Lower Columbia Estuary Partnership Sea Level Rise Impacts Study: Summary of Results

The Estuary Partnership received funding from US EPA in June 2018 for a baseline assessment of potential impacts of sea level rise (SLR) on lower Columbia R. tidal wetlands. These wetlands provide numerous ecologic functions and are particularly important as rearing habitat for several salmonid species, including 13 ESA listed Columbia River stocks (Bottom et al., 2005). Since the late 1800's more than 70% of lower Columbia R. tidal wetlands have been lost or disconnected from tidal influence due to various anthropogenic practices (Marcoe et al., 2016), severely limiting the amount of habitat available to juvenile salmon and other species. This extensive loss underscores the need for this assessment, given the importance of this habitat and potentially significant changes due to SLR.

Project funding was used to develop a user driven, rule-based, predictive modeling tool to quantify the potential for tidal wetland migration for a given SLR scenario. Methodology is consistent with existing marsh migration tools, including SLAMM, NOAA Sea Level Rise Viewer, MAST, and other localized models, with input types tailored to the lower Columbia R. This customization was justified by:

- Complexity of lower Columbia hydraulics (Fig. 1a), arising from non-linear tidal effects over a 145-mile tidal reach, combined with fluvial effects governed by dam discharge. Accordingly, water level does not respond uniformly throughout the estuary to a given SLR at the ocean (Fig. 1b). For this reason, we applied simulated water level outputs from a calibrated hydraulic model to establish a relationship between current water levels and wetland elevations and accurately predict the expected shift due to SLR. Simulated SLR scenarios are consistent with expected values published by NOAA, NAS, and the Washington Coastal Resiliency Program.
- Relevant source data possessed by the Estuary Partnership, including high resolution digital terrain, landcover, flow barrier, and extensive present marsh elevation points. These data have been pre-processed and quality assessed and are readily applicable to our model.
- The extensive presence of levees and other flow barriers, which have disconnected a large percentage of former tidal wetlands. Assessing how these natural-based leveed floodplain systems will respond to SLR is a critical element of assessing overall tidal wetland migration potential in the lower Columbia R. To obtain a better understanding of this, a localized model that is capable of a detailed analysis of these features is required.

The SLR impacts tool was developed within a GIS framework. Hydraulic model outputs of current and SLR induced water surface profiles are input, along with digital terrain, land cover, existing wetland elevation range, and flow barrier information, to quantify estuary-wide potential changes in wetland habitat for chosen SLR scenarios. The Estuary Partnership analyzed 0.5, 1.0, and 1.5 m SLR scenarios. Our results highlight the important role that leveed floodplain systems may serve in overall potential for tidal wetland migration. While project scope did not allow for a detailed assessment of the potential for levee overtopping due to SLR, a coarse assessment was performed (Fig. 2), which results in a wide range of potential gain or loss of wetland (Fig. 3) depending on the degree of overtopping of levee features under SLR conditions.

Results of this effort are currently being finalized, and data is not yet available for sharing. Final steps include making the data available through online portals including ArcGIS Online, West Coast Ocean Data Portal, PMEP, and others, and publishing the results in a peer reviewed publication. This project is directly relevant to, and provides a strong foundation for, our proposed work to be funded under the 2019 EESLR program.

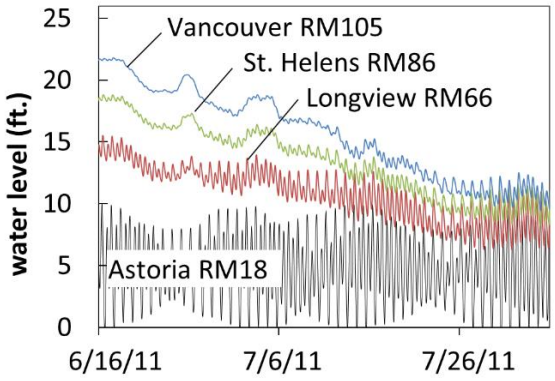

Figure1a. *Water level profiles at 4 lower Columbia R. stations. Full tidal response near the mouth (RM 18) is muted with distance upriver due to frictional and fluvial effects.*

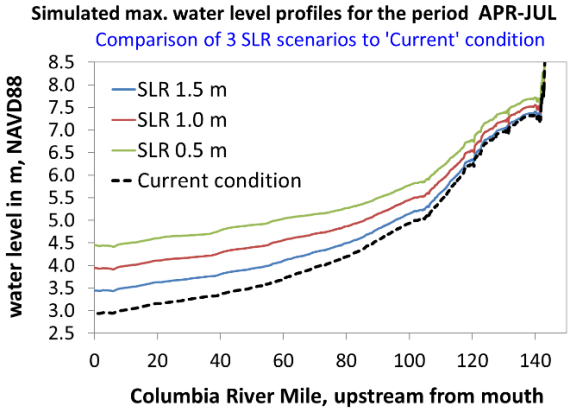

Figure1b. *Model simulated water level for current condition and 3 SLR scenarios. For a given SLR, increase in water level diminishes w/ distance upstream.*

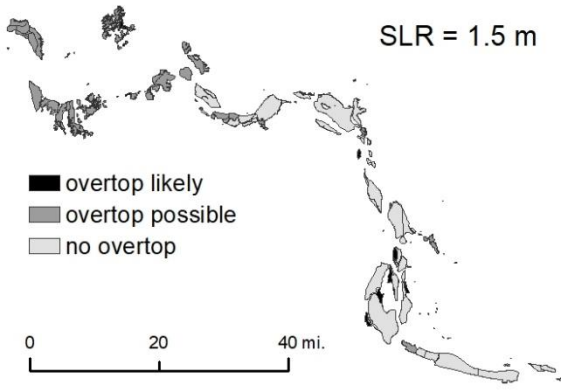

Figure2. *Coarse assessment of lower Columbia R. levee overtop potential for a 1.5 m SLR. Levees that could 'possibly' overtop could contribute to significant gains in marsh migration, and thus require more detailed assessment.*

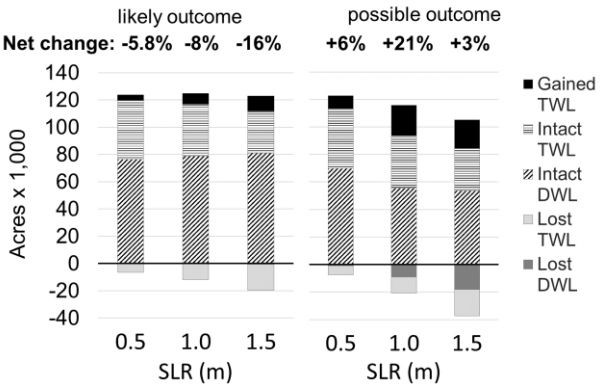

Figure3. *Quantitative results from lower Columbia SLR impacts model, with potential overall % change in tidal wetland area for 'likely' and 'possible' levee overtopping. Wide range in potential change for these two conditions highlights the need for more detailed assessment.*
Key: TWL = tidal wetland, DWL = diked wetland