Greetings and welcome to the **APRIL 2015** edition of the WDFW Climate News Digest. Our purpose is to provide highlights of relevant climate change news, events and resources for WDFW staff. Feedback or suggestions for items to include in future editions are much appreciated – many *thanks* to those who have sent links and references and please keep them coming. Note that previous editions of the newsletter are now stored on the Habitat Program Sharepoint site and on the agency's climate change web page.

Thanks for contributions this month from Dan Siemann (DNR), Hedia Adelsman (Ecology), the North Pacific Landscape Conservation Cooperative, Steven Boessow, Peggy Miller Bruce Botka, Justin Allegro and Maria Hunter.

WHAT'S HAPPENING AT WDFW?

Are you working on a project that may be affected by climate change? Have you considered or included climate change in research proposals, workshops or other activities? Please be in touch to share your experience!

CLIMATE ADAPTATION AT OTHER ORGANIZATIONS

Congressional Research Service Releases: "Climate Change Adaptation by Federal Agencies: An Analysis of Plans and Issues for Congress"
The Government Accountability Office (GAO) since 2013 has identified the changing climate as one of the 30 most significant risks facing the federal government. This report reviews current actions of selected federal departments and agencies to adapt their own missions, infrastructure, operations, and personnel to impacts from projected climate change. It identifies common approaches among agencies, examples of specific actions, and notable barriers the federal government faces.
Click here to download the report.

LEARNING OPPORTUNITIES

April 13th, 10:00-11:30 am, Pacific, Webinar: The U.S. Climate Resilience Toolkit
Organizer: NOAA

April 15th, 12:30 pm, Pacific, Webinar: Fire, Bugs, and Humans: Modeling Interacting Disturbances in Anthropogenic Landscapes
Organizer: U.S. Department of Interior - Northeast Climate Science Center

April 22nd, 10:00 to 11:30 am , Pacific, Webinar: "Riparian Restoration Tool for Climate Change Resiliency"
Come learn about an innovative riparian planting and restoration decision support tool, funded by the Appalachian Landscape Conservation Cooperative (LCC) that is now available to the conservation community. The speaker is Jessica Rhodes, U.S. Fish and Wildlife Service. For more information and to register, go to:
https://nctc.adobeconnect.com/safeguarding_april2015/event/event_info.html

The Webinar: "Rangewide Climate Vulnerability Assessment for Threatened Bull Trout" recording is now available
https://nccwsc.usgs.gov/webinar/442.

Data and publications from this project can be found on the project's online project page. For more information about the research presented in this webinar, please contact the speaker, Jason Dunham, jdunham@usgs.gov.

May 12-14, 2015 - National Adaptation Forum

The National Adaptation Forum is a biennial gathering of the adaptation community to foster information exchange, innovation, and mutual support for a better tomorrow. The Forum will take place from May 12 - 14, 2015 in St. Louis, MO.
Click here for more information.

June 16 - 18, 2015 –" Climate Change Adaptation Planning"

Hosted by the Institute for Tribal Environmental Professionals to provide tribal environmental professionals an intro to climate change, adaptation planning, and tools and resources for the planning process.

RESOURCES

Climate Change Adaptation by Federal Agencies

A new report from the Congressional Research Service entitled Climate Change Adaptation by Federal Agencies, describes government agency plans to anticipate and adapt to the effects of climate change. The report surveys the range of agency responses, and identifies common approaches among agencies, examples of specific actions, wide-ranging vulnerabilities, and notable barriers to adaptation.

USFS -R&D "Climate Shield" Project

Recent research just published in *Global Change Biology* may be of interest for long-term conservation planning of native trout species like bull trout and cutthroat trout on 50 national forests in the northwest. The "Climate Shield" project pulls together huge interagency fish and stream temperature datasets to make precise predictions about which streams are most likely to continue supporting these species later this century as climate change progresses. A significant dimension to this recent research was designing a website that hosts all the information as user-friendly digital maps and GIS databases covering 450,000 stream kilometers so that the science could be easily accessed & applied by managers & conservation interests to do more efficient planning & investment.
Climate Shield website: http://www.fs.fed.us/rm/boise/AWAE/projects/ClimateShield.html
RMRS press release: http://www.fs.fed.us/rmrs/news/releases/content/?id=15-03-02

Climate Resilience Toolkit unveils Water Resources section

The U.S. Climate Resilience Toolkit's Water Resources topic section is now live. Explore climate-related risks and opportunities related to municipal water supplies, flooding, drought, and water-related ecosystems. You'll also find tools and case studies that help manage water-related climate risk and help build resilience.
Explore Water-Related Climate Resilience Tools »
Read Case Studies about Climate Resilience »

Fact sheet from the Union of Concerned Scientists: *Confronting Climate Change in Washington*.

Excerpts from the fact sheet:
The Pacific Northwest has already warmed at least 1.3°F over the last century and climate models project temperatures in the region to increase between 3 and 9°F by the end of this century depending on whether

we reduce or continue to increase our global warming emissions. Our fact sheet synthesizes the latest science on the current impacts and future risks of climate change in Washington, including the consequences to shellfish hatcheries from an acidifying ocean, record-breaking wildfires and other damages to forests, and declining snowpack and earlier snowmelt in the mountains that jeopardizes summer water supplies. These changes will impact:

- Washington's $270 million shellfish industry that produces one-quarter of the nation's oysters and supports 3,200 jobs.
- Washington's tourism industry that contributes $17 billion annually to the state's economy.
- Firefighting costs, which totaled $180 million in 2014 as fires scorched 425,000 acres.
- Washington's timber industry that generates $16 billion in gross business income and supports 45,000 jobs.
- Hydroelectricity production, which accounts for 70 percent of the Washington's electricity supply.

Climate Change: Evaluating Your Local and Regional Water Resources
From the USGS California Water Science Center

CLIMATE SCIENCE NEWS

West Coast waters shifting to lower-productivity regime, new report finds
Large-scale climate patterns that affect the Pacific Ocean indicate that waters off the West Coast have shifted toward warmer, less productive conditions that may affect marine species from seabirds to salmon, according to the 2015 State of the California Current Report delivered to the Pacific Fishery Management Council. The report by NOAA Fisheries' Northwest Fisheries Science Center and Southwest Fisheries Science Center assesses productivity in the California Current from Washington south to California. Among the highlights of the new State of the California Current Report:

- Record-high sea surface temperatures combined with shifts in the Pacific Decadal Oscillation, North Pacific Gyre Oscillation and weaker upwelling of deep, cold waters indicate declining productivity in the California Current.
- After several productive years the biomass of tiny energy-rich organisms called copepods, which support the base of the West Coast food chain and provide important food for salmon, has declined significantly.
- California sea lion pups and seabirds called Cassin's auklets found dying and emaciated in large numbers in recent months may reflect the transition to less productive marine conditions.
- Although commercial fishery landings have remained high in recent years, the fishing fleet has become more specialized in terms of targeting specific fisheries. That may expose the vessels to more fluctuations of catch and revenue if those fisheries decline.

Will Seattle Have Enough Water This Summer?
From Cliff Mass's Blog
The bottom line: wise management of water by Seattle Public Utilities and increasingly efficient use of water by the regional population will probably allow us to get through the summer without much problem. Although this year has been warm and relatively snow-free, there has been normal precipitation, generally delivered every few weeks by warm, wet atmospheric river events. The fascinating thing about this year is that it is so much like conditions we expect in roughly 2070 under global warming: warmer, less snowpack, and near-normal precipitation. If we can get through this summer without much inconvenience it will be a good sign for our ability to adapt to a changing climate...at least in terms of drinking water in Seattle. But it will take wise management of our water storage and usage to ensure this. Read more here.

Interaction of Atlantic and Pacific oscillations caused 'false pause' in warming

Excerpt from Science Daily

The recent slowdown in climate warming is due, at least in part, to natural oscillations in the climate, according to a team of climate scientists, who add that these oscillations represent variability internal to the climate system. They do not signal any slowdown in human-caused global warming. "We know that it is important to distinguish between human-caused and natural climate variability so we can assess the impact of human-caused climate change on a variety of phenomena including drought and weather extremes," said Michael Mann, Distinguished Professor of Meteorology, Penn State. "The North Atlantic and North Pacific oceans appear to be drivers of substantial natural, internal climate variability on timescales of decades."

Ocean Circulation Change: Sea Level Spiked for Two Years along Northeastern North America

Excerpt from Science Daily

Sea levels from New York to Newfoundland jumped up about four inches in 2009 and 2010 because ocean circulation changeS. The unusual spike in sea level caused flooding along the northeast coast of North America and was independent of any hurricanes or winter storms. A new article documents that the extreme increase in sea level rise lasted two years, not just a few months. A four-inch increase in sea levels from New York to Newfoundland occurred in 2009 and 2010 because ocean circulation changed, reports a UA-led team of geoscientists. The team linked the spike to a change in the ocean's Atlantic Meridional Overturning Circulation and also a change in part of the climate system known as the North Atlantic Oscillation. The researchers then used computer climate models to project the probability of future spikes in sea level. The team found that, at the current rate that atmospheric carbon dioxide is increasing, such extreme events are likely to occur more frequently.

Anthropogenic Warming has Increased Drought Risk in California

From the North Pacific Landscape Conservation Cooperative

A study published in the Proceedings of the National Academy of Sciences Journal finds that climate change is exacerbating the intensity of the California drought. The record-setting drought has led to acute water shortages, groundwater overdraft, critically low streamflow, and enhanced wildfire risk. Analysis shows that California has historically been more likely to experience drought if precipitation deficits co-occur with warm conditions and that such confluences have increased in recent decades, leading to increases in the fraction of low-precipitation years that yield drought. In addition, the study suggests that anthropogenic warming is increasing the probability of the co-occurring warm-dry conditions that have created the current California drought.

Climate Science: The Future of Coastal Ocean Upwelling

From the North Pacific Landscape Conservation Cooperative

Many climate models predict that coastal upwelling will intensify in three of the most productive marine ecosystems of the world. This result comes at a time when scientists are still debating the evidence supporting an increase in coastal upwelling and its effects on coastal ecosystems and global carbon cycling. Increased upwelling currents will strongly affect marine ecosystems at Eastern Boundary Upwelling Systems, but the long-term future of coastal acidification, dead zones, and primary productivity probably depends on the properties of the water that comes to the surface.

Is the Monthly Temperature Climate of the United States Becoming More Extreme?

From the North Pacific Landscape Conservation Cooperative

NOAA researchers used a new data set of monthly temperatures, adjusted for detected inhomogeneities, to evaluate whether monthly temperature climate of the U.S. has become more extreme. Over the past twenty to thirty years there has been a shift toward more frequent very warm months, and less frequent

very cold months. Therefore, the overall monthly temperature climate has not become more extreme. Mid-twentieth century including the 1930s was an earlier period of frequent very warm months, a result of very warm daytime temperatures, while nighttime temperatures were not unusual. Compared to the earlier midcentury warm period, recent decades have been more (less) extreme in the summer (winter) in the west while Midwest summers have been less extreme.

East Antarctica Melting Could be Explained by Oceanic Gateways

From the National Science Foundation

Researchers have discovered two seafloor gateways that could allow warm ocean water to reach the base of Totten Glacier, East Antarctica's largest and most rapidly thinning glacier. The discovery probably explains the glacier's extreme thinning and raises concerns about how it will affect sea level rise. Totten Glacier is East Antarctica's largest outlet of ice to the ocean and has been thinning rapidly for many years. Although deep, warm water has been observed seaward of the glacier, until now there was no evidence that it could compromise coastal ice. The result is of global importance because the ice flowing through Totten Glacier alone is sufficient to raise global sea level by at least 11 feet, equivalent to the contribution of the West Antarctic Ice Sheet if it were to completely collapse.

SPECIES AND HABITATS

Nature Climate Change Article: "Vulnerability and Adaptation of U.S. Shellfisheries to Ocean Acidification"

This study presents an explicit, multidisciplinary vulnerability analysis of coastal human communities to help to prioritize societal responses to ocean acidification. The study analysis focuses on shelled mollusks' harvests, which are likely to be harmed by ocean acidification. Results highlight the U.S. regions most vulnerable to ocean acidification, important knowledge and information gaps, and opportunities to adapt through local actions. This research illustrates the benefits of integrating natural and social sciences to identify actions and other opportunities while policy, stakeholders, and scientists are still in relatively early stages of developing research plans and responses to ocean acidification.
Click here to access the article.

The New Climate Normals: Gardeners Expect Warmer Nights

From Climate.gov

Among the most important factors determining which plants can survive where is how cold the winter is. Updated each decade, the U.S. Climate Normals from NOAA's National Climatic Data Center are 30-year averages of many pieces of weather information collected from thousands of weather stations nationwide. Each time they are updated, an old decade is dropped, and a new one is added. The last update was in July 2011: the decade 1971-1980 was dropped, 2001-2010 was added, and the new 30-year window for the U.S. Climate Normals became 1981-2010. Maps of climate-related planting zones were created by the National Oceanic and Atmospheric Administration (NOAA) in 2011 as a special service to the American Public Garden Association. In 2012, the U.S. Department of Agriculture (USDA), using data collected by NOAA, updated their official Plant Hardiness Zone Map, the standard by which gardeners and growers can determine which plants are most likely to thrive at a location.

Climate Change Implications in the Northern Coastal Temperate Rainforest of North America

From the North Pacific Landscape Conservation Cooperative

We are pleased to share the release of a new climate synthesis publication developed by a number of NPLCC Partners. The publication synthesizes an expert review of climate change implications for hydroecological and terrestrial ecological systems in the northern coastal temperate rainforest of North

America. This synthesis is based on an analysis of projected temperature, precipitation, and snowfall stratified by eight biogeoclimatic provinces and three vegetation zones. Read more & download full report

Arctic Warming will Promote Atlantic-Pacific Fish Interchange

From the North Pacific Landscape Conservation Cooperative

For millions of years, extremely cold arctic water temperatures and low nutrient levels have served as a barrier separating marine organisms in the North Atlantic from those in the North Pacific. However, a recent study published in *Nature Climate Change*, finds that rising ocean temperatures are dissolving the barrier. Researchers projected the potential northward progression of 515 species following climate change and report the rate of potential species interchange between the Atlantic and the Pacific via the Northwest Passage and the Northeast Passage. By 2100 up to 41 species could enter the Pacific and 44 species could enter the Atlantic, via one or both passages. This exchange of fish species may trigger changes for biodiversity and food webs in the North Atlantic and North Pacific, with ecological and economic consequences to ecosystems that at present contribute 39% to global marine fish landings.

Study Published on Storage and Release of Organic Carbon from Glaciers and Ice Sheets

From the North Pacific Landscape Conservation Cooperative

The impact from melting glaciers due to climate change is more complex than just causing changes to global sea-levels. Melting glaciers will impact the flow of organic carbon to oceans around the world. This study provides a global-scale estimate for the storage and release of organic carbon from melting glaciers. This research is crucial to better understand the role glaciers play in the global carbon cycle, especially as climate warming continues to reduce glacier ice stores and release ice-locked organic carbon into downstream freshwater and marine ecosystems. Glaciers represent a substantial reservoir of organic carbon and as glaciers are lost worldwide along with the corresponding release of carbon, high-latitude marine ecosystems will be affected.

Global Warming May Boost Dead Zones in Oceans

From the North Pacific Landscape Conservation Cooperative

Researchers at the University of California, Davis, analyzed ocean sediment data and found that the last time the planet experienced a major temperature change, oxygen levels fell sharply along the continental margins in the eastern Pacific Ocean. This discovery raises concerns about whether current warming trends will make regions of the oceans uninhabitable for marine life that need oxygen for survival. Major changes in the distribution of oxygen are already underway in the modern ocean. Modern losses of dissolved oxygen have been detected in every ocean basin by oceanographers and modern instrumentation:

With millions of starfish dying all along the West Coast, Washington State Democrats say it's time for Congress to intervene

Excerpt from The Columbian

The outbreak, first noticed in the state by rangers in Olympic National Park in June 2013, has hit 20 species of starfish, also known as sea stars. After getting lesions on their bodies, the sea stars begin curling up and soon lose their legs, shriveling up and disintegrating into mush. Researchers fear the epidemic may be the result of a virus caused by climate change, with the disease showing its fastest progression in warmer ocean waters. "There has never been an outbreak of disease in natural populations of animals that I know that's been this large," said Drew Harvell, a professor of ecology and evolutionary biology at Cornell University who's been studying the starfish deaths on the San Juan Islands, in northwestern Washington state.

Climate Refuges Found Where Corals Survive, Grow

Excerpt from Science Daily

Reef-building corals, already thought to be living near their upper thermal limits, are experiencing unprecedented declines as the world's oceans continue to warm. New evidence from scientists at Florida Institute of Technology shows there may be some climate refuges where corals will survive in the future. The study appears in the March issue of *Global Change Biology.*

POLICY AND MANAGEMENT - MITIGATION AND ADAPTATION

Southwest Climate Science Center Paper: "Are Conservation Organizations Configured for Effective Adaptation to Global Change?"

The Department of the Interior's Southwest Climate Science Center recently co-authored a paper that investigates whether conservation organizations are equipped to adapt to climate change. This paper discusses the capacity of conservation organizations to adapt to changing environmental conditions, focusing primarily on public agencies and nonprofits active in land protection and management in the U.S. The paper reviews how organizations anticipate and detect impacts and discusses whether they are sufficiently flexible to prepare and respond by reallocating resources. The paper hypothesizes how configuration of different organizations enables them to protect particular conservation targets and discusses resources that may help conservation organizations assess their capacity to adapt.
Click here to access the paper.

"More Than Scientists" seeks to show human side of climate experts

By Marianne Lavelle from The Daily Climate

Advocates for climate action have been trying for some time to emphasize the human side of climate change. A new campaign goes one better: It seeks to show a glimpse of the essential humanity of climate scientists. Dozens of climate scientists tell their stories—their hopes for the future, and their fears—in more than 200 brief videos that have been put together by the More Than Scientists project. By "stepping out from behind the data" to share their stories as musicians, artists, hikers, and parents, the scientists hope to inspire people to get more involved in pushing for deployment of solutions, said a prepared statement by the group. More than Scientists is a project of the Seattle-based Climate Change Education Project and its founder, Eric Michelman, a technology whiz who is credited with inventing the mouse click wheel, and a devoted climate activist. Michelman said in a prepared statement that the idea of the campaign is to "make a better connection between the scientists and the people that need to hear their message."

Mission Accomplished

Excerpt from Earth Island Journal

"It's as if unparalleled chutzpah had a baby with unbelievable irony. The sharp-eyed bloggers at Grist.org somehow came across a 1962 edition of *Life* magazine that featured an ad from Humble Oil bragging about how the company generates enough energy every day to "melt 7 million tons of glacier." As history would have it, Humble later merged with Standard, which became today's ExxonMobil

The Humble ad must be just a weird coincidence, right? After all, it's not as if the greenhouse effect was well understood in 1962. Except, that is, for television viewers who saw a 1958 Frank Capra-produced show on weather titled *The Unchained Goddess*. The educational film featured a physicist who warned, "Even now, man may be changing the climate through the waste products of his civilization…. It's been calculated that a few degrees rise in the Earth's temperature would melt the polar ice caps." Incredibly, this would be news to many people 50 years later. At least that's the takeaway from a survey of climate change news coverage conducted by DailyClimate.org. The DailyClimate editors counted 32,400 stories on climate change published worldwide in 2009, a 17 percent increase from 2008. That sounds impressive until you compare it with other major news stories. Climate change received less coverage than topics such as "Balloon Boy," the "White House Party Crashers," and the "Bill Richardson Scandal."

Embrace Unknowns, Opt for Flexibility in Environmental Policies, Experts Say

From Science Daily

We make hundreds, possibly thousands, of decisions each day without having full knowledge of what will happen next. Life is unpredictable, and we move forward the best we can despite not knowing every detail. It's no different in the natural world. Earth is warming, fish stocks and species counts fluctuate and we're experiencing more extreme weather. Conservation managers need to act quickly and make decisions about how to address these issues -- even though questions remain. That's the argument of two University of Washington researchers whose perspectives article appears Feb. 27 in Science. "Modern science is producing lots of new knowledge, but we question whether that knowledge is going to accumulate fast enough to be useful as systems change rapidly," said Daniel Schindler, a co-author and UW professor of aquatic and fishery sciences. "We have to learn how to manage our ecosystems and natural resources in a reality where uncertainties dominate. That often means we have to make tough decisions with lousy knowledge." The authors offer several suggestions:

• Create policies that have legs: When developing a policy to manage fisheries or allocate water distribution in agriculture, for example, make it flexible so it can continue to effectively manage the resource, no matter how it changes in the future.

• Support policies that encourage ecosystem diversity: Opt for plans that encourage organism and habitat diversity, because casting a larger net will let the policy be most responsive no matter what happens in the future.

• Invest more in monitoring: Don't just collect data, but actively analyze the data, drawing connections to the past and assessing what that relationship might mean for the future. Do more field-based monitoring and less predictive modeling.
• Expect a future that's different from the past: Move away from a "better safe than sorry" approach to management and assume the ecosystem will shift in unexpected ways. Design policies that can adapt based on how the ecosystem changes.

E. Schindler And Ray Hilborn. Prediction, precaution, and policy under global change. *Science*, February 2015 DOI: 10.1126/science.1261824