CALIFORNIA DEPARTMENT OF WATER RESOURCES

NEWS FOR IMMEDIATE RELEASE

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Severity of Past Droughts Quantified by New Streamflow Reconstructions

SACRAMENTO – As part of ongoing work to improve California's drought preparedness and better adapt to climate change, the Department of Water Resources (DWR) today released a report examining tree-ring data to help better understand historic periods of drought. The report helps develop long-term reconstructions of streamflow or precipitation for the Klamath, Sacramento, and San Joaquin river basins. The report, prepared for DWR by researchers at the University of Arizona, is available is available here. Funding for part of the Klamath Basin work was provided by the U.S. Bureau of Reclamation under its WaterSMART program.

Initial work on the reconstruction project began in 2010, at a time when California was just emerging from the 2007-09 drought. Completion of the final report coincides with a new three-year drought and a Water Year 2014 that so far is one of the driest years in the historical record.

California's roughly one hundred years of observed data are, however, only a small subset of the hydrologic record that can be reconstructed by measuring tree rings and calibrating them to observed data. The tree-ring measurements made for this project allowed development of reconstructions that begin in the year 900 for the Sacramento River and San Joaquin River systems, and in the 1500s for various sites in the Klamath Basin.

"Streamflow reconstruction from tree rings takes advantage of the great longevity and climate sensitivity of several tree species in California and Oregon," said lead author David Meko, a University of Arizona research professor of dendrochronology. "The tree-ring patterns record unusual climate events and modes of variability that occurred before the short period of gaged streamflow."

Drought is a recurring part of California's climate. The report's reconstructions show numerous periods of four or more years when streamflows were below median conditions.

In addition, the report reveals that all three river basins share common major periods of extreme low flow conditions, although the degree of severity varies from river to river. The most severe shared periods were the 1100s (20 – 50 year sustained dry periods), 1570 to early 1580s (up to decades-long periods), and 1920s -1930s (up to 20-year periods). The Sacramento and San Joaquin basins shared 1580 as the single driest year of record. The driest single year for Klamath River streamflow was 1655 (1580 was 17th driest). The graphic below illustrates notable low-flow periods in the river basins. A tabulation listing all dry periods of four or more years is attached.

Paleoclimate information such as these reconstructed streamflows captures a broader range of hydrologic variability than provided in the historical record, thereby putting our short period of observed droughts in perspective.

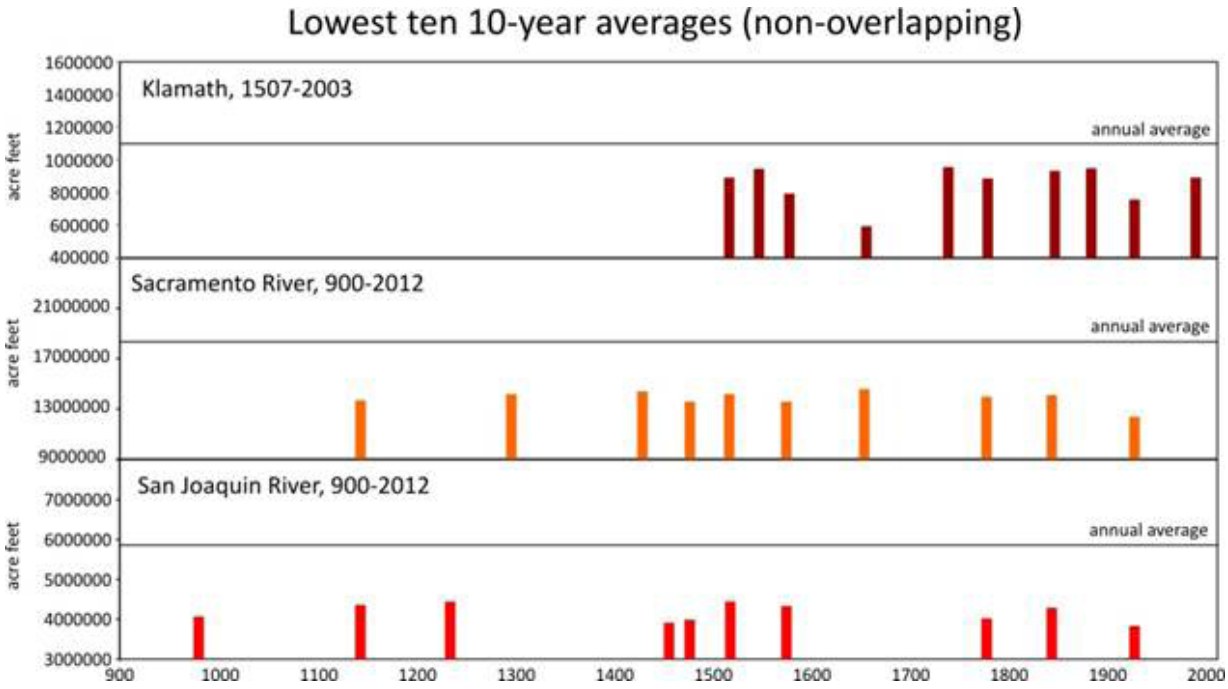
A repeat of the "Dustbowl Drought" of the 1920s and 1930s (our most severe historical event in terms of duration) with today's urban and agricultural development would sorely challenge California's infrastructure and institutional framework for water management. That challenge would pale in comparison to the time of the Medieval Climate Anomaly, when sustained severe drought gripped much of the western United States.

Paleoclimate information is useful in helping to understand and model natural variability in the climate system that may provide clues for improving drought prediction at the seasonal time scales important for water management.

Jeanine Jones of DWR said, "Drought prediction skillful enough to use for water management decision-making remains a research challenge for the science community. Having improved climate forecasting capabilities at time scales of months to a year in advance would provide great benefit for drought preparedness."

Looking into the future, the reconstructions also help provide context for expected impacts of climate change. The report compares drought durations seen in the paleoclimate record with those projected by downscaled global climate change models run to simulate conditions by the end of the century. The results indicate that the paleoclimate data may be useful for assessing future climate projections in the context of past centuries.

Report co-author Connie Woodhouse, professor and interim head of the University of Arizona School of Geography and Development, said, "These tree-ring records document the range of drought characteristics, including duration, that have occurred in the past, under natural climate variability. These droughts could occur in the future, but under warmer temperatures that will further exacerbate their impacts."



Klamath = Klamath River at Keno

Sacramento River = Sacramento River runoff

San Joaquin River = San Joaquin River runoff

Sacramento River runoff is the sum of unimpaired flow in million acre-feet at:
Sacramento River above Bend Bridge

Feather River at Oroville (aka inflow to Lake Oroville)
Yuba River near Smartville

American River below Folsom Lake

San Joaquin River Runoff is the sum of unimpaired flow in million acre-feet at:

Stanislaus River below Goodwin Reservoir (aka inflow to New Melones Res.)

Tuolumne River below La Grange (aka inflow to New Don Pedro Reservoir)

Merced River below Merced Falls (aka inflow to Lake McClure)

San Joaquin River inflow to Millerton Lake

Runs[a] with length ≥4 years in three flow reconstructions

Klamath[b]		Sacramento4c		San Joaquin4[d]	
Years	**N**	**Years**	**N**	**Years**	**N**
1515-1522	8	921- 924	4	946- 950	5
1540-1543	4	945- 950	6	977- 981	5
1547-1552	6	975- 981	7	1072-1075	4
1578-1582	5	1072-1075	4	1143-1148	6
1592-1597	6	1130-1136	7	1155-1158	4
1642-1646	5	1143-1148	6	1172-1177	6
1648-1668	21	1150-1158	9	1210-1213	4
1738-1744	7	1170-1177	8	1233-1239	7
1756-1761	6	1233-1239	7	1294-1301	8
1764-1767	4	1292-1301	10	1395-1402	8
1775-1779	5	1390-1393	4	1407-1410	4
1783-1787	5	1395-1400	6	1425-1428	4
1792-1798	7	1407-1410	4	1450-1461	12
1843-1846	4	1425-1432	8	1463-1466	4
1848-1852	5	1451-1457	7	1471-1483	13
1873-1876	4	1475-1483	9	1505-1508	4
1880-1884	5	1515-1521	7	1518-1523	6
1912-1915	4	1540-1543	4	1540-1545	6
1917-1920	4	1569-1572	4	1569-1572	4
1924-1935	12	1578-1582	5	1578-1582	5
1987-1992	6	1592-1595	4	1592-1595	4
		1636-1639	4	1629-1632	4
		1645-1648	4	1645-1648	4
		1652-1655	4	1652-1655	4
		1753-1760	8	1688-1691	4
		1780-1783	4	1753-1757	5
		1843-1846	4	1780-1783	4
		1856-1859	4	1793-1796	4
		1917-1922	6	1843-1846	4
		1926-1935	10	1855-1859	5
		1946-1951	6	1928-1931	4
		1959-1962	4	1946-1950	5
		1987-1992	6	1959-1962	4
				1987-1992	6
				2000-2004	5

a runs defined as consecutive years below median
b Klamath River at Keno, 1507-2003; median =1113 thousand acre-feet (TAF)
c Sacramento River runoff, 900-2012, median=17800 TAF
d San Joaquin River runoff, 900-2012, median=5598 TAF

With California facing one of the most severe droughts on record, Governor Brown declared a drought State of Emergency and directed state officials to take all necessary actions to prepare for water shortages. The Governor signed legislation to immediately help communities deal with the devastating dry conditions affecting our state and to provide funding to increase local water supplies after it was passed with bipartisan support in the legislature.

Governor Brown met with President Obama about crucial federal support during the ongoing drought, and the state continues to work with federal partners to ensure coordinated drought monitoring and response. Governor Brown and the administration have also expressed support for federal legislation introduced by Senators Feinstein and Boxer and Representatives Jim Costa, Tony Cárdenas and Sam Farr.

Across state government, action is being taken. The Department of General Services is leading water conservation efforts at state facilities, and the California State Architect has asked California school districts and Community Colleges to act on the Governor's call to reduce water usage. The Department of Transportation is cutting water usage along California's roadways by 50 percent. Caltrans has also launched a public awareness campaign, putting a water conservation message on their more than 700 electronic highway signs.
In January, the state took action to conserve water in numerous Northern California reservoirs to meet minimum needs for operations impacting the environment and the economy, and recently the Department of Water Resources and U.S. Bureau of Reclamation announced they would seek the authority to make water exchanges to deliver water to those who need it most. The State Water Resources Control Board announced it would work with hydropower generators and the Federal Energy Regulatory Commission to preserve water in California reservoirs, and the California Department of Fish and Wildlife and the California Fish and Game Commission restricted fishing on some waterways due to low water flows worsened by the drought.

The state is working to protect local communities from the dangers of extreme drought. The California Department of Public Health identified and offered assistance to communities at risk of severe drinking water shortages and is working with other state and local agencies to develop solutions for vulnerable communities. CAL FIRE hired additional firefighters and is continuously adjusting staffing throughout the state to help address the increased fire threat due to drought conditions. The California Department of Food and Agriculture launched a drought website to help farmers, ranchers and farmworkers find resources and assistance programs that may be available to them during the drought.

Even as the state deals with the immediate impacts of the drought, it's also planning for the future. In 2013, the California Natural Resources Agency, the California Environmental Protection Agency and CDFA released the California Water Action Plan, which will guide state efforts to enhance water supply reliability, restore damaged and destroyed ecosystems and improve the resilience of our infrastructure.

Governor Brown has called on all Californians to voluntarily reduce their water usage by 20 percent, and the Save Our Water campaign launched four public service announcements encouraging residents to conserve and has resources available in Spanish. Last December, the Governor formed a Drought Task Force to review expected water allocations and California's preparedness for water scarcity. In May 2013, Governor Brown issued an Executive Order to direct state water officials to expedite the review and processing of voluntary transfers of water.

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The Department of Water Resources operates and maintains the State Water Project, provides dam safety and flood control and inspection services, assists local water districts in water management and water conservation planning, and plans for future statewide water needs.