MEETING SUMMARY

Columbia Basin Regional Advisory Committee Webinar

Climate Change Projections for the Columbia Basin

April 21, 2021 12pm – 2:00pm Pacific Time/1pm - 3:00pm MT via Zoom

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The Columbia Basin Regional Advisory Committee met on April 21, 2021 for a webinar on climate change impacts on Columbia River ecosystems. The presentations described historical and future climate changes in the Columbia Basin, anticipated watershed and landscape effects, and impacts to fish and aquatic communities in the reservoirs and river segments managed under the Columbia River Treaty (CRT). How this information is being considered as part of the Indigenous-led CRT ecosystem function studies was also described. These notes provide the key points from the presentations.

View the presentations on the B.C. CRT website here.

Welcome

Brooke McMurchy, B.C. Columbia River Treaty Team

Brooke McMurchy welcomed attendees and began the webinar with an acknowledgement of the traditional Indigenous territories that all participants, spread throughout the Canadian Columbia Basin and Victoria, were joining the webinar from.

Brooke then provided the following updates on CBRAC activities:

- The CBRAC Steering Committee is looking at dates for CBRAC sessions over the summer. The dates will be confirmed after the Steering Committee has had a chance to review.
- Topics being considered for upcoming meetings include: BC Hydro operations update, review of the revised CBRAC Terms of Reference, update on socio-economic performance measures development and BC Hydro Integrated Resource Plan follow-up session.

Columbia River Treaty Ecosystem Function Climate Change Study Introduction

Cindy Pearce, Ecosystem Function Climate Change Study Lead

View the Columbia River Treaty Ecosystem Function Climate Change Introduction presentation.

- Indigenous Nations and Basin residents have concerns about climate change effects on ecosystems that are impacted by the reservoirs and regulation of flows in the Columbia River system. This study provides background information for consideration in all of the CRT ecosystem function studies.

- To explore how ecosystems could be considered and, ideally, enhanced in a modernized Treaty, the CRT Negotiation Advisory Team[1] (NAT) established an Ecosystem Function (EF) Subcommittee, led by the Ktunaxa, Secwepemc and *Syilx* Okanagan Nations, and including representatives from Environment and Climate Change Canada, B.C. Ministry of Forests Lands, Natural Resource Operations and Rural Development, and the Upper Columbia Basin Environmental Collaborative. The EF Subcommittee's work involves developing goals and objectives for enhancing ecosystems impacted by the operations of dams and reservoirs to meet the CRT, and ways to measure whether these goals and objectives are met through computer modelling. It focuses on four broad ecological themes: ecosystem productivity, floodplain/riparian/wetlands, aquatic ecosystems, and anadromous (ocean-going) fish species, including salmon.
- The group is currently conducting a number of studies to supplement the existing ecosystem data that will inform their work and the CRT negotiations. One of these studies is focused on climate change. The purpose of this climate change study is to enable the EF Subcommittee and study teams to incorporate climate change information into all their work.
- This study doesn't result in a report, but instead, provides a collection of information and supports for the EF study teams. The climate change study team brings together experts in the areas of regional climate change, hydrology, land-based ecology, aquatic ecology, and fish ecology. Their work so far includes:
    - Developing an annotated compilation of key references.
    - Sharing information with the EF study teams via two in-depth webinars.
    - Providing guidance to the EF study teams on how to consider climate change in the work they are already doing.
    - Standing by to support the EF study teams on request.
    - Reviewing draft reports to make sure climate change is appropriately integrated.
    - Preparing a short climate change summary for a background section that will be included in all the study reports.
- The NAT has customized a computerized water management model to evaluate alternative dam and reservoir operations for the Columbia River. A special set of water inflow forecasts that incorporate climate change projections are being developed so that future climate change can be factored in when alternative dam and reservoir operations scenarios are evaluated.

[1] The Negotiation Advisory Team includes representatives from Canada, B.C. and the Ktunaxa, Secwepemc and *Syilx* Okanagan Nations and provides advice and information to Canada's negotiating team.

Regional Climate Change and Hydrology Impacts

Markus Schnorbus, Lead Hydrologic Impacts, Pacific Climate Impacts Consortium, University of Victoria

View the Regional Climate Change and Hydrology Impacts presentation.

The Pacific Climate Impacts Consortium (PCIC) produces climate change projections of the future, and for this work, resulting changes in hydrologic conditions. PCIC's modeling covers the entire Columbia Basin, though the results presented today focus on the Canadian portion of the Basin.

Emission Scenarios

- To conduct climate change studies, trajectories of emissions into the future are needed.
- Future emissions depend on a number of factors that are impossible to predict - for example: societal structure; economic structure; decisions that are made politically and economically; and, the technological trajectory of society.
- Thus, a number of scenarios or storylines are developed based on assumptions about population growth, GDP, and how future society will evolve economically, technological and sociologically, each with a different emissions trajectory.
- Four global emissions scenarios have been created by the Intergovernmental Panel on Climate Change (IPCC). They are named as 'representative concentration pathways' (RCP) of carbon dioxide concentrations in the atmosphere, with higher numbers representing larger loads of carbon dioxide concentrations, greater global temperature increases and more severe climate changes.
- The scenarios are named: RCP2.6, RCP4.5, RCP 6.0 and RCP 8.5.

Projected Basin Climate Changes

- Temperatures are expected to get warmer overall, for all seasons, and especially in the summer.
- The Basin is predicted to have less precipitation in the summer, and more in the winter and fall, with greater total precipitation annually.
- With warmer temperatures, there will be less snow and more rain. The snow line is already moving to a higher elevation and the amount of snow that accumulates is shrinking.
- Consequently, snow cover, glaciers, and eventually glacier melt are anticipated to decrease. Reduced snow cover is greatest in the U.S. portions of the Basin and the southern watersheds in B.C.

Projected Basin Hydrology Changes

- The total annual Basin runoff isn't expected to change, but spring freshet flows are anticipated earlier, and at higher levels, with longer, lower summer flows and increased flows in the fall and winter due to less snow and more rain.

Related Watershed and Landscape Changes

Greg Utzig, Kutenai Nature Investigations

View the Related Watershed and Landscape Changes presentation.

Greg Utzig presented on potential climate induced changes to the ecosystems in the Basin that will ultimately impact Columbia reservoir and riverine ecosystems.

Ecosystem shifts

- This work is based on three climate change projections for the Basin that span from warm/moist to hot/wet and hot/dry future conditions for several regions of the Basin. Future ecosystem types are then predicted based on the projected climate changes – in some cases future climate is predicted to support ecosystems currently found as far away as the B. C. coast and the U.S. Rocky Mountains.
- With the warm/moist projections, ecosystems are expected to shift a lot including an increase in grass/sage lands at lower elevations and a decrease in alpine habitats as forested ecosystems migrate upslope.
- With the hot/wet projections, a similar pattern is observed, with the addition of a coastal transition forest type in the mountains.
- With the hot/dry projections, more drastic changes are predicted to occur, with grassland ecosystems dominating the lower elevations throughout the region, and cedar/hemlock inhabiting high elevations.
- The ecosystems that develop will depend on the response of each species as the climate changes. For example, projections indicate expansion of Ponderosa pine over time.
- Future projections indicate only Glacier National Park will be consistently cool/wet and able to support ecosystems adapted to these conditions.
- Climate changes will also shift insect and disease dynamics within ecosystems which will impact the species composition.

Wildfire and climatic extremes

- Future temperature increases and reduced summer precipitation were incorporated in an analysis of wildfire seasons, with results predicting an average of four times the historical area burned in the 2020s and an increase of up to 100 fold in the 2080s.
- Several examples were provided of the streamflow impacts of climactic extremes, including high intensity rain, rain on snow and high rainfall following wildfires, that resulted in high stream flows, debris flows, property damage and loss of life. These events are expected to increase in the future.
- An example of the climate change impacts on a wetland was reviewed, illustrating potential impacts on reservoir wetlands including substantially increased evaporation.

Climate Change Impacts on Water Quality and Aquatic Communities

Janice Brahney, Utah State University

View the Impacts on Water Quality and Aquatic Communities presentation.

Janice Brahney presented on the impacts to water quality and aquatic communities from the effects of climate change, covering three emerging sources of consequences of climate change: habitat changes/reorganization, wildfire and glacier loss.

Habitat change/reorganization and Wildfire

- Transition to drier ecosystems might not be smooth due to rapid changes from wildfires, which is occurring more frequently and in unexpected locations. Wildfires cause direct and indirect impacts on water quality via changes to the landscape, water composition and soil.
- Fire influences how water moves through the soil, often resulting in increased sediment in streamflows, and this is anticipated to be a long-term change.
- After the 2003 wildfire at Okanagan Mountain Park, an experiment was conducted on the land affected by the fire, with the following results:
    - The amount of streamflow increased substantially with higher flows earlier in the season.
    - After the fire, increased sediment was brought into the streams and nutrients were more easily moved into the water flows.
    - Vegetation was removed from the landscape, resulting in less shade in riparian zones. This has an impact on fish as the increased water temperature makes their habitat less suitable.
    - Carbon is lost to the atmosphere during a fire and is depleted in streamflows following fires.
    - Elevated nutrients remained throughout the 5 year study, especially at lower elevations.

Glacier Loss

- The ongoing melting and retreat of glaciers means that the amount of streamflow is decreasing rapidly in some Basin streams.
- Glacier water is cold and has both turbidity and nutrients. The retreat of glaciers leads to warmer waters with lower turbidity and nutrients. This is shown by studies of transitional systems, where glaciers are melting. A pattern of higher nutrient content in glacier-fed lakes and streams was found in these systems.
- Glacier melt has a 3-degree suppression effect on stream temperatures, keeping streams cooler, which impacts the habitat suitability for fish, especially for cold water dependent species, including salmon.
- We are already seeing the effects of climate change in shifts in aquatic communities, including an increase of Didymo (rock snot), an undesirable aquatic species. A study showed that:

- Didymo blooms were more likely at higher stream temperatures, with more light penetration.
- In glacier-fed rivers, cold, sediment-laden glacier meltwaters suppress the amount of Didymo produced.
- Earlier glacier and snow melt dates results in a change in the timing of available nutrients and light levels that favours Didymo.
- No impacts were seen on fish, but larvae shifted to a smaller size. There could also be significant impacts on organisms that can't move around

Fish and Fisheries Impacts

Howard Stiff, Aquatic Biologist/Statistician, Department of Fisheries and Oceans

View the Fish and Fisheries Impacts presentation.

Howard thanked his fellow presenters and provided The Columbia Basin Climate Source website as a resource for anyone who had not had the opportunity to access it yet. The website is an interactive tool where site visitors can view climate projections specific to the Columbia Basin, read climate data, and find resources on how to support climate action.

Howard then provided a presentation on fish and fisheries impacts in the Columbia Basin. Climate changes challenge the capacity for fish to survive through:

Increasing water temperatures

- Water temperatures are the main drivers for fish behaviours, physiology, and ecology.
- The optimal water temperature for salmonids is 15°C; salmonids are stressed at higher than 17°C and 25°C is lethal. Other cold water fish species, such as bull trout, have similar temperature tolerances.
- As temperature goes up, migration can be impacted and habitat becomes fragmented and reduced for cold water species.
- Temperature affects the chemistry of lakes and can lead to what is called the 'temperature oxygen squeeze' where conditions become unsuitable for fish.

Lifecycle impacts

- The Okanagan is a spring melt dominated system. Water temperatures in the lower Okanagan can reach 22 degrees in the summer. Fish lifecycle impacts in warm years and with changing streamflows include:
    - Tributary access: thermal or hydrologic (low flow) barriers.
    - Spawn timing impacts: peak spawn timing is happening an average of nine days later.
    - Egg hatching period impacts: delayed timing by two weeks.
    - Fry rearing: High flush rates result in low salmon survival because river flows control the amount of phytoplankton, which are a food source for fish.
    - Smolt (young fish) migration to the sea: Shifting earlier by 1-2 weeks; the faster growth rate of smolts should improve marine survival rates.

Extreme flows/flood events

- Higher and earlier spring freshets, including extreme flows impact life-stage events. We are experiencing and expecting more spring flood events which impact fish.
- Erosion and sediment from flood events can block tributary access to spawning sites.

Conclusions

- Going forward, maintaining the sustainability of fish populations is going to be challenging.
- We have been working on restoring salmon in the Basin with limited success; climate change will complicate these efforts.
- With regards to Upper Columbia salmon reintroduction planning, a lot is going into deciding what conditions work best for salmon in the Upper Columbia. We are going to work together to collaboratively develop what the best approach might be.
- It will also be important to incorporate Indigenous traditional ecological knowledge. In the Upper Columbia Basin, salmon reintroduction is driven by the Ktunaxa, Secwepemc and *Syilx* Okanagan Nations and also involves the Government of Canada and the Province of B.C. The five governments are working together to incorporate Indigenous knowledge.

Cindy Pearce reiterated that the climate change study team is standing by to advise the other ecosystem function study teams as they move forward with their research.

Brooke McMurchy wrapped up the webinar by thanking everyone for their questions and thanking the speakers for taking time to present. She also reminded attendees to save the date for the virtual Bringing the Salmon Home Festival on May 10-16, 2021.