Drought & Health

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Public Health Emergency Preparedness
June 24, 2015
Water is essential for life. It is a human right.

- UN Human Right to Water and Sanitation (2010)
  - Sufficient
  - Safe
  - Acceptable
  - Accessible
  - Affordable
  (http://www.un.org/waterforlifedecade/human_right_to_water.shtml)

- California Human Right to Water (2012)
  - “…every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes.”
What do we use water for?

- **SUSTAIN LIFE**
  - Stay hydrated
  - Grow food & fiber

- **Sanitation and Hygiene**
  - Sewer systems
  - Washing hands, bodies, food, homes
California Water Use

- Agricultural (80%)
- Residential
- Environmental
  - Maintain and restore aquatic and riparian ecosystems
- Industrial
- Hydropower
- Impacts on water use
  - Climate, population density/growth, socio-economics, cost

How Much Water Are California Cities Using?

Gallons of water used per person per day, not including water used for agriculture

- Palm Springs
- Tahoe
- Hillsborough
- Fresno
- Bakersfield
- Sacramento
- Riverside
- Sonoma
- Anaheim
- San Jose
- San Diego
- Oakland
- Los Angeles
- Monterey
- Long Beach
- Eureka
- Santa Barbara
- Santa Cruz
- San Francisco

Per capita water usage for each city is based on the city's water supplier's per capita usage in 2010.


http://www.motherjones.com/environment/2014/02/wheres-californias-water-going
What is drought?

Drought is a natural phenomenon in which rainfall is lower than average for an extended period of time, resulting in inadequate water supply.
How bad is this drought?

U.S. Drought Monitor
California

June 16, 2015

Sierra Snowpack Water Content
Percent of Average on April 1

LAST 10 YEARS

<table>
<thead>
<tr>
<th>Year</th>
<th>Water Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>137%</td>
</tr>
<tr>
<td>2006</td>
<td>125%</td>
</tr>
<tr>
<td>2007</td>
<td>39%</td>
</tr>
<tr>
<td>2008</td>
<td>102%</td>
</tr>
<tr>
<td>2009</td>
<td>83%</td>
</tr>
<tr>
<td>2010</td>
<td>104%</td>
</tr>
<tr>
<td>2011</td>
<td>171%</td>
</tr>
<tr>
<td>2012</td>
<td>52%</td>
</tr>
<tr>
<td>2013</td>
<td>42%</td>
</tr>
<tr>
<td>2014</td>
<td>25%</td>
</tr>
<tr>
<td>2015</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: Dept. of Water Resources
Note: “Water year” is Oct. 1 – Sept. 30

LOWEST YEARS

<table>
<thead>
<tr>
<th>Year</th>
<th>Water Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>39%</td>
</tr>
<tr>
<td>1976</td>
<td>37%</td>
</tr>
<tr>
<td>1988</td>
<td>29%</td>
</tr>
<tr>
<td>1977</td>
<td>25%</td>
</tr>
<tr>
<td>2014</td>
<td>25%</td>
</tr>
<tr>
<td>2015</td>
<td>5%</td>
</tr>
</tbody>
</table>

Intensity:

- **D0** - Abnormally Dry
- **D1** - Moderate Drought
- **D2** - Severe Drought
- **D3** - Extreme Drought
- **D4** - Exceptional Drought

June 16, 2015
Cumulative groundwater depletion in California’s Central Valley from USGS and GRACE

Source: Jay Famigletti
Almaden reservoir near San Jose, January 2014

South Lake Eastern Sierras
June 15, 2015


Ripples on a section of dry lake bottom near Folsom Dam, east of Sacramento. (Dan Brekke/KQED)
Drought and Health

- Water quantity, availability, affordability
- Water quality
- Food costs/insecurity
- Wildfire
- Dust

- Vector-born disease
- Infectious disease
- Sanitation
- Recreational risk
- Mental Health
Water quantity

• Most communities in California not reliant on a single source of water, but some are
  • Some groundwater reliant on annual rainfall
  • Some small systems reliant on stream flow

• Some communities facing acute water shortages now

• Impacts on water costs
  • Tiered water rates
  • Fines for exceeding allotments
Water Quality in California

- Over 21 million Californians rely on contaminated groundwater as primary source of drinking water
  - Over 4 million people (especially in rural areas) highly vulnerable to groundwater contamination
  - Clean-up of contaminated water very costly
- US EPA estimates California will need to spend approximately $40 Billion on infrastructure improvements to ensure delivery of safe drinking water over next 20 years
Drought & Water Quality

- Increase concentration of pollutants and contaminants in groundwater and surface water
  - Toxics and metals
  - Bacteria, protozoa, amoeba (warming and concentration)
- Runoff with dry and compacted soils may also increase risk of water contamination
- Reduced stream and river flows can cause stagnation & low O2 levels
- Use of recycled water for food irrigation/processing may increase risks of E. coli and Salmonella
Drought and Food

- Limits in growing season
- Reduced yields due to crop loss or fallowing
- Conditions that encourage insect and disease infestation in some crops
- Low crop yields can result in rising food prices and shortages,
  - Food insecurity associated with diabetes, obesity.
- Affects health of livestock and cost of feed
  - Herd culling can increase meat and dairy prices
- Impacts on fisheries
How Thirsty Is Your Food?

One head of broccoli 5.4 gallons of water
One walnut 4.9 gallons of water
One head of lettuce 3.5 gallons of water
One tomato 3.3 gallons of water
One almond 1.3 gallons of water
One pistachio 0.75 gallons of water
One strawberry 0.4 gallons of water
One grape 0.3 gallons of water

California's Thirstiest Crops
Fodder for cows (alfalfa, pasture, corn) is high on the list

- alfalfa
- almonds and pistachios
- pasture
- rice
- tree fruits and walnuts
- corn
- flax, hops etc.
- grapes
- citrus, avocados etc.
- lettuce, broccoli etc.

Million acre-feet of water per year, 2009-2010

Source: California Department Water Resources

http://www.motherjones.com/environment/2014/02/wheres-californias-water-going
Where Does Your Food Come From?
California’s drought affects the whole country’s fruits, veggies, and nuts.

Percentage of Total US Production by County

What's Selling from California
The state’s top agricultural products are billion-dollar businesses

Fallowed Crop Land 2011 vs 2014

Source: U.S. Department of Agriculture

http://www.motherjones.com/environment/2014/02/wheres-californias-water-going
http://earthobservatory.nasa.gov/IOTD/view.php?id=85199
Drought & Air Quality

- Increased dust and particulate levels
  - Increased pollen
  - Wildfire smoke
- Exacerbation of respiratory conditions eg. asthma
- Increase risk for bronchitis and bacterial pneumonia
  - Dust bowl: 1000s of deaths due to “dust pneumonia”
- Airborne toxins from freshwater algal blooms (cyanobacteria)
- Coccidioidomycosis – valley fever
  - Fungal spores carried in dust
Wildfire

- Wildfire risk significantly increased with drought
- Contamination of surface water
  - Ash, fire retardant, debris
- Direct impact especially on small water systems
- Rim Fire could have impacted SF water supply for months with increased turbidity – non-potable if turbidity above certain amount
- Economic impacts
Drought & Vector-Borne Disease

- Expand breeding grounds for some mosquitos (e.g. Culex pipiens)
  - Reduction in water levels increases stagnation
  - Improper rainwater collection can create stagnant water pools
  - Stagnant water in unused/unfilled swimming pools

- 2014 record year for WNV cases
- 2015 mosquito populations swelling early in year
- Outbreaks of WNV have occurred under these conditions
Recreational risk

- Possible increase risk for waterborne disease (bacteria, protozoa, metals, other contaminants) due to warming and concentration
- Some pathogens (e.g. amoeba such as Naegleria fowleri) more common due to warmer water temps associated with low water levels
- Risks associated with shallower waters or exposure of debris/rocks
Sanitation and Hygiene

- Water conservation efforts should not inhibit proper sanitation and hygiene
  - Personal hygiene
  - Hand washing
  - Washing fruits and vegetables
- CDC recommends low-flow aerators
Drought and Mental Health

• Drought stress may be different than stress in other disasters
  • extended event - no single moment of impact
  • anxiety builds over time & becomes chronic
  • less noticeable to self & others
  • may not be viewed as seriously because damage not as visible

• Impact is worst for already stressed farm families and communities
  • May be greater for young farmers, farmers with second off-farm job, women in farm families

• Drought and suicide
  • Australia
  • U.S. Mid-west

Displacement and Migration
Economic impacts
“Billions of dollars and tens of thousands of jobs”

- Wildfire
  - Injury, air quality, displacement
  - Likely to be biggest economic impact of drought

- Agriculture

- Rangeland/cattle/dairy

- Unemployment
  - 1/3 CV jobs related to farming
    - Farmworkers, food processing, truck drivers, ag support
    - E.g. last drought CV unemployment soared, many ineligible for unemployment

- Supply and price of water-dependent goods
  - Water, forage, food grains, fish, hydroelectric power

http://topics.bloomberg.com/california/
DWR/NWRI drought response workshop
Drought and the Future

• Water in increasingly short supply because of growing demands from agriculture, an expanding population, energy production and climate change.
  • Billion people lack access to clean drinking water
  • Groundwater depletion happening rapidly

• Longer, deeper droughts in many places, associated with climate change impacts

• Human adaptation to prolonged, extreme drought is difficult or impossible
  • Historically, the primary adaptation to dust-bowlification has been abandonment
  • 100,000s fled midwest in US dust-bowl era

• Need planning now to deal with drought-spurred migrations, growing areas non-arable land in densely populated countries and global bread-basket
  • Feeding some 9 billion people by mid-century in the face of a rapidly worsening climate may well be the greatest challenge the human race has ever faced.
Drought: What can be done? (1)

• Ensure access to clean and safe drinking water
  • Lifeline water rate
  • Connect small systems to neighboring water systems to create reliable supplies
• Safety net for impacted communities
Drought: What can be done? (2)

- Water Conservation & Efficiency: 20% urban reduction 2020
  - Pricing, restrictions, metering, efficient irrigation/appliances, leak repair, education

- Water recycling and re-use
  - Gray water systems
  - Recycling of waste water
  - Rainwater /stormwater capture and reuse

- Green Infrastructure
  - Bioswales, green roofs, permeable pavements, trees
  - Benefits
    - Retain/reuse water, reduce flooding, improve water quality, provide water supply locally
Drought: What can be done? (3)

- Water is a public trust: Protect Water Resources
  - Source protection, pollution protection, land use to maximize replenishment
  - California Water Impact Network principles for a sustainable water future

- Water Management (DWR)
  - Supply diversification: Integrated Regional Water Management
  - Groundwater monitoring and management
  - Expand underground storage
  - Delta management

- Desalination
  - Energy intensive, costly, waste brine

- Agricultural Management
  - Soil: build for moisture retention, stabilize erosion
  - Drought-resistant crops and pasture
  - Moisture-conservation methods
Public Health Role

- Ensure access to adequate supplies of safe and clean drinking water, water for sanitation and hygiene, and water for healthy food production

- **Educate the public about water, climate change, and health**

- Advocate for health, equity, and sustainability in water policies and programs

- **Protect our precious water resources**
  - Source protection, pollution protection, replenishment

- Support policies, programs, funding, and infrastructure to enhance water supply sustainability
  - Water conservation and efficiency
  - Water recycling and reuse (e.g. gray water)
  - Repaired and expanded infrastructure (green and gray)
  - Water and soil management
  - Safety net systems (e.g. lifeline water rates)

- **Increase monitoring for water-related health risks and outcomes**

- Enhance public health preparedness for water impacts of climate change
Climate change impacts on water in California

- **Higher Highs**
- **Drier Dries**
- **Reduced Runoff**

### Rising Temperatures Expected Late in the Week

**Record Highs Possible for many locations Friday**

<table>
<thead>
<tr>
<th>Location</th>
<th>Thursday Highs</th>
<th>Friday Highs</th>
<th>Friday Record Highs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Beach</td>
<td>90</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>Downtown L.A.</td>
<td>91</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>Woodland Hills</td>
<td>92</td>
<td>93</td>
<td>95</td>
</tr>
<tr>
<td>Burbank</td>
<td>91</td>
<td>92</td>
<td>90</td>
</tr>
<tr>
<td>Palmdale</td>
<td>83</td>
<td>86</td>
<td>85</td>
</tr>
<tr>
<td>Thousand Oaks</td>
<td>88</td>
<td>89</td>
<td>N/A</td>
</tr>
<tr>
<td>Ojai</td>
<td>82</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>Santa Maria</td>
<td>87</td>
<td>85</td>
<td>83</td>
</tr>
<tr>
<td>Santa Ynez</td>
<td>88</td>
<td>89</td>
<td>N/A</td>
</tr>
<tr>
<td>Paso Robles</td>
<td>86</td>
<td>90</td>
<td>83</td>
</tr>
</tbody>
</table>

**Prepare For Unseasonably Hot Weather:**
- Very warm Thursday – Saturday "Hottest of Friday"

**Heat Weather Safety Actions**
- Drink plenty of water
- Dress in lightweight, loose clothing
- Stay out of midday sun
- Check on neighbors and elderly
- Know the signs of heat-related illness

**If you must perform outdoor activities:**
- Do not consume alcoholic or caffeinated beverages
- Take frequent breaks in shaded areas

**Hotter Hots**

- Your body’s ability to dissipate heat

### Wetter Wets
Drought & Climate Change

- Warming temperatures due to climate change
  - Larger fraction of precipitation falls in downpours
  - More storm water lost to storm runoff (vs absorbed in soil)

- Larger fraction of mountain precipitation fall as rain rather than snow, due to warming
  - Lower stream flows in spring and summer.

- Snowpack melts earlier due to warming
  - Reduced stream flows in late-spring, summer
  - What snowpack there is melts earlier in a warming world, further reducing flows later in the

- Higher temperatures mean higher evaporation rates
  - Losses of water from reservoirs
  - Drier soil

- Arctic ice loss may change the jet stream
Drought and climate change

• No clear consensus re is this drought caused by climate change
  • California has had very severe droughts before

• Drought is clearly exacerbated by climate change warming

• California is mostly an arid state; the increase in temperature will persist, and it changes the water dynamics

• Longer term, climate models for California show climate change happening now
  • More consistency in predictions for increased drought in SW

• Climate change is the tapestry on which we are watching drought unfold - and it is warmer now than in prior droughts, making the impacts of drought more severe
“Climate change is the defining health challenge of our time.” Margaret Chan, World Health Organization

“Climate change threatens our fragile existence on this planet.” Jim Kim, World Bank
June 23, 2015

- White House National Dialogue on Climate Change and Health
- Lancet Commission on Climate Change and Health
Highest levels CO₂ in at least 800,000 years

Atmospheric CO₂ at Mauna Loa Observatory

Scripps Institution of Oceanography
NOAA Earth System Research Laboratory

PARTS PER MILLION

YEAR


320 340 360 380 400
The window for action is rapidly closing

65% of our carbon budget compatible with a 2°C goal already used

Total Carbon Budget: 790 GtC

Amount Used 1870-2011: 515 GtC

Amount Remaining: 275 GtC
The Choices We Make Will Create Different Outcomes

With substantial mitigation

Without additional mitigation

Change in average surface temperature (1986–2005 to 2081–2100)
The Choice is Ours
What can PHEP do?

- Be a leader - talk to colleagues, communities, decision makers
- **Integrate climate change in PHEP** planning, training, exercises, and education/outreach: disaster risk reduction
- Develop and implement **urban heat island mitigation** strategies and other climate resilience initiatives
- Support local, state, and federal climate action strategies with health and equity **co-benefits**
- Support **clean, safe, renewable, energy**
- Support rapid acceleration/ funding for **active transportation**
- Support **building standards** for climate resilience
- Advocate for green zones and **just transition**
Join the webinar series to learn more!

http://phasocal.org/water-initiative/
Resources

CDC: http://www.cdc.gov/nceh/drought/
