Greetings and welcome to the **MARCH 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 David Price, Dawn Phelps, Bob Vadas and Bruce Botka.

WHAT'S HAPPENING AT WDFW?

Climate Change and the State Wildlife Action Plan Revision

We are working to integrate climate change into our revision of the State Wildlife Action Plan, a document the US Fish and Wildlife Service requires in order for WDFW to be eligible for State Wildlife Grants funding. Generous support by the NPLCC (North Pacific Landscape Conservation Cooperative) is enabling us to direct some additional resources towards this task. Over the next months we will be integrating sensitivity to climate change into fact sheets developed for our Species of Greatest Conservation Need, and assessing how to leverage conservation actions to maximize resilience to climate change. We will also be developing a "Climate Watch List" for both species and habitats, and exploring monitoring needs and citizen science opportunities for especially vulnerable species and habitats. Stay tuned for more to come, or if you'd like to learn more please be in touch with Lynn Helbrecht, who is serving as the State Wildlife Action Plan Coordinator (as well as the Climate Change Coordinator!) for the next several months.

CLIMATE ADAPTATION AT OTHER ORGANIZATIONS

Institute for Tribal Environmental Professionals Releases Video Highlighting Climate Change Impacts on Tribes in the Pacific Northwest

The Institute for Tribal Environmental Professionals (ITEP) recently produced a video, "Adapting to Change," that highlights climate change impacts on tribes and their resources in the Pacific Northwest and Alaska, as well as their adaptation efforts. The video also includes information from ITEP's Climate Change Adaptation training. Click here to view the video.

Washington Sea Grant Develops Community-based Sea Level-Rise Projections

Washington Sea Grant partnered with the Jamestown S'Klallam Tribe and Adaptation International to develop a set of local sea level rise projections, and sea level scenario maps for the Jamestown S'Klallam community. The assessments are being used to identify priority adaptation actions, tribal areas or resources that are particularly vulnerable to sea level rise, and have also been integrated into community long-term planning. Additionally, Washington Sea Grant is partnering with North Olympic Peninsula Resource Conservation District and Adaptation International on a multi-sector climate change vulnerability assessment and adaptation plan, including sea level rise and coastal flooding projections for coastal communities in Clallam and Jefferson Counties.

NOAA Turning the High Beams on Ocean Acidification

NOAA is providing a grant of $1.4 million over three years to help shellfish growers and scientific experts work together to expand ocean acidification (OA) monitoring in waters that are particularly important to Pacific coast communities, such as in oyster hatcheries and coastal waters where young oysters are grown. Part of this grant will be used to increase the number of shellfish growers and hatchery owners that have the capability to detect ocean changes. This will be achieved by training individuals how to monitor OA and

encouraging them to work together in communities of practice, developing more accurate and affordable sensors to measure these changes, and making the data from these sensors readily accessible: http://www.nwfsc.noaa.gov/news/features/ocean_acidification/index.cfm

Alaska Sea Grant: Documenting traditional knowledge from Alaska Native hunters
Alaska Natives are witnessing climate changing the ecology around their communities. Three communities in the Southwestern part of the state are partnering with Alaska Sea Grant researchers to share their traditional hunting knowledge in an effort to conserve their marine environment. Click here for more.

LEARNING OPPORTUNITIES

March 10th, 11:00-12:00 Pacific, *Webinar: "*Developing Future Sea Level Rise and Storm Surge Scenarios",
U.S. DOT Federal Highway Administration Webinar Series - Building a Climate Resilient Transportation System . Click here to register.

March 10th, 12:00 pm, *Webinar:* Bull Trout Climate Vulnerability
This **project**, supported by the Northwest Climate Science Center, seeks to elaborate how climate-related threats influence bull trout across five western states (OR, WA, ID, MT, NV) that form the southern margin of the species' range. Join this webinar to learn more about this project and the team's findings. To Register, please click here.

- **March 10-11th, Tribal Leaders Summit on Climate Change, Doubletree Lloyd's Center, Portland, OR.**
- Purpose of the summit is to convene Tribal Leaders to discuss Climate Change Impacts, Share Tribal Strategies, Plans, Policy on Climate Change, Energy, and Carbon Emissions, identify Tribal Needs and Funding Opportunities and Discuss the opportunity to develop a NW Tribal Action Plan on Climate Change Register Online Now.

March 12th, 8:00 am, Pacific, *Webinar*: Researchers will present updates on the **development of tools used to project the impact of climate change on deer and waterfowl populations. Learn More here**

March 18th, 11:00-12:00 Pacific, *Webinar:* "The Buzz on Blue Carbon: An Introduction to Coastal Blue Carbon Concepts and Opportunities"
Organizer: Restore America's Estuaries. Click here for more.

March 19th, *Webinar,* 11:00-12:00 Pacific, "Vulnerability and Adaptation Strategies of Pteropods in the California current ecosystem",
presented by: Dr. Nina Bednarsek, NOAA Pacific Marine Environmental Laboratory.
The ocean uptake of anthropogenic CO2 has shoaled the aragonite saturation horizon in the California Current Ecosystem, but only a few studies to date have demonstrated widespread biological impacts of ocean acidification under present-day conditions. Pteropods are especially important for their role in carbon flux and energy transfer in pelagic ecosystems. In the California Current Ecosystem, conditions are becoming increasing unfavorable for sustaining pteropod population. Preliminary results of calcification and survival abilities in pteropods demonstrate that coastal pteropod population is already under increased effect of ocean acidification. To register click on this link: **http://nctc.adobeconnect.com/e38bhffptvd/event/event_info.html**

March 25th, 10:00-11:30 Pacific, *Webinar,* Enhancing the Climate Resilience of America's Natural Resources"

In October 2014, the Obama Administration released its Priority Agenda for Enhancing the Climate Resilience of America's Natural Resources, which provides high level policy guidance that will shape the priorities and actions of Federal agencies responsible for natural resources management. The webcast will provide an overview of the key actions and priorities identified in the President's Priority Agenda, offer examples of how these priorities are being addressed by Federal agencies. Fact **Sheet:** http://www.whitehouse.gov/administration/eop/ceq/Press_Releases/October_8_2014
Click here to register: http://nctc.adobeconnect.com/safeguarding03252015/event/event_info.html.

May 12-15, *Conference*, St. Louis, MO. 2nd National Adaptation Forum

RESOURCES

Sea Level Rise and Coastal Flooding Impacts

Part of the NOAA Digital Coast, the Gulf Sea Level Rise and Coastal Flooding Impacts tool is composed of data from coastal managers and scientists that provides a preliminary look at sea level rise and coastal flooding impacts in the United States. See more maps and data products on Climate.gov.

CLIMATE SCIENCE NEWS

Effects of Climate Oscillations on Wind Resource Variability

Researchers recently published a paper in Geophysical Research Letters evaluating natural climate variations in U.S. wind resource. Using cyclostationary empirical orthogonal functions (CSEOFs) researchers assessed the variability of the wind resource on annual and interannual time scales at all locations across the U.S. This study evaluated impacts on wind resource variability from the modulated annual cycle (MAC) and the El Nino-Southern Oscillation (ENSO), and revealed variation in the wind speed of up to 30% at individual sites. The results presented in this study have important implication for predictions of wind plan power output and siting.

Extreme Weather Events are Expected to Double

The El Niño/Southern Oscillation is the planet's strongest source of interannual climate variability, alternating irregularly between El Niño and La Niña. The 1998–1999 extreme La Niña event that followed the 1997–1998 extreme El Niño event switched extreme El Niño-induced severe droughts to devastating floods in western Pacific countries, and vice versa in the southwestern United States. During La Niña events temperatures drop in the central Pacific Ocean. Research led by Wenju Cai suggests that La Niña events will become twice as frequent, occurring once every 13 years instead of once every 23 years. 75% of this increase will occur in years following extreme El Niño events, leading to more frequent swings between opposite climatic extremes.

Can we trust climate models?

Excerpt from the abstract: "What are the predictions of climate models, should we believe them, and are they falsifiable? Probably the most iconic and influential result arising from climate models is the prediction that, dependent on the rate of increase of CO2 emissions, global and annual mean temperature will rise by around 2–4°C over the 21st century. We argue that this result is indeed credible, as are the supplementary predictions that the land will on average warm by around 50% more than the oceans, high latitudes more

than the tropics, and that the hydrological cycle will generally intensify. Beyond these and similar broad statements, however, we presently find little evidence of trustworthy predictions at fine spatial scale and annual to decadal timescale from climate models. Hargreaves, J. C. and Annan, J. D. (2014), Can we trust climate models?. WIREs Clim Change, 5: 435–440. doi: 10.1002/wcc.288

OWSC March Newsletter Available

The March edition of the Office of the Washington State Climatologist newsletter is now available here: http://www.climate.washington.edu/newsletter/) and attached to this email. Topics include: - February climate summary, Temperature and precipitation outlook, March snow climatology, Snowpack and drought update

National Academies release two reports on climate intervention

Climate intervention, also known as "geoengineering," refers to deliberate, large-scale manipulation of Earth's climate intended to counteract human-caused climate change. The National Academies Press has released two reports that assess the potential impacts, benefits, and costs of two different proposed classes of climate intervention: carbon dioxide removal and reflecting sunlight. Neither of these types of interventions should take priority over mitigation and adaptation, the reports stress.

Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration»
Climate Intervention: Reflecting Sunlight to Cool Earth »

NOAA Research report -- Rivers in the Sky

Yes, there are rivers in the sky! Atmospheric rivers, to be exact, are narrow bands of moisture that occasionally form above the Pacific Ocean and flow towards North America's west coast, drenching it in rain and packing it with snow.

Read the NOAA Research Feature »
Watch a NOAA animation on Atmospheric Rivers »

Satellite images reveal ocean acidification from space

From Science Daily

Pioneering techniques that use satellites to monitor ocean acidification are set to revolutionise the way that marine biologists and climate scientists study the ocean. This new approach, published in the journal *Environmental Science and Technology*, offers remote monitoring of large swathes of inaccessible ocean from satellites that orbit the Earth some 700 km above our heads. The new techniques use satellite mounted thermal cameras to measure ocean temperature while microwave sensors measure the salinity.

SPECIES AND HABITATS

Between now and 2050, forests are one of our "most promising" geo-engineering tools

From Robinson Meyer in the Atlantic

in a new report, Oxford University researchers say that our best hopes to adapt to climate change might be two things we already know how to do: plant trees and improve the soil. Both techniques, said the report, are “no regrets.” They’ll help the atmosphere no matter what, they’re comparatively low-cost, and they carry little additional risk. Specifically, the two techniques it recommends are *afforestation*—planting trees where there were none before—and *biochar*—improving the soil by burying a layer of dense charcoal.

Sardines move north due to ocean warming

From Science Daily

Sardines, anchovies and mackerels play a crucial role in marine ecosystems, as well as having a high commercial value. However, the warming of waters makes them vanish from their usual seas and migrate north, as confirmed by a pioneering study analysing 57,000 fish censuses from 40 years. The continued increase in water temperature has altered the structure and functioning of marine ecosystems across the world. The effect has been greater in the North Atlantic, with increases of up to 1.3 ºC in the average temperature over the last 30 years. This variation directly affects the frequency and biogeography of a group of pelagic fish, which includes the sardine (Sardina pilchardus), anchovy (Engraulis encrasicolus), horse mackerel (Trachurus trachurus) and mackerel (Scomber scombrus), among others, which feed off phytoplankton and zooplankton and that are the staple diet of large predators such as cetaceans, large fish and marine birds. The new study, published in *Global Change Biology* and that has developed statistical models for the North Sea area, confirms the great importance of sea temperatures.
Ignasi Montero-Serra, Martin Edwards, Martin J. Genner. Warming shelf seas drive the subtropicalization of European pelagic fish communities. *Global Change Biology*, 2015; 21 (1): 144 DOI: 10.1111/gcb.12747

In a warmer world, ticks that spread disease are arriving earlier, expanding their ranges
From Science Daily
In the northeastern United States, warmer spring temperatures are leading to shifts in the emergence of the blacklegged ticks that carry Lyme disease and other tick-borne pathogens. At the same time, milder weather is allowing ticks to spread into new geographic regions.

Climate Change Accelerates Hybridization Between Native and Invasive Species of Trout
From the NW Climate Science Center. This study combines long-term genetic monitoring data with high-resolution climate and stream temperature predictions to evaluate how recent climate warming has influenced the spatio-temporal spread of hybridization between threatened native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) and non-native rainbow trout (*Oncorhynchus mykiss*), the world's most widely introduced invasive fish. Despite widespread release of millions of rainbow trout over the past century within the Flathead River system[5], a large relatively pristine watershed in western North America, historical samples revealed that hybridization was prevalent only in one (source) population. During a subsequent 30-year period of accelerated warming, hybridization spread rapidly and was strongly linked to interactions between climatic drivers—precipitation and temperature—and distance to the source population. Specifically, decreases in spring precipitation and increases in summer stream temperature probably promoted upstream expansion of hybridization throughout the system. **Read the articles here and here**. More information about impacts and prevention of invasive species and hybridization can be found on the USGS Northern Rocky Mountain Science Center website or by contacting Clint Muhlfeld at cmuhlfeld@usgs.gov

Warm ocean temperatures may mean major coral bleaching
NOAA scientists are warning that warm ocean temperatures in the tropical Pacific and Indian Oceans could set the stage for major coral bleaching events across the globe in 2015. Their warnings follow severe bleaching in 2014, and come with the release of the most recent outlook from NOAA's Coral Reef Watch, a weekly product that forecasts the potential for coral bleaching up to four months in the future.
Read the NOAA news release »
Visit NOAA's Coral Reef Watch »

POLICY AND MANAGEMENT - MITIGATION AND ADAPTATION

Noted climate-change skeptic linked to corporate money

From the New York Times: Documents show Wei-Hock Soon, a scientist who attributes global warming largely to variations in the sun's energy, has accepted more than $1.2 million from the fossil-fuel industry but failed to disclose that in most of his scientific papers.

A 50th anniversary few remember: LBJ's warning on carbon dioxide

By Marianne Lavelle, The Daily Climate Feb. 2, 2015

It is a key moment in climate change history that few remember: This week marks the 50th anniversary of the first presidential mention of the environmental risk of carbon dioxide pollution from fossil fuels. President Lyndon Baines Johnson, in a February 8, 1965 special message to Congress warned about build-up of the invisible air pollutant that scientists recognize today as the primary contributor to global warming. "Air pollution is no longer confined to isolated places," said Johnson less than three weeks after his 1965 inauguration. "This generation has altered the composition of the atmosphere on a global scale through radioactive materials and a steady increase in carbon dioxide from the burning of fossil fuels."

Georgetown Climate Center Announces "The Great American Adaptation Road Trip"

The two authors visited more than 30 communities across the United States that are responding to climate change impacts and preparing for more to come. The report highlights six cases from ongoing climate resilience, mitigation, and adaptation work. Communities across the country are learning lessons about preparing for climate change. This report explains why these communities have been successful in implementing their projects and describes what is needed to prompt climate change preparation in more places across the country.