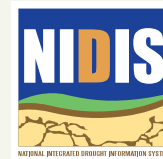


Drought indicators & triggers in the Pacific Northwest Drought Early Warning System

Kelly Helm Smith

National Drought Mitigation Center
For Henry's Fork Watershed Council
Rexburg, Idaho, December 13, 2016





The Blue Marble

Nasa photo of Earth 1972

Image courtesy of NASA



- Water
- Land use
- Agriculture

“The Science and Policy of Climate Variability and Climate Change: Intersections and Possibilities,” by Geoff Cockfield and Stephen Dovers, in *Drought, Risk Management and Policy: Decision Making Under Uncertainty*, ed. by Botterill and Cockfield, 2013

Photo: Compiled by Chuck Nelson. “A true-color cropped image of portion of the Sacramento-San Joaquin River Delta. This image was taken from a California Department of Fish and Game website available to the public as a GIS file and is part of a U.S. Department of Agriculture National Agricultural Imagery Program flight.”

<http://www.csuchico.edu/inside/2012-05-10/bigpicture-2.shtml>



From Bandera: Cowboy Capital of the World, Palo Alto College, San Antonio, Texas
<http://pacweb.alamo.edu/InteractiveHistory/projects/rhines/StudentProjects/1999/bandera/BANDERA.htm>

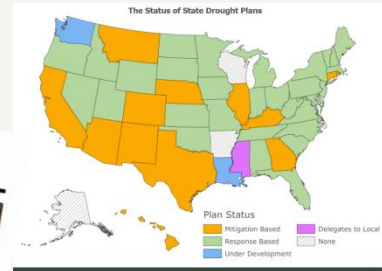
Planning tools for all scales



Nation



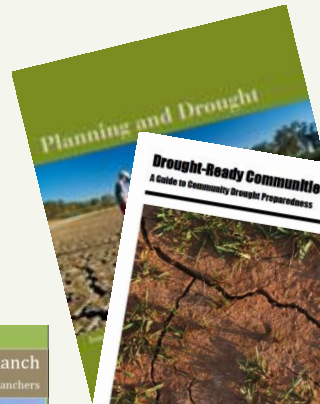
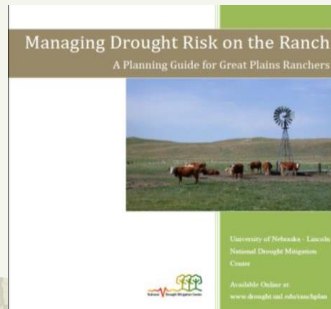
Basin



Tribal/
State

Community

Individual



Contexts & Opportunities for Drought Planning at Different Levels of Government

Federal	Monitoring NIDIS: NOAA, USDA, USGS, NASA & more	Policy & planning National water or drought policy, agriculture policy	Land & Water Management Corps, Reclamation, Interior, Agriculture, Hazard Mitigation	Relief & Response NDRP: USDA, SBA, IRS & more (FEMA)
State	Monitoring Federal, state & local data	Water & resource management State water policies, plans	Drought plans Agriculture Drinking water Fire	Emergency Management Hazard plans
Sub-state	Monitoring Federal, state & local data	District authorities & organizations vary by state: Irrigation, soil & water conservation, natural resources, groundwater management, watershed-based Also, hydropower		Emergency Management Hazard plans
Local (county & municipal)	Monitoring Federal, state & <i>supply-specific</i> local data	Municipal water supply plans, including drought contingency plans	Land use planning: Xeriscapling, green infrastructure,	Emergency Management Hazard plans



Drought.gov
U.S. Drought Portal

U.S. North America Global Search NIDIS...
Event Search Document Search Data Search



Home

Data, Maps & Tools

Regions

Research

Resources

What is NIDIS?

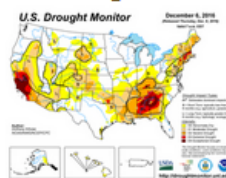
FAQs

Calendar

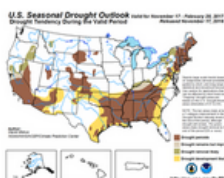
Contact Us

Where is drought this week?

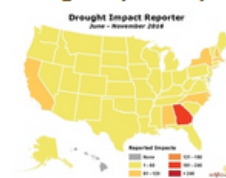
U.S. Drought Monitor



U.S. Seasonal Drought Outlook



Drought Impacts Report



Wildfire Risks



NIDIS in Your Region



As of Nov. 29 - Dec. 6, 2016, drought (D1-D4) is impacting:

25.4%

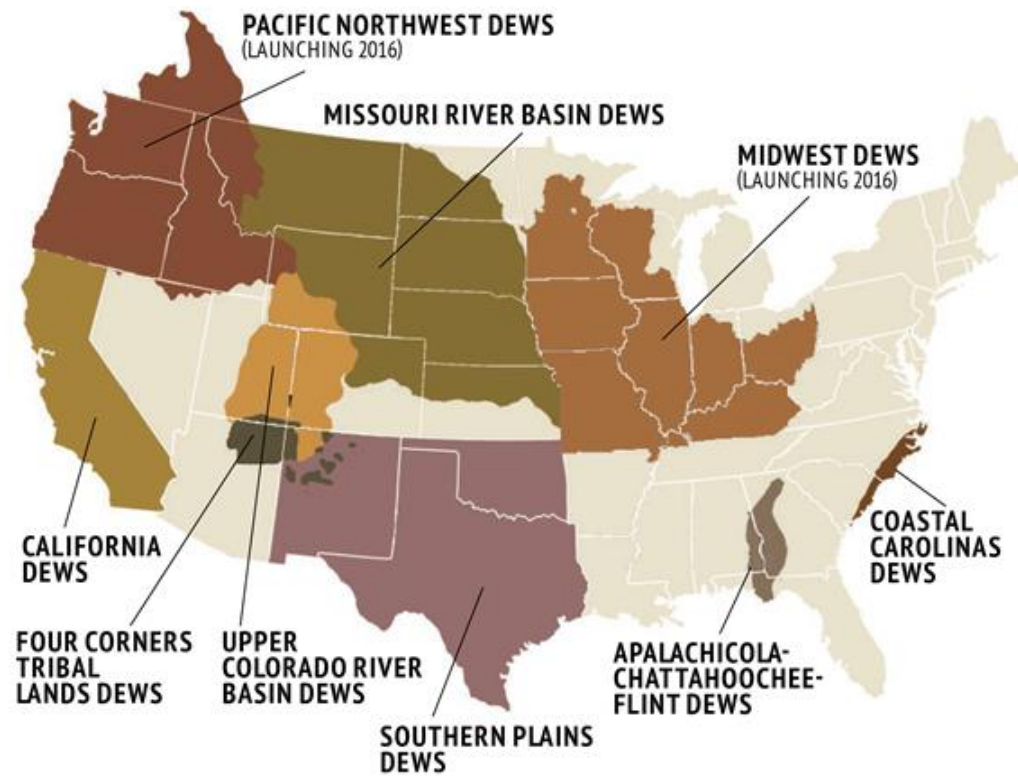
of the US and 30.4% of the lower 48 states.

145.6 million

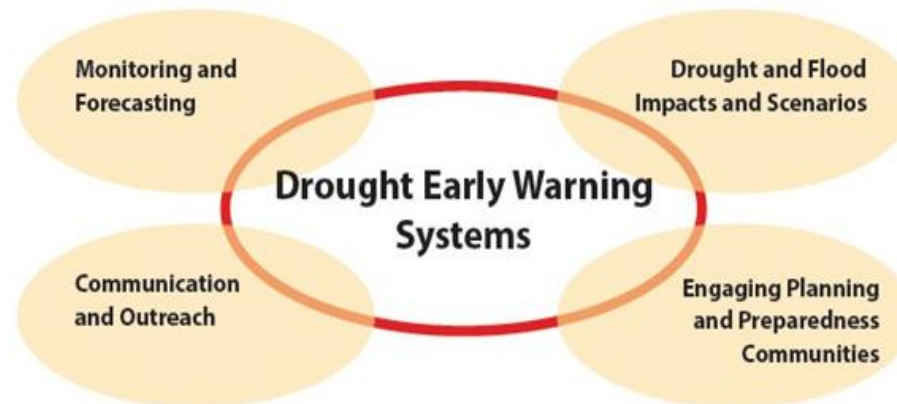
people in the U.S. and 148.5 in the lower 48 states.

During the past seven days, several frontal systems moved across the contiguous United States. Heavy precipitation (generally 2-6 inches, locally 10 inches or more) fell from southern Texas east-northeast across the Gulf Coast states and the Tennessee Valley. Two inches of precipitation or more (liquid equivalent) was also reported across portions of the Northeast and the Pacific Northwest. Most of the remainder of the Lower 48 states reported light to moderate precipitation (less than 2 inches).

NIDIS Drought Early Warning Systems



KEY COMPONENTS OF NIDIS DEWS



From the PNW DEWS strategic plan draft:

“Each state in the Pacific Northwest has an existing state drought plan, but many are out of date or in the process of being updated. These plans often have a strong emphasis on drought indicators (utilizing data from agencies like USGS, NRCS, RFCs, NWS and others) but often lack triggers for initiating action and impact information to inform those decisions.”

PNW DEWS Indicators & Triggers workshop

Boise, Sept. 26-27, 2016

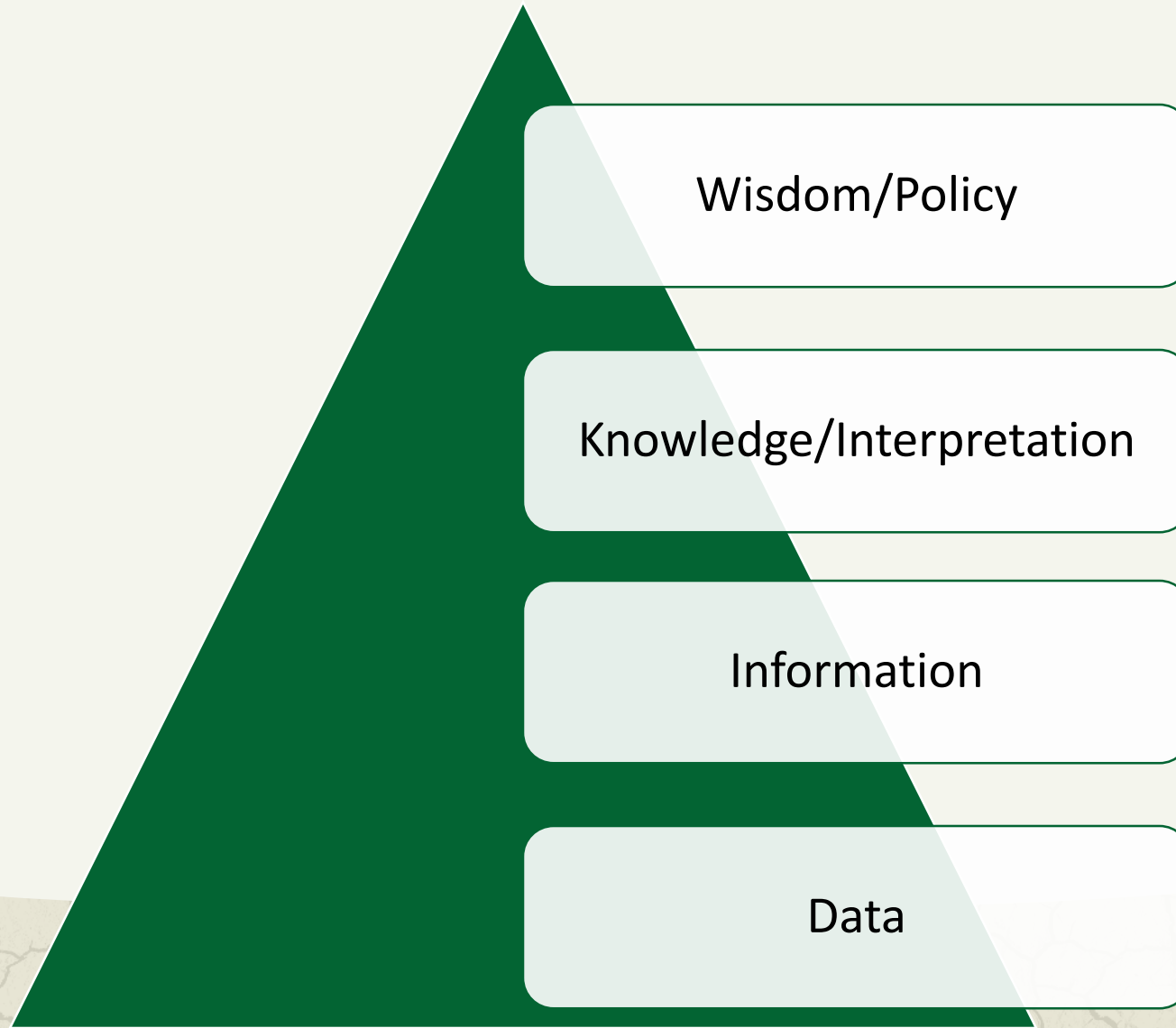
- Drought coordinators & planners, climatologists
- Finding the connections between
 - Indicators
 - Impacts
 - Triggers



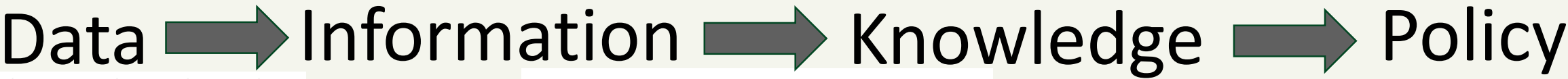
Takeaways

- Looking for standardized ways to collect impacts
- Looking for certainty ... where it may not exist
- Need to sync or harmonize messaging across scales

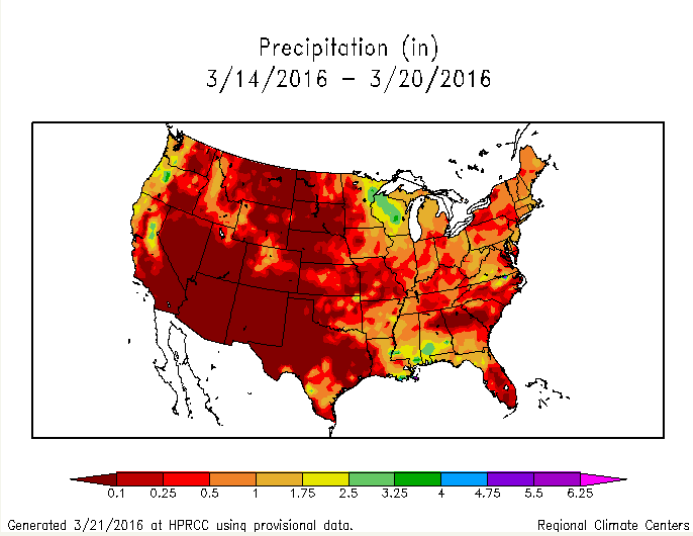
Data-Information-Knowledge-Wisdom



Physical drought



	A	B	C	D
1	Date	Precipitat	Precip No	TMax
2	11/5/1942	0	FALSE	80.71
3	11/12/1942	0	FALSE	76.57
4	11/19/1942	0.55	FALSE	74.57
5	11/26/1942	0.2	FALSE	69.28
6	12/3/1942	1.47	FALSE	
7	12/10/1942	0.24	FALSE	61.42
8	12/17/1942	1.23	FALSE	65.85
9	12/24/1942	3.43	FALSE	63.57
10	1/1/1943	0.001961	FALSE	63.85
11	1/8/1943	2.39	FALSE	58.57
12	1/15/1943	6.87	FALSE	70.57
13	1/22/1943	1.6	FALSE	71.14
14	1/29/1943	0.05	FALSE	69.28
15	2/5/1943	1.6	FALSE	73.71
16	2/12/1943	0.15	FALSE	58.85
17	2/19/1943	0.7	FALSE	74.28
18	2/26/1943	1.4	FALSE	60.14
19	3/5/1943	2.11	FALSE	64.85
20	3/12/1943	1.67	FALSE	78.71
21	3/19/1943	3.85	FALSE	70.28
22	3/26/1943	0.75	FALSE	77.57
23	4/2/1943	0	FALSE	82.85

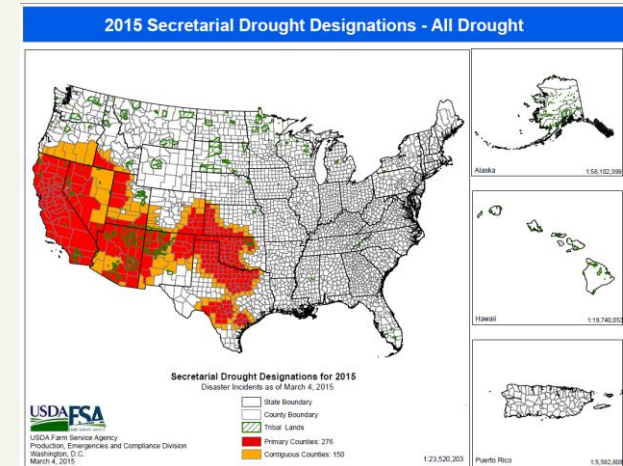
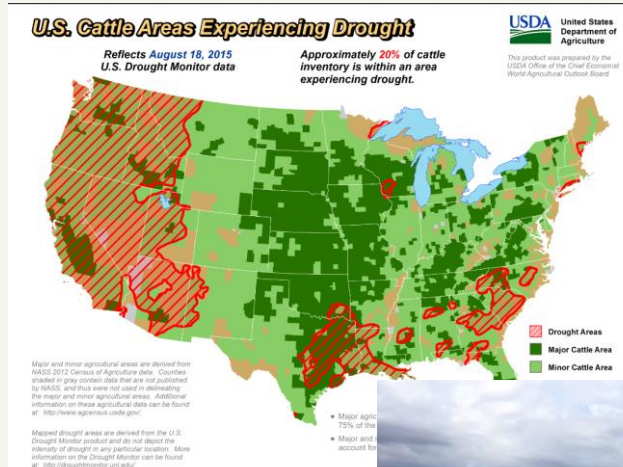


Severity Indicators and Impacts (U.S. Drought Monitor, Colorado Modified Palmer Drought Index (CMPDI), SWSI, SPI)	Drought Phase and Response Summary	Actions to be Considered
Drought Monitor D2 Severe Drought D2 ranges: CMPDI or SWSI ¹ : -3.0 to -3.9 SPI ² : -1.3 to -1.5 Indicator blend Percentile: 6-10 Impacts: Crop or pasture losses likely; water shortages common; water restrictions likely to be imposed CMPDI Less than -2.0 in any river basin or modified Palmer climate division SPI Less than -1.0 (six month)	Phase 2 Drought Task Force and Impact Task Forces are activated; Potential Drought Emergency Declared	- DTF Chairs prepare Governor's Memorandum of potential drought emergency based on recommendations from WATF. - Governor's Memorandum activates the Drought Task Force and Necessary Impact Task Forces. - The DTF Chairs and CWCB meet with activated Impact Task Force chairs to outline Phase 2 activity. - Activated ITF's make an initial damage or impact assessment (physical and economic). - ITF's recommend opportunities for incident mitigation to minimize or limit potential impacts - Periodic reports are made by the ITF chairs to the DTF Chairs. - ITF chairs designate their respective department Public Information Officer (PIO) to interface with media for their relative area of concern and develop media messages. - Relevant state agencies undertake response and incident mitigation actions with their normal programs with available resources. - The DTF conducts a gap analysis identifying any unmet needs that cannot be handled through normal channels.
Drought Monitor D3 Extreme Drought to D4 Exceptional Drought D 3 Ranges CMPDSI or SWSI ¹ : -4.0 to -4.9 SPI ² : -1.6 to -1.9 Indicator blend Percentile: 3-5 Impacts: Major crop/pasture losses; widespread water shortages or restrictions very likely to be imposed D4 Ranges: CMPDI or SWSI: -5.0 SPI ² : -2.0 or less Indicator blend Percentile: 0-2	Phase 3 Drought Emergency is declared by Proclamation of the Governor.	- Governor's Memorandum updated to activate additional Impact Task Forces as necessary. - Activated ITFs continue to assess, report, and recommend response measures and incident mitigation. - Unmet needs are reported to the DTF Chairs. - DTF Chairs determine the unmet needs that can be met by reallocation of existing resources. Those which cannot be forwarded to the Governor with recommendations to support a request for a Presidential Drought Declaration. - Governor may request a Presidential Declaration. - If approved, Federal-State Agreement establishes Colorado Office of Emergency

Agricultural drought impacts

Data → Information → Knowledge → Policy

CALIFORNIA CROP WEATHER - WEEK ENDING 8/16/2015													
STATIONS	TEMPERATURE				GROWING DEGREE DAYS AT 50°F BASE			RAIN DAYS			PRECIPITATION 1"		
	Average Week Ending 8/16/2015	Departure from Normal 2'	High	Low	Normal 1 Year		This Season	This Week	This Season	Normal Season 2'	Normal Year 2'	This Week	This Season
					This Year	Normal 1 Year							
					January 1 - 8/16/2015	January 1 - 8/16/2015	July 1 - 8/16/2015	July 1 - 8/16/2015	July 1 - 8/16/2015	July 1 - June 30			
-- Degrees Fahrenheit --					-- Number --			-- Days 2'		-- Inches of Precipitation --			
North Coast													
Eureka WFO	62	4	72	53	95	39	5	0	0.16	0.32	38.10		
Ukiah	73	-1	105	49	1,346	948	2	0	0.13	0.05	38.90		
Santa Rosa AP	72	5	104	51	766	690	2	0	0.05	0.06	31.01		
Napa State Hosp	73	5	104	52	979	756	1	0	0.01	0.05	26.46		
Central Coast													
San Francisco A	70	7	92	58	548	294	0	0	0	0.03	20.11		
San Jose AP	73	3	97	57	929	1,015	1	0	0.02	0.06	15.08		
Salinas AP	70	6	93	54	627	325	2	0	0.07	0.04	12.91		
Monterey AP	67	7	81	55	429	125	4	0	0.12	0.09	20.35		
King City Ag	74	5	104	52	999	806	2	0	0.03	0.01	12.30		
Paso Robles AP	76	3	107	52	1,327	1,093	2	0	2.09	0.01	13.08		
Sacramento Valley													
Redding	81	2	107	60	2,496	1,708	1	0	0.04	0.12	33.52		
Red Bluff	79	-2	105	60	2,256	1,833	1	0	0.03	0.10	24.07		
Willows SW	76	1	102	53	1,857	1,407	1	0	0.05	0.06	19.03		
Orville AP	78	2	101	58	2,025	1,530	1	0	0.01	0.08	28.75		
Mayville	77	-1	102	56	1,812	1,340	0	0	0	0.07	22.07		
Sacramento AP	78	3	105	58	1,658	1,345	0	0	0	0.05	17.93		
San Joaquin Valley													
Stockton	78	2	104	58	1,705	1,543	2	0	0.02	0.05	13.84		
Modesto AP	79	3	104	63	2,026	1,651	0	0	0	0.05	13.12		
Merced Maraudy	78	0	104	67	1,780	1,530	0	0	0	0.03	12.50		
Madera AP	79	1	105	59	1,989	1,740	2	0	0.12	0.01	11.94		
Fresno AP	82	3	105	64	2,339	1,896	2	0	0.43	0.01	11.23		
Lemoore NAS	80	3	105	60	2,102	1,897	2	0	0.12	0	7.89		
Visalia AP	79	2	102	61	2,107	1,730	3	0	0.20	0.01	11.03		
Bakersfield AP	83	1	105	67	2,561	2,122	1	0	0.04	0	6.49		
Cascade Sierra													
Alturas AP	66	0	93	37	628	349	12	0	1.44	0.46	12.13		
Mount Shasta AP	68	3	91	46	811	373	6	0	1.50	0.55	39.16		



Types of Drought

- **Meteorological**
- **Environmental/ecological**
- **Agricultural**
- **Hydrological**
- **Socioeconomic**

- There are ***indicators and indices*** used to identify *all* of these types of drought at various thresholds
- There is ***no one definition*** of drought
- Thus, there is ***no “one-size-fits-all”*** drought index or indicator

Monitoring Drought

Parameters (Indicators) to measure:

temperature, precipitation, soil moisture, reservoir/lake levels, streamflow, ground water, snow pack, snow water equivalent, ET, vegetation health/stress, and ***impacts!***

Assessing Drought:

Meteorological/Agricultural Indices

- Percent of normal precipitation
- Deciles
- Standardized Precipitation Index (SPI/SPEI)
- Palmer Drought Severity Index (PDSI, scPDSI)
- Aridity Index

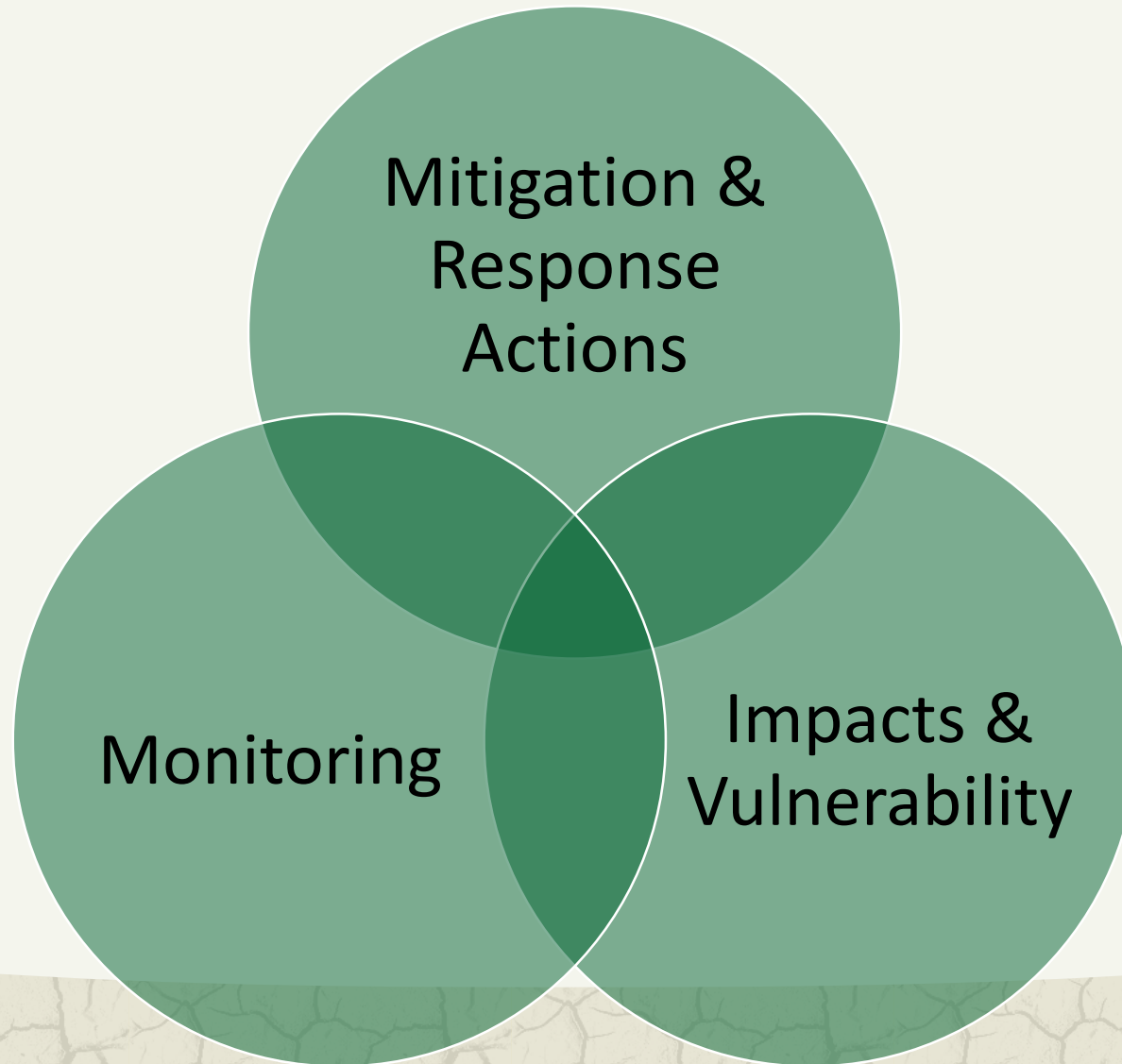
Hydrologic Drought Indices

- Palmer Hydrological Drought Index (PHDI)
- Surface Water Supply Index (SWSI)

Triggers

- When to take preventive or remedial action, i.e.:
 - Give acetaminophen if fever is 100 degrees or higher
 - Reduces political or crisis-driven element, provides accountability
- *Not* in the sense of an involuntary tipping point (ecological or systems use)
- Matrix of indicators
- Often a guideline, not a hard and fast rule

Heart of a drought plan



Know your vulnerability

- What do you want to protect?
- What effects of drought do you want to prevent?
- Impacts point to underlying vulnerability
 - What impacts did you experience in the last drought?
 - What impacts do you anticipate in the next drought?
- Why did/do these impacts happen, and how could they be prevented?

Federal drought trigger: U.S. Drought Monitor triggers the Livestock Forage Disaster Program

- D2 (severe drought) intensity in any area of the county for at least eight consecutive weeks during the normal grazing period is eligible to receive assistance in an amount equal to one monthly payment;
- D3 (extreme drought) intensity in any area of the county at any time during the normal grazing period is eligible to receive assistance in an amount equal to three monthly payments;
- D3 (extreme drought) intensity in any area of the county for at least four weeks during the normal grazing period or is rated a D4 (exceptional drought) intensity at any time during the normal grazing period is eligible to receive assistance in an amount equal to four monthly payments;
- D4 (exceptional drought) in a county for four weeks (not necessarily four consecutive weeks) during the normal grazing period is eligible to receive assistance in an amount equal to five monthly payments.



[About Us](#)

[Hawaii Drought Plan](#)

[County Drought Notices](#)

[Drought Monitor](#)

CURRENT CONDITIONS IN HAWAII

U.S. Drought Monitor
Hawaii

January 13, 2016
Revised 4:10 PM HST, Jan 13, 2016
1981-2010 US

	Drought Conditions				
	D0	D1	D2	D3	D4
MAUI	0.0	0.0	0.0	0.0	0.0
Island of Lanai	0.0	0.0	0.0	0.0	0.0
Island of Molokai	0.0	0.0	0.0	0.0	0.0
Island of Oahu	0.0	0.0	0.0	0.0	0.0
Island of Maui	0.0	0.0	0.0	0.0	0.0
Island of Hawaii	0.0	0.0	0.0	0.0	0.0

Legend:
D0: Extreme Drought
D1: Severe Drought
D2: Moderate Drought
D3: Significant Drought
D4: Marginal Drought

Legend:
D0: Extreme Drought
D1: Severe Drought
D2: Moderate Drought
D3: Significant Drought
D4: Marginal Drought



Source: National Drought Mitigation Center (NDMC) For the United States Drought Monitor, click [here](#).

DROUGHT NOTICES

Hawaii Drought Stages and Indicators

Table 5.3: Drought Stage Characteristics			
Drought Stage	SPI Time Interval and Value		
	Water Supply Sector	Agriculture & Commerce Sector	Environment, Public Health & Safety Sector
Normal	12-month SPI 0.99 to -0.99	3-month SPI 0.99 to -0.99	3-month SPI 0.99 to -0.99
Moderate	12-month SPI -1.00 to -1.49 for two consecutive months	3-month SPI -1.00 to -1.49 for two consecutive months	3-month SPI -1.00 to -1.49 for two consecutive months
Severe	12-month SPI -1.50 to -1.99 for two consecutive months	3-month SPI -1.50 to -1.99 for two consecutive months	3-month SPI -1.50 to -1.99 for two consecutive months
Extreme	12-month SPI less than -2.00 for two consecutive months	3-month SPI less than -2.00 for two consecutive months	3-month SPI less than -2.00 for two consecutive months

Recommended State Agency Drought Response Actions

Table 7-3: Recommended State Agency Drought Response Actions			
Agency	Normal	Drought	Recovery
DOA	• Monitor reservoir levels. • Monitor stream levels at existing diversion locations. • Report any observed change in resource and ground-water aquifer conditions for irrigation source wells. • Notify system users of low reservoir conditions. • Notify the WRC, CLDCs, and SDC of declining reservoir levels. • Advise all users to prepare for possible implementation of voluntary and/or mandatory water conservation plans. • Advise and encourage water users to implement appropriate water conservation measures, wherever possible (e.g., voluntary reduction of water use for equipment/vehicle washdown and for premarket washing of produce and flowers, and utilization of efficient irrigation methods).	• Implement more frequent monitoring of reservoir, stream, and well levels. • Continue notification of system users regarding storage and supply conditions. • Implement more frequent updates to the WRC, CLDCs, and the SDC regarding storage and supply conditions, and emerging drought impacts. • Document supply conditions and drought impacts, and use this information to prepare emergency drought relief requests for submittal to the HDC. • Implement voluntary and/or mandatory water restrictions for system users. • Implement available water conservation measures and agency water shortage plans, if any.	• Continue frequent monitoring of reservoir, stream, and well levels. • Continue periodic notification of system users regarding storage and supply conditions. • Continue regular updating of the WRC, CLDCs, and the SDC regarding storage and supply conditions, improving drought conditions. • Conduct post-drought impact assessments and data collection on economic losses. • Evaluate the effectiveness of drought response and mitigation measures implemented by the agency pursuant to the drought episode. • Re-evaluate the adequacy of source and storage facilities. • Evaluate the quantity and water use for large agricultural water users.

Drought Communication Protocol

Table 7-1: Drought Communication Protocol (continued)				
Drought Stage	Communication Actions and Guidelines			
	Hawaii Drought Council	State Drought Coordinator	Water Resources Committee	County/Local Drought Committees
Drought	- Convene quarterly HDC meetings to monitor current and forecasted drought conditions. - The Office of the Governor shall be updated quarterly on current conditions through its representative on the HDC and/or the SDC. - As conditions warrant, more frequent HDC meetings may be convened. - HDC State agency members (e.g., Department of Agriculture) may issue Public Service Announcements (PSA), water conservation and/or other Public Notices, as appropriate. - Issuance of State agency PSAs and/or Public Notices should be coordinated with the SDC.	- Based on consultation with the WRC, the SDC shall provide quarterly updated reports to the HDC (and CLDCs) on current and forecasted drought conditions. - If drought conditions worsen, monthly drought reports shall be submitted to the HDC and CLDCs. - SDC shall update and post current and forecasted drought information onto the Hawaii Drought Website. - Initiate regular monthly (and if necessary, weekly) communication and coordination with the WRC and CLDCs via email, fax, phone, or meetings.	- Convene at least quarterly to review/evaluate current and forecasted statewide drought conditions and report to the SDC. - WRC shall evaluate and incorporate CLDC drought information within reports to the SDC. - As conditions warrant, monthly WRC meetings may be convened. In this event, monthly drought reports shall be made to the SDC.	- Convene at least quarterly to review/evaluate local drought conditions and report to the SDC. - As conditions warrant, more frequent CLDC meetings should be convened. - CLDC shall communicate and notify local members regarding current and forecasted drought conditions. - Reports of drought impacts should be solicited from local stakeholders and reported to the SDC. - CLDC agency members (e.g., county water departments) may issue Public Service Announcements (PSA), water conservation and/or other Public Notices, as appropriate. - Issuance of county PSAs and/or Public Notices should be coordinated with the SDC.

Big Hole River Drought Management Plan

Temperature and streamflow values trigger progressively stricter restrictions on angling, working with outfitters, media, etc. to:

1. Put irrigators and outfitters on notice that restrictions may be needed, examine options, encourage conservation.
2. Suggest anglers find another destination or activity.
3. Close certain reaches.



https://bigholewatershed.files.wordpress.com/2012/07/dmp-2012_finalv2.pdf

Questions, comments, suggestions?



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Drought.unl.edu
Drought.gov