**Full Proposal Template for Submitting Proposed Changes to the Central Valley Project Improvement Act Chinook Salmon Coarse Resolution Models**

This template is for a ***full proposal*** for changes to the CVPIA Chinook salmon decision support models. More detail is expected in a full proposal than in the pre-proposal. Please provide one form per issue to the CVPIA Science Coordinator.

**Proposal Title** (provide concise 1-5 word title for proposal):

Spawning Habitat Decay Proposal

**Proposal Sponsor Names and Contact Info** (provide name, affiliation, email, phone number for each proposal sponsor):

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**Date of Submission**: January 4, 2022 (last updated 1/19/22)

**Submodel of Concern**:

Not Applicable

**Submodel Parameter(s) of Concern**:

N/A

**Issue of Concern** (provide a concise narrative describing the issue of concern):

The current salmonid DSMs include a spawning habitat decay rate (i.e. loss of suitable spawning habitat through time) generated from a random uniform distribution that ranges from zero to a watershed-specific maximum value. Suitable spawning habitat area is reduced by the proportion generated from this distribution each month, regardless of flow conditions. Due to this disconnect from hydrology, DSM simulations do not include a physically accurate representation of spawning habitat decay. Spawning habitat decay is a function of sediment transport capacity, which is proportional to the magnitude and duration of flows above the incipient motion threshold flow (i.e. the flow at which bedload sediment begins to mobilize).

**Proposed Change to the Model** (provide specific changes to the model, and identify parameter or data values when applicable):

This proposal would replace the spawning decay rate derived from a uniform distribution with a site specific spawning habitat decay rate (calculated daily and aggregated to monthly for the simulation period of record) based on modeled sediment transport rates and tied to the flow inputs to the DSMs. This change will first be implemented for the mainstem Sacramento River spawning habitat, and then on other tributaries as the hydraulic modeling required becomes available.

**Scientific Rationale for the Proposed Change to the Model** (include specific hypotheses and support from published/unpublished references or ongoing research and monitoring activities):

The mainstem Sacramento and 11 of the 25 tributaries in the DSMs have large dams. These dams and the reservoirs they impound trap most of the sediment supply that would naturally replenish spawning gravels needed to maintain suitable spawning habitat. When sediment transport continuity is interrupted by a dam, the flow downstream of the dam can become sediment-starved (hungry water) and prone to erode the channel bed and banks, producing channel incision, coarsening of the bed material, and loss of spawning gravels for salmonids (Kondolf 1997). These processes are tightly linked with river flows; with little to no sediment transport (or spawning habitat decay) in dry years and large volumes of sediment transport (and spawning habitat decay) occurring in wet years where flows are maintained above the incipient threshold flow. Hydrodynamic models are powerful tools for predicting the potential mobilization and transport of sediment in river ecosystems (Lepesqueur et al 2019). Therefore, where available, model-derived estimates of sediment transport should be used to more accurately simulate spawning habitat decay in DSM watersheds with large dams that create hungry water conditions.

**Instructions on How to Integrate the Proposed Change into the Model**:

We propose developing this new method of incorporating spawning habitat decay in the DSMs on the Sacramento River where the US Bureau of Reclamation (USBR) Technical Service Center (TSC) has recently completed detailed two-dimensional hydrodynamic and sediment transport modeling (SRH2D; USBR 2020). Based on consultations with Dr. Blair Greimann at the USBR TSC, the following method should be used to improve spawning habitat decay representation in the DSMs:

1. Acquire the “augmented” gravel bedload rating curves sediment transport (Qs) to flow (Q) generated by SRH2D for the Sacramento River Gravel Augmentation Study\*;
2. Use Qs capacity rating curve to convert daily flows for the DSM period of record to daily sediment transport of spawning gravel;
3. Adjust gravel transport mass to account for difference between transport capacity and actual transport;
4. Sum daily transport mass to get monthly average transport mass for all months in the DSM simulation period;
5. Convert mass transport to lost area (assume 1 - 2 foot average depth of spawning gravels);
6. Estimate average monthly gravel augmentation measured or planned as an area;
7. Calculate new spawning habitat input for DSM as:

Spawning habitat area in current month = area in previous month – area lost to transport in current month + area added through augmentation in current month

1. Create a time series of spawning habitat area for the full DSM simulation period using values calculated in the previous step.
2. Expand this approach to other watersheds after integrating in DSM for the Sacramento River and testing sensitivity of model results to new input.

\*As of January 2022, gravel bedload rating curves are available for the Sacramento River between Keswick and the confluence with Clear Creek. The initial implementation of the new spawning habitat decay approach in the DSMs will extend the decay from this reach to cover the entire Upper Sacramento River reach in DSM using available data on spawning habitat for the entire reach.

**Citation(s) of Documents Supporting the Proposed Change to the Model** (provide a full citation as would appear in a published journal article, *and* provide copies of the reference or unpublished data sets):

[Kondolf, G.M. 1997. Hungry Water: Effects of Dams and Gravel Mining on River Channels. Environmental Management Vol. 21, No. 4, pp. 533-551.](https://scholar.google.com/scholar_url?url=https://www.researchgate.net/profile/George-mathias-Kondolf/publication/225898396_Hungry_Water_Effects_of_Dams_and_Gravel_Mining_on_River_Channels/links/54ca58f00cf22f98631af152/Hungry-Water-Effects-of-Dams-and-Gravel-Mining-on-River-Channels.pdf&hl=en&sa=X&ei=DoKqYZ-cCYuNygT22YSICQ&scisig=AAGBfm26T8raW50-oSpzqVyM0Kckrq34-Q&oi=scholarr)

[Lepesqueur, J. R. Hostache, N. Martínez-Carreras, E. Montargès-Pelletier, and C. Hissler. 2019. Sediment transport modelling in riverine environments: on the importance of grain-size distribution, sediment density, and suspended sediment concentrations at the upstream boundary. Hydrol. Earth Syst. Sci., 23, 3901–3915.](https://hess.copernicus.org/articles/23/3901/2019/hess-23-3901-2019.pdf)

[USBR. 2020. Sacramento River Gravel Augmentation Study. Technical Report No. ENV-2020-060. U.S. Department of the Interior. May 2020.](https://www.sacramentoriver.org/forum/publications/side_channels/SacramentoRiverGravelBudgetReport_Final_508.pdf)