
Multiple Lines of Evidence (MLOE)

1. What is the health of streams?

- Benthic Macroinvertebrates
- Benthic Algae

- General Constituents
- Metals
- Nutrients
- Organics

Water Chemistry

Condition?

Physical Habitat

Toxicity
## Monitoring Effort

<table>
<thead>
<tr>
<th>Station</th>
<th>Pre-Fire Sample Year</th>
<th>Post Fire Sample Year</th>
<th>No. of Revisits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Tujunga Wash</td>
<td>2009</td>
<td>2010</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2012</td>
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<td>NS</td>
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<td></td>
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<td></td>
<td>3</td>
</tr>
<tr>
<td>Gould Mesa</td>
<td>2009</td>
<td>2010</td>
<td>2011</td>
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<tr>
<td></td>
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<td></td>
<td>2012</td>
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<td>NS</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Lynx Gulch</td>
<td>2008</td>
<td>2010</td>
<td>2011</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>2012</td>
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<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td></td>
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<td>3</td>
</tr>
<tr>
<td>Rush Creek</td>
<td>2007</td>
<td>2010</td>
<td>2011</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>2012</td>
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<td></td>
<td></td>
<td></td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>4</td>
</tr>
<tr>
<td>Shortcut Canyon</td>
<td>2008</td>
<td>2010</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2012</td>
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<td></td>
<td></td>
<td></td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>
Analysis Methods

• Biological communities (Primer 6)
  • Rare species trimmed (1 occurrence & < 4 individuals)
  • 128 species used for analysis
  • Data 4\textsuperscript{th} root transformed
  • Bray-Curtis Similarity Index
  • Multidimensional Scaling (MDS)

• Abiotic & biological metric data
MDS: Pre & Post Fire Sites

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

Groups:
- ▲ c
- ▼ d
- □ a
- ◆ b
- ○ e
- + f

Similarity 40

2D Stress: 0.17
MDS: Pre & Post Fire Sites

Watershed Effect & Pre/Post Fire

LA River WS

San Gabriel River WS
Big Tujunga Wash

Pre-Fire

Post-Fire
Arroyo Seco at Gould Mesa

Pre-Fire

Post-Fire
MDS: Station Trajectory Through Time

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

Groups
▲ c
▼ d
▲ a
♦ b
● e
+ f

Similarity 40

Gould Mesa
Lynx Gulch

Pre-Fire

Post-Fire
MDS: Station Trajectory Through Time

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

Groups

- c
- d
- a
- b
- e
- f

Similarity

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Groups
- c
- d
- a
- b
- e
- f

Similarity
40

Shortcut Canyon
Rush Creek

Pre-Fire

Post-Fire
MDS: Station Trajectory Through Time

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

Groups
• c
• d
• a
• b
• e
• f

Similarity
40

Rush Creek
MDS: Important Species

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

Big Tujunga

Baetis adonis

- 30
- 120
- 210
- 300
Gould Mesa

MDS: Important Species

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17

Baetis adonis

- 30
- 120
- 210
- 300
MDS: Important Species

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17

Simulium

- 30
- 120
- 210
- 300

Lynx Gulch
MDS: Important Species

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17

Micropsectra

Lynx Gulch
MDS: Important Species

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17

Hydropsyche

7
28
49
70

Shortcut Canyon
MDS: Important Species

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17
MDS: Important Metrics

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17

SensitiveEPT%

7
28
49
70
MDS: Important Metrics

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

Lynx Gulch Creek

2D Stress: 0.17

Sensitive EPT%

7
28
49
70
MDS: Important Metrics

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17

Sensitive EPT%:
- 7%
- 28%
- 49%
- 70%

Rush Creek
MDS: Important Metrics

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17

SensitiveEPT%

7
28
49
70

Shortcut Canyon
MDS: Important Metrics

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17

Gould Mesa

Eroded

- 10
- 40
- 70
- 100
MDS: Important Metrics

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17

Lynx Gulch Creek

Eroded

- 10
- 40
- 70
- 100
MDS: Important Metrics

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.17

Rush Creek
Conclusions

• Bray-Curtis Similarity Index, based on species presence, and MDS showed differences in pre-fire and post-fire conditions
  • We could track changes of biotic and abiotic conditions over time
  • It takes at least two to three years for biological communities to return to pre-fire conditions
• Little information from dry weather chemistry
Lessons Learned

• Increase the number of sites
• Increase sample frequency immediately following event, especially for biology
• Conduct wet weather chemistry sampling below burn sites
• Choose indicators for which there are resources that can be allocated for the duration of the study (5 years)
  • Eliminate data gaps
# 2009 Station Fire

## Soil Burn Severity (%)

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Unburned/Very Low</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Big Tujunga</td>
<td>8</td>
<td>15</td>
<td>73</td>
<td>4</td>
</tr>
<tr>
<td>Upper Big Tujunga</td>
<td>18</td>
<td>14</td>
<td>51</td>
<td>17</td>
</tr>
<tr>
<td>Arroyo Seco</td>
<td>8</td>
<td>17</td>
<td>64</td>
<td>11</td>
</tr>
<tr>
<td>Upper West Fork San Gabriel</td>
<td>19</td>
<td>23</td>
<td>49</td>
<td>9</td>
</tr>
<tr>
<td>Middle West Fork San Gabriel</td>
<td>24</td>
<td>38</td>
<td>38</td>
<td>0</td>
</tr>
</tbody>
</table>


## Erosion Hazard Rating (%)

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Unburned/Very Low</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Big Tujunga</td>
<td>5</td>
<td>56</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td>Upper Big Tujunga</td>
<td>1</td>
<td>13</td>
<td>37</td>
<td>49</td>
</tr>
<tr>
<td>Arroyo Seco</td>
<td>6</td>
<td>21</td>
<td>35</td>
<td>38</td>
</tr>
<tr>
<td>Upper West Fork San Gabriel</td>
<td>11</td>
<td>29</td>
<td>22</td>
<td>38</td>
</tr>
<tr>
<td>Middle West Fork San Gabriel</td>
<td>18</td>
<td>39</td>
<td>20</td>
<td>23</td>
</tr>
</tbody>
</table>

## CRAM and IBI Scores

### Los Angeles River Watershed

<table>
<thead>
<tr>
<th>Score</th>
<th>Effluent (mean ± SD)</th>
<th>Urban (mean ± SD)</th>
<th>Natural (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBI</td>
<td>10 ± 6.2</td>
<td>10 ± 6.2</td>
<td>40 ± 18.4</td>
</tr>
<tr>
<td>CRAM</td>
<td>35 ± 5.2</td>
<td>37 ± 8.8</td>
<td>74 ± 12.3</td>
</tr>
</tbody>
</table>

### San Gabriel River Watershed

<table>
<thead>
<tr>
<th>Score</th>
<th>Mainstem (mean ± SD)</th>
<th>Lower (mean ± SD)</th>
<th>Upper (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBI</td>
<td>13 ± 6.8</td>
<td>15 ± 14</td>
<td>55 ± 16</td>
</tr>
<tr>
<td>CRAM</td>
<td>35 ± 3.9</td>
<td>45 ± 18</td>
<td>86 ± 7.2</td>
</tr>
</tbody>
</table>