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StreamNotes

The Technical Newsletter of the National Stream and Aquatic Ecology Center

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Case Study: Restoration of the Camp Polk Meadow Preserve on Whychus Creek

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Historical accounts suggest that the Camp Polk reach of Whychus Creek (Figure 1) was once one of the most productive for steelhead and chinook salmon in the Upper Deschutes Basin, Oregon. A century of agricultural development, water diversions, channel straightening and berming, and stream "clean-outs" led to severely degraded aquatic habitats. Additionally, the stream has been subjected to a substantially-altered hydrograph; the over-allocation of water rights resulted in a completely dewatered stream during summer months as recently as 1999. Due to these manipulations, a once dynamic wetland meadow complex with multiple flow paths was converted

Figure 1: Aerial view of Camp Polk Meadow Preserve with flows returned to the valley floor (2014). (Photo credit: Russ McMillian)

StreamNotes is an aquatic and riparian systems publication with the objective of facilitating knowledge transfer from research & development and field-based success stories to on-the-ground application, through technical articles, case studies, and news articles. Stream related topics include hydrology, fluvial geomorphology, aquatic biology, riparian plant ecology, and climate change.

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to a xeric pasture, with an incised, straight, single thread channel running along the toe slope of the valley (Figure 2). Stream habitat became dominated by long, simple riffles, an armored bed, minimal riparian vegetation, and elevated stream temperatures. Due to habitat simplification and a lack of adequate flow, fish populations struggled in Whychus Creek. Additionally, the construction of the Pelton-Round Butte Dam Complex on the Deschutes River blocked all anadromous passage to the upper basin.

In 2005, the Dam Complex was relicensed. With the Federal Energy Regulatory Commission (FERC) re-licensing of the dams, fish passage requirements were included to restore anadromy to the upper Deschutes Basin and Whychus Creek for the first time in over five decades. In anticipation of passage restoration, the Deschutes Land Trust acquired the Camp Polk property for the sole purpose of restoring the site to its fullest potential. At the same time the Deschutes River Conservancy began working on securing senior instream water rights. The Deschutes Land Trust partnered with the Upper Deschutes Watershed Council for assistance in project management and development, as well as with the U.S. Forest Service (under the Wyden Amendment) for the development of a project design and implementation. Through conservation actions and purchases or leases, senior base flow instream water rights were acquired, making the restoration of Camp Polk feasible and allowing for the recolonization of steelhead and chinook salmon.

Figure 2: Typical pre-project conditions along Whychus Creek through the Camp Polk project area. Channel incision in this section was over three meters, with the stream cutting to bedrock at some locations. Bankfull discharge for Whychus Creek is about 8.5 m^3/s (300 cfs).

Restoration Planning

In 2005, in partnership with multiple groups and agencies, the Forest Service developed a plan to restore Whychus Creek at Camp Polk. The overall project goal was to restore Whychus Creek and its associated floodplain to provide high quality salmon, steelhead, and trout spawning and rearing habitat as well as wetland and riparian habitat for resident and migratory wildlife. The specific project goals and objectives were to:

1. Restore dynamic hydrologic function including floodplain connectivity, elevated shallow groundwater table, and sediment/nutrient storage. Dynamic hydrologic function includes:
   - Development of vertical and horizontal variability on the floodplain
   - Activation of channels and floodplains at various flows
   - Supporting a changing channel pattern that occurs through avulsion and formation of oxbows, point bars, and mid-channel bars
   - Maintaining diverse and abundant instream habitats including slot pools, pocket pools, alcoves, mid-channel pools, backwater areas, glides, and riffles.
2. Provide dynamic, high quality, and diverse habitat for redband trout, steelhead, chinook salmon, and bull trout, as well as the Oregon spotted frog.
3. Restore a diversity of riparian, wetland, and wet meadow habitats for wildlife.

The concept was to take a hydrologic process-based approach and encourage the evolution and development of a highly dynamic valley bottom. An alternative approach would have been form based, with a single thread channel that has little opportunity for adjustment. In general, a *process-based approach* develops the baseline conditions that will allow the stream channels and valley bottoms to continue evolving through fluvial processes towards

more complex and dynamic habitats. In contrast, a *form-based approach* defines channel pattern, profile and dimension and uses features such as rock vanes and toe wood to minimize channel adjustment. Use of a process-based approach has the advantage of allowing the stream and valley to adjust to future disturbances, such fires and climate change.

This design approach restores the processes that formed and maintained the broad, depositional valley prior to anthropogenic disturbances. In this way, the stream could transition from a transport reach to a depositional reach with transitory sediment storage in point bars and mid channel bars. The retention of appropriate sized spawning gravels in the stream channel, as well as the deposition of suspended sediments on the floodplain, are key components of the restoration design. The deposition of these gravels can result in channel avulsions, and the development of new flow paths. Encouraging this degree of freedom in the development and abandonment of flow paths was a bit contentious early on because of the concern that there would not be enough water in the channels for fish during summer low flows. This concern was assuaged by clarifying that the design would simply restore the hydrologic processes that were in place prior to disturbance when this reach provided productive spawning and rearing habitat. To accomplish this, the project was designed to be constructed in two phases, allowing the establishment of riparian vegetation for 2.5 years before the streamflow was diverted through the new meadow.

Implementation

Phase I began in June 2009 with floodplain grading and construction of stream channels and wood structures in the dry on the abandoned terrace (Figures 3 to 5). Riparian planting was also initiated in the fall of 2009. The constructed channels remained disconnected from live flow to allow for the development of riparian plantings along the belt width of the new channels. A temporary water right was secured to irrigate riparian plantings, allowing them to become established prior to exposure to full streamflow.

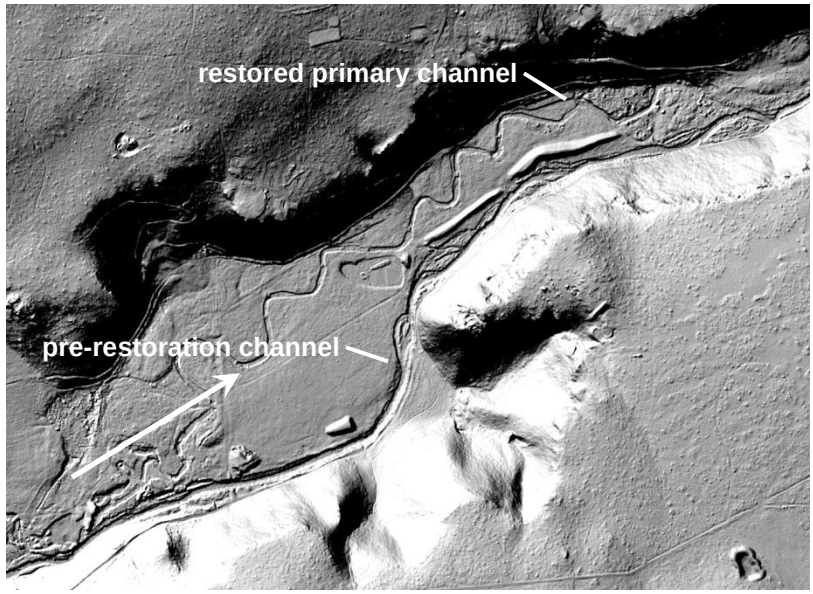


Figure 3: Camp Polk shaded relief LiDAR image of constructed mainstem channel. After establishing riparian vegetation, flow was diverted onto the valley floor and the incised pre-restoration channel was backfilled.

Phase 2 of the implementation began with the return of flows to the valley floor in February of 2012, once riparian plantings had become established. Over 40,000 cubic yards of fill and large woody material were placed within the straight, incised channel and graded to match the valley surface elevation.

Achievements from the project implementation are as follows:

- Construction of 2200 m of dominant flow path channels (Figure 3)
- Enhancement of 500 m of existing channel
- Construction of 6.7 km of side channel habitat
- Placement of 2,000 whole trees, resulting in more than 60 pieces per km (initially 1 per km)
- Increased number of mainstem pools (>1 m residual depth) from 3 to 37
- Decreased D_{84} at mid riffle from 130 mm to 70 mm
- Increased entrenchment ratio (floodprone width / bankfull channel width) from about 1 to greater than 30
- Planted over 200,000 native, riparian-dependent plants and added 11 ha (28 ac) of riparian plant community
- Increased wetland area by approximately 30 ha (73 ac)
- Elevated the shallow groundwater table to within 0.6 m of the floodplain surface, promoting healthy riparian vegetation and increasing hyporheic exchange. Pre-project depth to groundwater ranged from 1-3 m

Since the completion of Phase 2, Whychus Creek has experienced 14 flows of bankfull discharge or greater, with the largest event peaking at 42 m^3/s (1500 cfs, 25-year return interval). With each flood event, the channel complexity increases and the project becomes more dynamic. Should the Deschutes River Conservancy secure more water for summer base flow, the channels can easily accommodate that increase. With climate change and potentially a rapidly changing hydrograph, the channels are free to adjust as needed to the new state.

Project Monitoring

Project monitoring is critically important for tracking long-term success. The monitoring plan includes provisions for monitoring the following elements:

- Discharge
- Groundwater recovery;, using piezometers distributed in cross sections across the valley
- Surface water temperature
- Stream channel dimension, pattern and profile
- Streambed composition; particle size distribution at pool tail crests and mid-riffle
- Riparian vegetation establishment success and cover
- Wetland creation
- Invasive weeds
- Fish habitat, spawning, and populations
- Photopoints

Land Management Implications

A project of this type and scale requires the help and expertise of many groups and individuals. While the Forest Service was responsible for the development of the design and project implementation, our partners were and are critically important in making this project a success. The partnership in the Deschutes Basin between the Forest Service, local non-profits and engaged agencies has allowed us to work collaboratively across land ownership and achieve meaningful recovery in aquatic habitat as well as all the associated riparian habitats and ecological benefits. The same entities involved in this project are working together to achieve many more kilometers of rehabilitation on public and private lands. Listed below are a few of the features that we feel are essential to project success;

- The scale on which this project was implemented allowed us to restore the entire valley floor, without compromise to channel evolution/development.

Figure 4: Pre and post-riparian construction photos of the Camp Polk Meadow (2009 and 2014). The arrows indicate the same structure in each image.

- The establishment of a healthy riparian forest is critical to the long term success of the project. We invested heavily in plantings and gave them time to become established prior to initiating flow onto the valley floor.

The success of this project has been a catalyst for further restoration on Whychus Creek, including nearly 10 km of downstream riparian corridor, on former ranching lands.

Additional Information

For additional information regarding this project, please refer to the following:

- Additional information:
  - Deschutes Land Trust
  - Upper Deschutes Watershed Council
- Videos

Figure 5: Typical pool and wood structure constructed in Whychus Creek.

Notices and Technical Tips

- High-resolution aerial imagery is available in GIS for locations throughout the world (oftentimes at 30 cm resolution). To utilize this resource in ArcGIS, select the pulldown next to the add data plus sign, choose "Add Data From ArcGIS Online…", search for "imagery," and select "World Imagery." (Other basemap layers, such as topographic imagery, are also available from ArcGIS online.) For more information on ESRI's World Imagery, click here.

- High-resolution aerial imagery from Digital Globe has been made available to the employees of federal agencies through a program with the National Geospatial-Intelligence Agency. This imagery is oftentimes available at better than 50 cm resolution and is collected multiple times each year. For more information on this program, click here. To register or login, click here.
- Engineering projects along stream corridors require flow frequency estimates for their designs. Where sufficient streamgage data are available, the likely best method for developing flow frequency relationships are from statistical analyses of streamgage data. The standard procedure for developing these estimates use the logPearson frequency analysis, as detailed in Bulletin 17B (Interagency Advisory Committee on Water Data 1982). The National Stream and Aquatic Ecology Center has released a spreadsheet tool for computing flow frequency estimates at streamgages, to implement the analysis procedures detailed in Bulletin 17B. A technical summary report has also been developed to support the use of this tool. To download the report and tool, click here.

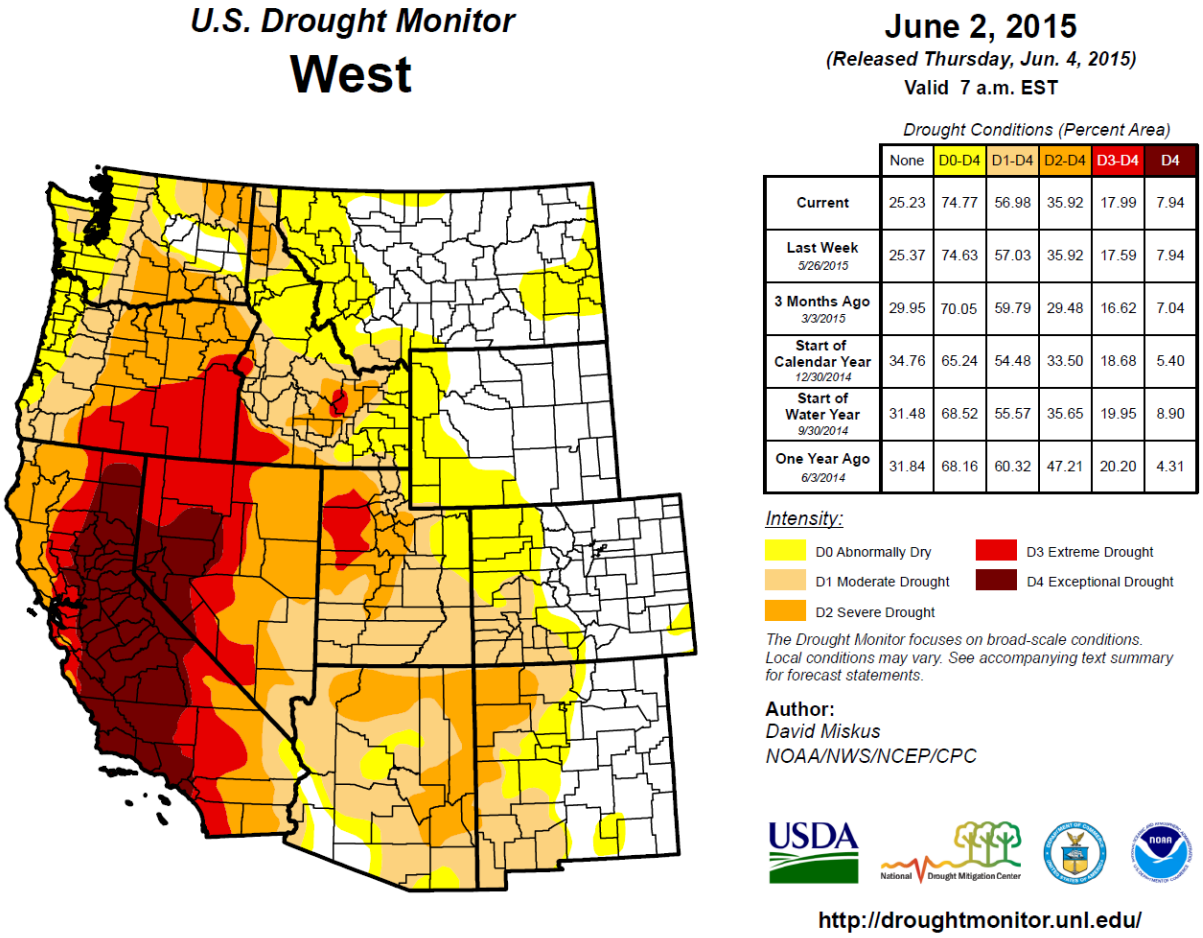
Western Drought Update: California's Record-Dry Conditions Continue

David H. Levinson

Climatologist and Program Manager, National Stream and Aquatic Ecology Center

As dry conditions continue across the western U.S. during the first half of 2015, much of the focus has been on California where the current drought remains in the "Severe, Extreme, and Exceptional" categories (North American Drought Monitor Classifications D2, D3 and D4, respectively). As shown in Figure 6, the majority of California is classified as having "Exceptional" drought (D4), which is defined as "Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams and wells creating water emergencies." In order for drought conditions to be classified as Exceptional the Palmer Drought Index (PDI) values need to reach -5.0 or less, and for the June 2, 2015 analysis from the National Drought Mitigation Center shows almost 94% of the state is classified as in D2 to D4 drought.

The current situation is now outside even the driest conditions that California has experienced over the past 120 years (reliable statewide precipitation data extend back to 1895). Figure 7 illustrates an analysis of precipitation and temperature anomalies since 1895, which are plotted as 3-year anomalies relative to the 20th century average (1901-2000). The extremely dry conditions seen in 2014 are clearly the warmest and driest of the entire period of record for the state. The state-wide temperature anomaly for the 3-year period ending in 2014 is over 0.5 °F higher than 2003, the year previously warmest on record, and the most recent 3-year period is the driest of the entire record.



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	25.23	74.77	56.98	35.92	17.99	7.94
Last Week 5/26/2015	25.37	74.63	57.03	35.92	17.59	7.94
3 Months Ago 3/3/2015	29.95	70.05	59.79	29.48	16.62	7.04
Start of Calendar Year 12/30/2014	34.76	65.24	54.48	33.50	18.68	5.40
Start of Water Year 9/30/2014	31.48	68.52	55.57	35.65	19.95	8.90
One Year Ago 6/3/2014	31.84	68.16	60.32	47.21	20.20	4.31

Figure 6: U.S. Drought Monitor analysis from June 2, 2015 for the western U.S. (author: David Miskus NOAA/NWS/NCEP/CPC, and the National Drought Mitigation Center).

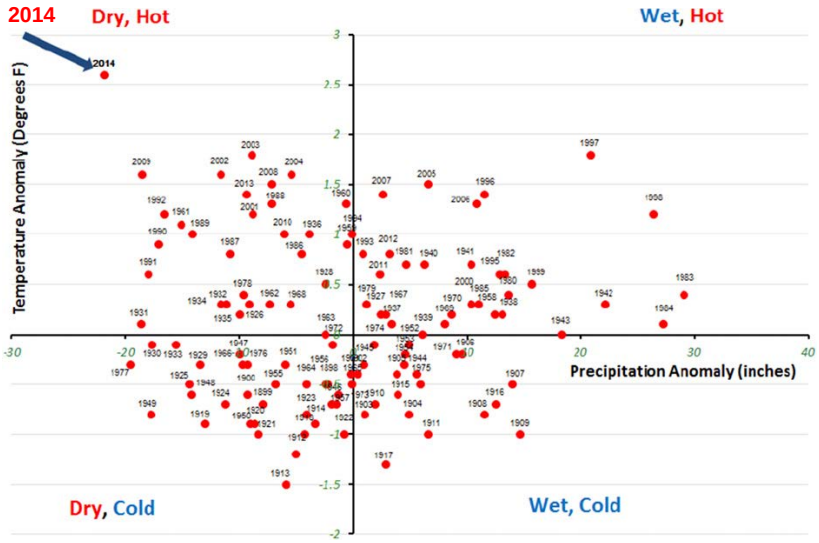


Figure 7: California temperature (°F) and precipitation anomalies (inches) from January 1895 to November 2014, plotted as 3-year anomalies relative to 1901–2000 mean (Mann and Gleick 2015). The arrow indicates year 2014. Data are from the NOAA National Climatic Data Center nClimDiv dataset.

An interesting aspect of California's precipitation measurements is the lack of a clearly defined long-term trend. Part of the issue with the lack of a significant trend is the widespread variability in precipitation that California experiences and the differences between the northern and southern portions of the state, and the strong connection between El Niño and La Niña events and the climate variability observed in wet and dry years. Currently California is experiencing a record period of dryness and long-term drought in terms of precipitation and runoff. In 10 of the past 14 years runoff in the Sacramento and San Joaquin basins has been below normal, with 3 of the driest and warmest years occurring during the same 14 year period (Mann and Gleick 2015).

Link to Climate Change

A significant discussion in the scientific community is the linkage between the current drought in California and climate change. A recent article by a group out of the Woods Institute for the Environment at Stanford University shows a significant connection between the increased drought risk in California and human-induced warming. Diffenbaugh et al. (2015) analyzed global climate simulations from Phase 5 of the Coupled Model Inter-comparison Project (CMIP5) to examine California's drought conditions with and without "anthropogenic forcing", and their results showed that "human activities have increased the probability that dry precipitation years are also warm." They also used an ensemble of model runs from the National Center for Atmospheric Research – NCAR's Large Ensemble (LENS) - which includes a single model experiment that enables quantification of the uncertainty arising from internal climate system variability. They used LENS to understand what the future may hold for California, and their results "reveal that additional global warming over the next few decades is very likely to create ~100% probability that any annual-scale dry period is also extremely warm."

Megadrought

The other concern with the current extended dry period is whether it is the beginning of a "megadrought", such as has been documented through paleo-climatic studies (Cook et al. 2007; Herweijer et al. 2007) to have occurred in the West and Southwest during the Medieval warm period (about 900AD to 1400AD). To address this issue, a recent study by Cook et al. (2015) examined the potential risk for megadroughts using an empirically derived drought reconstruction and three soil moisture metrics from 17 general circulation models (GCMs) to show that the models simulate "significantly drier conditions in the latter half of the 21st century compared to the 20th century and earlier paleo-climatic intervals." Figure 8 illustrates the results of their analysis for both the Southwest and Central Plains regions comparing the latter half of the 20th century (1950-2000) with projections for the latter half of the 21st century (2050-2099). In terms of decadal (11-year) and multi-decadal (35-year) drought, the model projections show a substantial increase in drought risk exceeding 80% for the latter half of the 21st century for both the Southwest and Central Plains. Based on their results, the author's stated that they "have demonstrated that the mean state of drought in the late 21st century over the Central Plains and Southwest will likely exceed even the most severe megadrought periods of the Medieval era in both the high and moderate future emissions scenarios, representing an unprecedented fundamental climate shift with respect to the last millennium."

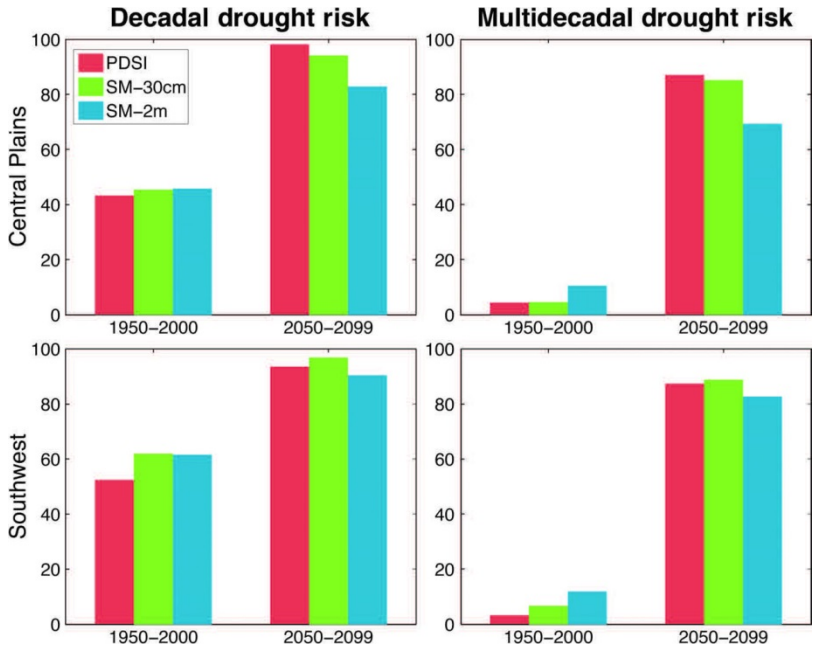


Figure 8: The risk (% chance of occurrence) of decadal (11-year) and multi-decadal (35-year) drought; calculated from a multi-model ensemble for 3 soil moisture metrics covering the summer season [June-July-August (JJA)], including: the Palmer Drought Severity Index (PDSI), and integrated soil moisture from the surface to 30 cm (SM-30cm), and 2 to 3 m (SM-2m) depths. Risk calculations are conducted for two separate model intervals: 1950–2000 (historical scenario) and 2050–2099 (RCP 8.5). Results for the Central Plains are in the top row, and those for the Southwest are in the bottom row (Cook et al. 2015).

Conditions Beyond California

In addition to California, drought conditions have developed, expanded, or worsened across other areas of the West. Of particular concern is the lack of snowpack and expanding drought conditions in the Pacific Northwest. As shown in the latest U.S. Drought Monitor map for the western U.S. (June 2, 2015; Figure 6), Extreme Drought (D3) has been designated for parts of Oregon, primarily across the southern and southeast portions of the state. In addition, Exceptional Drought (D4) has expanded across portions of western Nevada, with Extreme Drought designated in parts of Utah and southern Idaho.

Other areas of the West remain in moderate to severe drought (D1 and D2), with growing concerns over the potential for wildfires as conditions transition to the summer dry season in the Pacific Northwest and Northern Rockies. The lack of snowpack has been a critical impact in many areas, with record or near-record low snowpack and snow-water-equivalent (SWE) at many snow telemetry (SNOTEL) sites.

Land Management Implications

The key point for land managers in both studies described above is that climate model projections for the 21st century show a well-documented increase in potential evapotranspiration and drought risk, which will directly impact the forest and rangeland ecosystems that they will have to work in future decades. We will provide further updates on the drought situation in California and the West in upcoming issues of StreamNotes, continuing to focus on new research results and applied studies that provide insights on current and future conditions and impacts to streams, riparian zones and aquatic ecosystems.

References

Cook, B.I., T.R. Ault, and J.E. Smerdon, 2015. Unprecedented 21st century drought risk in the American Southwest and Central Plain. Science Advances, 1, e1400082.

Cook, E.R., R. Seager, M.A. Cane and D.W. Stahle, 2007. North American drought: Reconstructions, causes, and consequences. Earth Science Reviews, 81, 93-134.

Diffenbaugh, N.S., D.L. Swain, and D. Touma, 2015. Anthropogenic warming has increased drought risk in California. Proceedings of the National Academies of Science, 112 (13), 3931-3936.

Herweijer, C., R. Seager, E.R. Cook and J. Emile-Geay, 2007. North American droughts of the last millennium from a gridded network of tree-ring data. Journal of Climate, 20, 1353-1376.

Mann, M.E., and P.H. Gleick, 2015. Climate change and drought in the 21st Century. Proceedings of the National Academies of Science, 112 (13), 3858-3859.

Reintroducing StreamNotes, the Tech Transfer Newsletter of the National Stream and Aquatic Ecology Center

This issue is the first StreamNotes newsletter in over 3 years, with this long hiatus being the result of a number of personnel and structural changes within our organization. A lot has happened and changed within the Washington Office technical units over the past 3 years. The biggest change came in 2012, when the Watershed, Fish, Wildlife, Air, and Rare Plants (WFWARP) program combined both of the staff at its technical units: the Stream Systems Technology Center and the Fish and Aquatic Ecology Unit. An executive steering committee and new charter were developed to guide the integration of these units into one technical center, which was officially named the National Stream and Aquatic Ecology Center (NSAEC). A new charter for the Center was developed, and was officially signed by the Deputy Chief for the National Forest System (NFS) and Deputy Chief for Research and Development (R&D) in the summer of 2013. The primary focus of the Center is on developing tools and science applications for more effective management and conservation of watersheds, streams, riparian ecosystems, fisheries, and aquatic ecosystems on National Forests and Grasslands. The work performed at NSAEC is included within the following program elements:

- Environmental flows and water resource management
- Watershed, stream, riparian, and aquatic habitat restoration
- Condition, trend, and effectiveness monitoring of watershed, channel, aquatic habitat, and riparian vegetation
- Technology development, transfer, and application
- Technical support and training

As mentioned, there were also several personnel changes with the new Center's staff. The longtime program leader and hydrologist for the Stream Systems Technology Center, John Potyondy, retired in 2011. Not long after the program leader for the Fish and Aquatic Ecology Unit, Mark Hudy, transferred in the summer of 2012 to a position with the USGS at their headquarters in Reston VA.

In mid-2012, the Director and leadership staff for WFWARP began to recruit a scientist/program leader position to head up the new Center. The recruitment was completed in early fall 2012, when Dr. David Levinson (Figure 9) was offered and accepted the position as the new lead scientist and program leader for the Center. Dave has spent over 20 years working as an applied meteorologist and climatologist for the USDA Agricultural Research Service and Forest Service, U.S. Department of the Interior Bureau of Land Management, and the U.S. Department of Commerce National Oceanic and Atmospheric Administration. His technical background and expertise is in the climatology of storms and flooding, and monitoring and analyzing the impacts of climate change on natural resources. He is the author of numerous peer-reviewed publications, and recently served as a contributing author on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report.

Dave previously worked as the program manager for Ecosystem Function and Health at the Forest Service' Pacific Southwest Research Station, where he managed a diverse science program studying ecosystem and watershed processes. In addition, he served as

Figure 9: David Levinson, program leader for the National Stream and Aquatic Ecology Center.

a line officer for two of PSW's labs along with oversight of three experimental forests and two experimental watersheds. Dave also worked as a climatologist for NOAA's National Climatic Data Center, where he spent 7 years working on flood and storm impact studies. During his time with NOAA, Dave served as the agency's representative on the US Army Corps of Engineers' Risk Assessment Group, which focused on assessing the storm impacts from Hurricane Katrina on the central Gulf Coast. Prior to working with NOAA, Dave worked 4-years as a meteorologist for the BLM-Montana/Dakotas as the lead scientist and program coordinator for Montana/Idaho Airshed Group, the multi-agency smoke management program. Dave earned his MS Degree in Meteorology from the University of Hawai'i at Manoa, and a PhD degree in Geography and the Program in Atmospheric and Oceanic Sciences from the University of Colorado at Boulder.

In Dave's words, "I feel quite fortunate to have been chosen to work with such a dynamic group at the newly combined Center, which

Figure 10: Steven Yochum, hydrologist with the National Stream and Aquatic Ecology Center. On the White River National Forest, Colorado**.**

includes our aquatic ecologist Dr. Brett Roper, riparian ecologist Dr. David Merritt, fluvial geomorphologist Dr. Daniel Cenderelli, our new hydrologist Dr. Steven Yochum, and biological scientist Julian Scott. They are all top-notch applied scientists, and it's a great honor to work with them and lead the impressive program of work at the National Stream and Aquatic Ecology Center." Dan Cenderelli and David Merritt were introduced in previous issues of StreamNotes. For more information and contact information for the NSAEC team members, click here.

In 2014 the Center hired a new hydrologist. Dr. Steven Yochum (Figure 10) began work at the NSAEC last October. Steve comes to the Center from our sister agency at the USDA, the Natural Resources Conservation Service. Steve has also held positions with the U.S. Geological Survey, and in private consulting. He is a licensed professional engineer. Steve has 20 years of experience, with a focus on stream & riparian hydrology and stream restoration, hydrologic modeling, and water quality data collection and interpretation. He has a PhD from Colorado State University, with a focus on stream mechanics and restoration, and a dissertation on flow resistance and velocity prediction in the high-gradient stream channels common on National Forests. His experience includes providing technical leadership in response to the 2013 Colorado Front Range Floods, providing stream and riparian restoration planning and design services to enhance native trout populations and other riparian species, and developing plans to mitigate areas with excessive stream-bank erosion or gullying, and restoring valley-bottom lands impacted by historic mining practices. He has also performed hydrologic studies of post-wildfire conditions, instream salinity production from irrigated agricultural lands, numerous dam breach analyses, including documenting and evaluating an actual dam failure, and has developed probable maximum flood studies. He has also coordinated and interpreted a water quality monitoring program for the riverine inputs to the Chesapeake Bay, and has been active with watershed and site-specific hydraulic modeling, bridge scour analyses in riverine and tidally-influenced areas, and highway design in mountainous settings. He is an author of numerous peer-reviewed publications and technical reports.

As mentioned, the formation of the National Stream and Aquatic Ecology Center included combining staff from both of the previous technical units, which brought Dr. Brett Roper (Figure 11) over to the new Center. Brett is an aquatic ecologist with over 20 years of experience with the Forest Service. He received his MS in Forestry from Utah State University and a PhD in Fisheries Management from the University of Idaho. His focus is on

Figure 11: Brett Roper, aquatic ecologist with the National Stream and Aquatic Ecology Center.

understanding how land management activities, such as timber harvest, grazing, and road building, affect stream habitat, fish movement, and fish populations. He has also spent considerable time trying to improve monitoring protocols and analytical approaches to increase the ability to detect the effects land management activities have on aquatic resources. Brett was essential in developing the Pacific Fish—Interior Fish Biological Opinion (PIBO) Effectiveness Monitoring Program, and led the PIBO monitoring effort for over 12 years.