

CLIMATE CHANGE & MANAGEMENT OF RIVER, RIPARIAN, AND WETLAND HABITATS IN WYOMING

Summary from Wyoming Game and Fish Department
Climate Change Workshop - April 28-30, 2020



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Executive Summary

In April 2020, the Wyoming Game and Fish Department (WGFD) held a workshop where WGFD managers could learn about the latest science on recent and future climate changes, and discuss the consequences of those changes for aquatic and terrestrial habitat management in the State. Focused on river, riparian, and wetland ecosystems, the workshop was designed to help managers consider the ways in which those habitats might be impacted by a changing climate, which types of watersheds and Wildlife Management Areas might be most vulnerable to climate change, and what management actions would be important to helping fish, wildlife, and plants cope with those impacts. Ultimately, results from the workshop were intended to inform and be incorporated into the 2020 revision of the Wyoming Statewide Habitat Plan.

The **workshop goals** were to:

- Learn about the best-available climate change projections and research on impacts to river, riparian, and wetland habitats in Wyoming;
- Explore the consequences of climate change for the WGFD Statewide Habitat Plan actions and priorities;
- Identify climate-informed habitat protection and restoration actions that could be taken in specific Wildlife Habitat Management Areas or watersheds; and
- Develop a list of data, information, and analyses that would be useful for making climate-informed habitat management decisions in the near- and longer-term.

Although climate change presents challenges to meeting management goals across all habitat types in Wyoming, this workshop was focused on river, riparian, and associated wetland habitats. Narrowing the focus this way allowed for greater specificity in workshop discussions while ensuring relevance to both the aquatic and terrestrial habitat components of the Statewide Habitat Plan. Several workshop breakout sessions focused on one of four focal geographies across the state: the Bear River watershed in southwest WY, the Horse Creek watershed in southeast WY, the Spence and Moriarty Wildlife Management Area (WMA) in central WY, and the Yellowtail Wildlife Habitat Management Area (WHMA) in north-central WY. These watersheds and management areas were selected to represent a diversity of ecosystems and to intersect several common management issues.

The interactive portion of the workshop included breakout discussions on:

- Climate change impacts of concern facing river, riparian, and wetland habitats,
- Factors that influence the relative climate change vulnerability of watersheds and wildlife management areas (WHMAs/WMAs) across the state,
- What's different about "climate-informed" habitat management for river, riparian, and wetland ecosystems,
- Priority climate-informed strategies for inclusion in the 2020 revision of the Statewide Habitat Plan, and
- Climate-related research and information needs.

Climate Change Impacts of Concern

Climate projections vary somewhat across the four focal geographies, but all climate models that were examined for this workshop agree that Wyoming will be significantly hotter by 2040-2069 relative to the baseline period of 1971-2000. Warming is projected to occur across all seasons, with annual increases ranging from approximately +3°F to +8°F, depending on the climate model and assumptions about future greenhouse gas emissions. Associated with that warming will be an increase in the number of extremely hot days with heat index > 90°F, a longer growing season, and more growing degree days. Precipitation projections are more complicated and therefore less certain. However, a majority of climate models project that annual, winter, and spring precipitation will increase. Some climate models project decreases in summertime precipitation, although model agreement is medium-to-low and varies across the four focal geographies. Future projections for snow water equivalent (SWE) on April 1st vary across the four geographies, with Yellowtail WHMA and Bear River watersheds likely to see declines, Spence Moriarty WMA likely to see increases, and greater uncertainty for the Horse Creek watershed. Evapotranspiration is likely to increase at all locations in the spring and summer, with the exception of the Horse Creek watershed which may see declines in evapotranspiration in summer. Soil moisture is notably difficult to predict using climate models, but the models considered tend to suggest that soil moisture will increase in the spring and decrease in summer and fall. Other climate changes of note include high confidence that there will be increases in the intensity of precipitation events, springtime flooding, and future droughts; and rise in the elevation of mountain snowlines.

After reviewing the future climate projections, workshop participants identified more than 70 climate change impacts of concern related to the following aspects of river, riparian, and wetland ecosystems:

- Surface and groundwater availability (including quantity, quality, temperature, and timing),

- Physical stream conditions (including sedimentation and erosion),
- Aquatic habitat and species (including invasive aquatic species),
- Upland habitat and species (including invasive terrestrial species),
- Wetlands,
- Human water use (including irrigation).

With respect to hydrology, a common thread across the breakout groups surrounded the management implications of having to deal with both higher high flows and lower low flows, or greater fluctuations in stream flows across seasons and years. These hydrological changes could then lead to increasing rates of channel adjustments and erosion, which may render historical reference conditions less relevant when designing stream restoration projects. Biological impacts of concern to aquatic and terrestrial habitats include declines in some key habitats (e.g., for cold water fish such as cutthroat trout), shifts in species distributions (e.g., warmer-water fish moving upstream, and vegetation communities shifting upslope), and increases in the presence and abundance of invasive species. There was also a recognition that in addition to worrying about the direct effects of climate change on fish and wildlife and their habitats, it is also important to consider the “wild card” of how humans are responding to climate change. For example, climate changes will likely alter the timing and amount of water needed for irrigation, which could further limit water availability for fish, wildlife and plants.

Climate Change Vulnerabilities of Watersheds and Management Areas

Climate change vulnerability is defined as a function of a species’ or area’s exposure to changes in climate conditions (EXPOSURE), the sensitivity to those changes (SENSITIVITY), and the ability to cope with or respond to those changes (ADAPTIVE CAPACITY). An assessment of the relative vulnerability of watersheds or wildlife habitat management areas to the impacts of a changing climate can help target habitat protection and restoration efforts. Workshop participants identified a wide range of factors that might make a watershed or wildlife habitat management area relatively more or less vulnerable to the impacts of a changing climate on river, riparian, and wetland ecosystems, including:

Factors	Examples
Rate and magnitude of projected changes in climate	amount of warming, changes in precipitation, changes in snow water equivalent (SWE), timing of water availability, frequency of drought, elevational shifts in the snowline.
Physical conditions	geology, elevation, aspect, soils, size and shape of watersheds, amount of watershed above or below future snowline, topographic and geological diversity, presence of microclimates, stream basin connectivity (longitudinal, vertical, lateral, and temporal), presence or absence of barriers to movement
Ecological conditions	divergence from healthy condition, presence of invasive species, amount of vegetation cover, presence or absence of beaver activity, genetic diversity, presence of refugia
Hydrological conditions	amount of reservoir shoreline that could be exposed to lake level fluctuations, presence of wetlands, level of floodplain connectivity, soil water holding capacity, % of streams that are perennial/intermittent/ephemeral, whether the watershed is glacier-, snow-, or rain-fed
Water management	ability to manage water resources (via irrigation, reservoir operations), availability of water rights for instream use
Changes in disturbances	changes in pest outbreaks or wildfire regimes
Distribution and abundance of sensitive species	specialist species, species at the edge of their range, high vs. low species diversity
Land ownership	private versus public lands and the ability to do larger scale restoration efforts
Support and resources	funding and public support

What’s Different About Climate-Informed Management

Building off of discussions about climate change impacts and vulnerabilities, workshop participants tackled the question: *“What, if anything, might we need to do differently about our work to be effective in light of expected climate changes and impacts?”*

Breakout groups discussed how several core management strategies that are common to WGFD’s work -- riparian habitat protection and restoration, stream restoration, fish passage and stream connectivity, and water management -- might need to be modified in order to be

effective in a changing climate, and identified strategies that may not necessarily need to be different, but which were flagged as being particularly important or urgent to address climate change impacts.

Climate-Informed Modifications to Current Practices:	Strategies and Actions With Increased Priority and/or Urgency:
<ul style="list-style-type: none"> • Design projects under the assumption of increasing likelihood of higher high flows, lower low flows, and more frequent extreme flood events, rather than historic or current hydrological conditions. • Use plant species or genetic stock that is more likely to thrive under future climate conditions in restoration projects. • Craft restoration and connectivity projects with future species' ranges and habitat conditions in mind. • Take climate change into account when prioritizing projects and articulating project goals. • Increase flexibility around water management and habitat restoration to address new problems that will need new solutions. 	<ul style="list-style-type: none"> • Increased importance of retaining and conserving water. • Increased importance of securing and managing water rights. • Increased importance of riparian restoration and protection. • Greater urgency for landscape-scale conservation and management.

Priority Climate-Informed Actions for the Statewide Habitat Plan

Workshop participants identified over 75 habitat management actions that could help to address climate change impacts on river, riparian, and wetland habitats in Wyoming. There was a great deal of emphasis on actions relating to water availability and use. Nearly 20% of the identified actions related to water rights, water storage, water management, and irrigation. Strategies that the identified habitat management actions support include:

- Managing land and water use with an eye towards future conditions.
- Building watershed health and resilience to a changing climate.
- Maintaining species diversity and habitat needs in a changing climate.
- Making climate-informed decisions about angling, trapping, and setting goals for habitat management areas.
- Prioritizing habitat management efforts using a climate change lens.
- Establishing and implementing monitoring methods and protocols that can help to anticipate changes and set climate-informed priorities.

Information and Research Gaps

The final session of the workshop was dedicated to gathering participants' input on: ***What does the Agency need to know in order to make better climate-informed decisions in the next 5 years?***

In response, participants identified a large number of research questions, data products, and inventories that could help support climate-informed management decisions for river, riparian and wetland habitats. Workshop organizers combined similar topics from this discussion into a refined list of 44 information needs related to several themes, including: riparian and wetland ecosystems; aquatic habitat and fisheries; beaver and other process-based restoration approaches; assessments of climate change vulnerability, refugia, and prioritization/planning; invasive species; fish passage and stream connectivity; hydrology and water balance; stream restoration; water management; and baseline data and monitoring.

Following the workshop, we asked WGFD staff how useful each of the identified information needs would be to their ability to consider climate change effects on their work on river, riparian, and wetland habitats. Eight (8) of the information needs identified during the workshop were rated as being "Useful" or "Very Useful" by over 60% of survey respondents. These include efforts to identify important places for habitat management actions, such as streams that may become more (or less) suitable for particular fish species under a changing climate, or areas of "climate refugia" for imperiled species. They also include research designed to support our understanding of the effects of particular climate-informed management actions, such as the influence of process-based restoration approaches on water availability for downstream users, or how upland habitat treatments affect watershed hydrology under more intense precipitation events, or what are the tradeoffs and benefits of different water management approaches in a changing climate (e.g., flood vs. pivot irrigation, or managing water for instream vs. out-of-stream habitats). Lastly, they include information needs related to invasive species, such as which invasive species might be expected to increase or arrive in Wyoming as the climate changes, and what are the best management strategies for disadvantaging invasive plant and fish species.

Next Steps

The April 2020 Climate Change Workshop represented a valuable step in advancing WGFD staff's consideration of climate change in their habitat management work. Next steps to apply and build on the discussions at the workshop include:

- Incorporating climate-informed habitat management strategies into the 2020 Statewide Habitat Plan revision.
- Sharing this report within WGFD via a dedicated webpage, and formal and informal presentations.
- Presenting a summary of workshop discussions and products to the Wyoming Game and Fish Commission.
- Considering organizing similar climate change discussions within WGFD focused on additional regions, ecosystem types, or WGFD programs.
- Exploring research partnerships to focus on some of the high priority information needs identified by WGFD staff.
- Sharing methods and results from this project with other natural resource managers interested in making climate-informed management decisions.

