TACCIMO
Template for Assessing Climate Change Impacts and Management Options

TACCIMO Literature Report

Literature Report - Annotated Bibliography Format

Report Date: September 03, 2013

Content Selections

Water Resources

Water Quality

R1: Northern

R2 & R4: Mountain West

Water Supply

R1: Northern

How to cite the information containted within this report

Each source found within the TACICMO literature report should be cited individually. APA 6th edition formatted citations are given for each source. The use of TACCIMO may be recognized using the following acknowledgement:

"We acknowledge the Template for Assessing Climate Change Impacts and Management Options (TACCIMO) for its role in making available their database of climate change science. Support of this database is provided by the Eastern Forest Environmental Threat Assessment Center, USDA Forest Service."

Best available scientific information justification

Content in this Literature report is based on peer reviewed literature available and reviewed as of the date of this report. The inclusion of information in TACCIMO is performed following documented methods and criteria designed to ensure scientific credibility. This information reflects a comprehensive literature review process concentrating on focal resources within the geographic areas of interest.

Suggested next steps

TACCIMO provides information to support the initial phase of a more comprehensive and rigorous evaluation of climate change within a broader science assessment and decision support framework. Possible next steps include:

1. Highlighting key sources and excerpts
2. Reviewing primary sources where needed
3. Consulting with local experts
4. Summarizing excerpts within a broader context

More information can be found in the user guide. The section entitled Content Guidance provides a detailed explanation of the purpose, strengths, limitations, and intended applications of the provided information.

Where this document goes

The TACCIMO literature report may be appropriate as an appendix to the main document or may simply be included in the administrative record.

Brief content methods

Content in the Literature Reports is the product of a rigorous literature review process focused on cataloguing sources describing the effects of climate change on natural resources and adaptive management options to use in the face of climate change. Excerpts are selected from the body of the source papers to capture key points, focusing on the results and discussions sections and those results that are most pertinent to land managers and natural resource planners. Both primary effects (e.g., increasing temperatures and changing precipitation patterns) and secondary effects (e.g., impacts of high temperatures on biological communities) are considered. Guidelines and other background information are documented in the user guide. The section entitled Content Production System fully explains methods and criteria for the inclusion of content in TACCIMO.

Resource Area (Factor): Water Resources

Water Quality

R1: Northern

Davis, J. M., Baxter, C. V., Minshall, C. W., Olson, F., Tang, C. & Crosby, B. T. (2013). Climate-induced shift in hydrological regime alters basal resource dynamics in a wilderness river system. Freshwater Biology, 58, 306 – 319. doi:10.1111/fwb.12059

"When VIC [variable infiltration capacity] -generated hydrologic metrics were applied to the regression equation linking AFDM [ash-free dry mass] and hydrology [for tributaries of Big Creek, Idaho], shifts in peak flow timing were predicted to increase summer AFDM relative to the baseline scenario (i.e. +0 °C; Fig. 4a–c). When averaged across years, AFDM was nominally higher (12% ± 6; mean ± SE) in the +1 °C scenario, but 19 of the years had 0% prediction intervals that overlapped baseline predictions (Fig. 4a). In the +2 °C scenario, AFDM was 52% (±20) higher than in the +0 °C baseline scenario. Also, 15% of the years had biomass that exceeded the prediction intervals and were more than twice the baseline levels (Fig. 4b). On average, biofilm AFDM in the +3 °C scenario was 103% (±29) higher than in the baseline +0 °C scenario and outside the prediction intervals for 40% of the years (Fig. 4c). Furthermore, 30% of the years exhibited levels that were more than twice the baseline. "

"Our integration of hydrologic models and long-term ecological data [for tributaries of Big Creek, Idaho] indicates that flow regime shifts expected under changing climate could approximately double biofilm [algae, heterotrophic microbes and detritus embedded in a polysaccharide matrix on aquatic surfaces] AFDM [ash-free dry mass] during the summer in snowmelt-dominated catchments. In particular, earlier peak flows may allow biofilm to initiate growth earlier than is observed under contemporary hydrologic regimes, effectively lengthening the growing season (Fig. 6), as has been observed for terrestrial plants (Cleland et al., 2007). Interannual variability of biofilm AFDM could also be up to three times greater under these scenarios. Biofilm chl-a [chlorophyll a] responded similarly to hydrologic shifts, but it was not different from baseline in many of the years because of overlapping prediction intervals. "

"As hydrology can regulate biofilm biomass (Larned, 2010), others have asserted that hydrologic shifts will affect stream food webs (Meyer et al., 1999; Woodward et al., 2010), but such effects have not been quantified previously. We show [by coupling a biofilm–hydrology relationship (from a 20 year data set of hydrology and biofilm biomass) with VIC-generated hydrographs under several warming scenarios for tributaries of Big Creek, Idaho] that climate induced shifts in hydrologic regimes may change the amount and temporal variability of this basal resource, with probable implications for food webs in snowmelt dominated streams."

"In conclusion, our integration of a 20-year ecological data set [from Big Creek, Idaho] and hydrologic models suggests that biofilm biomass during the summer and interannual variability, as measured by AFDM [ash-free dry mass], would increase with hydrologic shifts expected under changing climate in streams whose hydrology is presently dominated by snowmelt. Average chl-a [chlorophyll a] exhibited similar increases; however, responses substantially overlapped the baseline scenario in most years. The temporal dynamics of biofilm growth and succession may also be affected by predicted shifts of peak flow from late spring to early spring or even winter. Therefore, hydrologic shifts may affect the seasonal dynamics of biofilm quality by altering the relative dominance of living versus senesced organic matter. Because biofilm is an important resource in many streams, such changes in its quantity, quality and associated temporal variability could have considerable implications for sustaining stream productivity under future climate scenarios. Our analysis therefore identified a potentially important pathway by which climate change may alter food webs in snowmelt-dominated streams."

"If earlier peak flows [in tributaries of Big Creek, Idaho] lead to earlier initiation of biofilm accrual, it may affect succession and the timing of peak biofilm quality (Fig. 6). For instance, under warming scenarios, AFDM [ash-free dry mass] was well above baseline in many years when chl-a [chlorophyll a] was not. Thus, hydrologic shifts may increase the relative contribution of detritus and heterotrophic microbes during these summers, potentially reducing biofilm quality. However, the predicted response for average chl-a sometimes exceeded that of AFDM (e.g. 2009), suggesting that summer biofilm quality could increase in other years. This, in combination with the greater interannual variability of AFDM observed in the +2 and +3 °C scenarios, indicates that biofilm quality may become less predictable under future conditions."

R2 & R4: Mountain West

Goode, J. R., Luce, C. H. & Buffington, J. M. (2012). Enhanced sediment delivery in a changing climate in semi-arid mountain basins: Implications for water resource management and aquatic habitat in the northern Rocky Mountains. Geomorphology, 139 – 140, 1 – 15. doi:10.1016/j.geomorph.2011.06.021

"Within central Idaho, recent climate driven increases in wildfire burn severity and extent have the potential to produce sediment yields roughly 10-times greater than those observed during the 20th century. Although coarse sediment is important for forming aquatic habitats, an order of magnitude increase in total sediment yields may have short-term negative consequences to biota, many of which are already threatened and endangered due to a long history of anthropogenic disturbance (Nehlsen et al., 1991; Montgomery, 2003). In addition, these elevated sediment yields are probably outside of the range of expectation`s for downstream reservoirs, which may have consequences for reservoir management and life expectancy."

Water Supply

R1: Northern

Moore, J. N., Harper, J. T. & Greenwood, M. C. (2007). Significance of trends toward earlier snowmelt runoff, Columbia and Missouri Basin headwaters, western United States. Geophysical Research Letters, 34 (L16402), 1 – 5. doi:10.1029/2007GL031022

"Our results [from assessing changes in runoff timing over the last 55 years at 21 gages unaffected by human influences], suggest that in the headwaters of the Columbia and Missouri rivers, far more gages show significant runoff trends related to discharge than those related to time. Similarly, an analysis of discharge timing into the Hudson Bay [Dery et al., 2005] found that peak discharge associated with snowmelt advanced by 8 days from 1964 to 2000 in response to decreasing runoff. "

Shepherd, A., Gill, K. M. & Rood, S. B. (2010). Climate change and future flows of Rocky Mountain rivers: converging forecasts from empirical trend projection and down-scaled global circulation modeling. Hydrological Processes, 24, 3864 – 3877. DOI: 10.1002/hyp.7818

"We also predict that, for the general interval from 2005 to 2055, there would be an approximately 15% further decrease in summer flows and an approximately 5% decrease in the overall annual flows of the Oldman River and adjacent rivers draining the central Rocky Mountain region. This provides a composite estimate intermediate between the ETP [empirical trend projection] and HCM [hydroclimatic modeling] forecasts, which would factor in the winter consideration from the Coquard et al. (2004) analysis."