Adaptive management for an international river basin: the future of the Columbia River Treaty

Themes and recommendations from the UC Berkeley workshop 9-11 May 2019

The Columbia River Treaty (CRT) between the U.S and Canada is nearing its 60th anniversary and is currently under renegotiation. The treaty has been recognized globally as a model for international cooperation on hydropower and flood control objectives. However, the treaty has also had detrimental social and environmental implications and faces new uncertainties related to a changing climate. Restoring ecosystem function in the basin as well as improving preparation and resilience to changing climatic and hydrologic conditions are top priorities in modernizing the CRT agreement.

In Spring 2017 UC Berkeley's Canadian Studies Program, Institute of International Studies, and Riverlab hosted a group of policy makers, scientists and indigenous representatives to discuss science needs for a modernized treaty. The group concluded that the "inevitability of a changing climate and hydrology throughout the basin threatens future water security for a range of economic and environmental uses and now demands a more flexible, resilient and adaptable management approach than envisaged by the framers of the original treaty" (*New Science Requirements In Support Of A Modernized Columbia River Treaty*, 2017).

Since the 2017 meeting the US and Canadian treaty entities entered into formal negotiations and both parties have expressed an interest in exploring the development of an adaptive management approach to facilitate ecosystem function and climate and hydrologic resilience in the Columbia Basin (Bankes & Cosens, 2014). In May of 2019 a second workshop was hosted at UC Berkeley bringing together a diverse group of experts to discuss the role of and requirements for a successful adaptive management (AM) approach for the Columbia River Basin.

AM is a cyclical process in which managers "deliberately design and carry out management actions as experiments to learn how the system responds to management and to increase the level of certainty regarding how best to achieve desired results" (Walters, 1997). It was first proposed in the Columbia River Basin by Dr. Kai Lee and others in 1985 for salmon fisheries recovery (Lee, 1999; Lee & Lawrence, 1985). Ambitious and progressive at the time, the framework was used to improve river flows for juvenile outmigration, hatchery operations, and fish transport. However, the use of AEM in the Columbia Basin encountered challenges due to the scale of the Columbia Basin, the intensive monitoring required, and pushback from political forces (Volkman & McConnaha, 1993).

At the 2019 Berkeley workshop the group of over 30 participants, including Lee, policy makers, scientists and indigenous representatives, discussed the tools and considerations required for successful application of AM to the Columbia River Treaty. Over three days the participants presented and discussed principles of adaptive management and successful precedents, and considered issues of legal perspectives, climate change, and power management relevant to revising the 55-year old treaty. The following themes and recommendations arose from the workshop:

Values

- An updated management agreement should start with identifying common guiding principles and values. Effective AM needs to embrace different worldviews and should be integrated with indigenous values and utilize indigenous knowledge. AM by itself does not guarantee ecosystem

function or necessarily protect indigenous culture and traditions. Tribes and First Nations impacted by the original agreement require that a modernized treaty ensures water quality and security, protects and mitigates impacts to first foods, and seriously considers indigenous cultural impacts.

AM precedents and lessons learned

- AM can follow principles of Shared Vision Planning (Werick & Palmer, 2001), which laid the groundwork for implementation of the adaptive mamangment program for management of the Great Lakes-St. Lawrence system by the International Joint Commission. The IJC has embraced adaptive management and has moved it from a concept to a cornerstone in the regulating of transboundary water levels and flows.
- The Great Lakes-St. Lawrence River Adaptive Management program (GLAM) provides a successful large-scale precedent, where predictive models and performance indicators are utilized to assess the potential benefits and impacts of different management actions to diverse stakeholders (Shantz, 2018). Performance indicators and decision criteria are then used to evaluate acceptable plan performance and make recommendations for future management. Stakeholder engagement, effective governance, and the combined use of empirical observation and modeling appear to be crucial factors to successful implementation of AM.
- Robust AM and good science require appropriate governance and special focus should be paid to institutional requirements and a common transboundary framework. Connections with other agencies/organizations and stakeholders is essential and needs to be continually maintained.
- Timely monitoring and evaluation are essential to AM, but funding can be a challenge. Targeted on-going assessment has proven to be the most cost-effective approach in the Great Lakes-St. Lawrence system, but on-going assessments need to be practical. Monitoring plans also have to consider event-based requirements and need to be able to mobilize quickly. Specific and comparable performance measures are key, and the use of “real-time” tools should be used where possible to accelerate monitoring cycles. Periodic evaluations with large temporal gaps have shown to have limited efficacy.
- Innovative approaches such as turn taking can help to achieve multiple desired benefits (Alexander et al., 2018). The existing paradigm tries to optimize all objectives at once over all kinds of water year types. Turn taking optimization dynamically adjusts priorities on different species and objectives and focuses on one year at a time. This approach may be able to achieve a more balanced suite of objectives over the long term.
- Climate change adaptation strategies should be integrated with AM. A changing climate requires ongoing attention and addressing uncertainty and risk related to climate change further requires a structured AM approach.

Ecosystem function and physical process considerations

- The environmental impacts of reservoirs created above CRT dams are massive and AM can be applied for the recovery of terrestrial and wetland ecosystem function within reservoir footprints. AM is particularly relevant for guiding ecosystem management within reservoir drawdown zones because these zones are directly impacted by reservoir water levels set by dam operators. For Arrow Reservoir, possible alternatives for water level management and

associated ecosystem benefits for various mid-elevation scenarios were analyzed to inform an AM plan (Thomson & Utzig 2016).

- Salmon are an invaluable resource in the Columbia basin and an integral part of indigenous life but success in restoring wild salmon populations in the Columbia Basin over the past 50 years has been limited and climate change will likely complicate the task going forward. Discharge and thermal regimes required by salmon in the Columbia River are influenced by climate variation as well as by hydro-system management making the sustainability of existing salmon populations and restoration of threatened or historically extirpated populations a socio-ecological system challenge to current and future management of the Columbia River. Adaptive management may offer a means by which to deal with high levels of uncertainty in managing the Columbia for multiple objectives of flood control, power generation and salmon maintenance/restoration going forward.
- Flow regulation and sediment transport impacts from CRT dams are also changing river channel form in reaches downstream of dams. These changes manifest over long time periods and have implications for fundamental physical and ecological processes of river systems. Mitigating these long-term impacts with a revised treaty, even with the use of adaptive management, will be challenging. (*Miles*)

Governance considerations

- Effective governance for a modernized treaty will require multiple scales of iterative operation. At the largest scale the U.S. and Canadian treaty entities need to be able to transform national interests based on ongoing results and monitoring. At an intermediate scale adaptive governance, basin commission, and restoration activity must be able to iteratively reframe assumptions and strategies within treaty goals. At a smaller scale, operating entities should employ adaptive management to design treaty actions and their implementation based on results and monitoring feedback.

Power supply and economic considerations

- Power supply from CRT dams and downstream U.S. dams will continue to be a critical resource for the Pacific Northwest. However, from a U.S. perspective, the power component of the treaty may be unsustainable as the Canadian Entitlement exceeds power benefits received by the U.S. There is significant economic value in power, carbon reduction, flood risk reduction, and ecosystem function and finding the right balance in these remains a challenge. An economic cost-benefit approach may help to address some CRT externalities.
- AM for ecosystem function will be more challenging than for power supply or flood risk because of much greater uncertainty in ecosystem responses to climate and management operations. The large scale of the Columbia Basin also makes for scientific and political difficulty.

Applying a basin wide perspective

- Dams have cumulative effects on basin processes and strategic dam planning can be used to minimize these impacts and identify optimal dam portfolios. In the Mekong River Basin a portfolio with optimized dam locations and operations was shown to reduce sediment trapping by 20% and provide more power generation than the actual built portfolio (Schmitt et al., 2018). To optimize multiple objectives in a modernized CRT a basin wide dam analysis should be

conducted that objectively assess benefits and impacts of all dams and considers flow, sediment, and fish passage options for each dam and associated river reaches. To identify optimal configurations at a basin wide scale all options need to be put on the table, including dam removal scenarios.

It is our hope that these recommendations and considerations can help to guide implementation of an adaptive management framework for a modernized Columbia River Treaty. Out of this workshop, the group produced a one-page communique, which was sent to both U.S. and Canadian negotiating teams, that recommended the implementation of AM to enable managers to more effectively balance future hydropower, flood protection, ecosystem function, and other needs with the reality of climate change (*Berkeley Group Recommends the Use of Adaptive Management as Part of a Revised Columbia River Treaty*). The group also expressed that there is still substantial work to be done to justify the need and level of investment that would be required to effectively implement adaptive management in the Columbia Basin.

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