Effects of Program Water Management on Juvenile and Non-reproductive Adult Pallid Sturgeon Life Stages

Juvenile and non-reproductive adult life stages have been combined due to 1) the lack of a clear delineation between these life stages and 2) the lack of any information specific to the juvenile life stage.

There is strong evidence that:

- Though they use a range of habitat, pallid sturgeon are more frequently captured in the deepest portions of the Lower Platte River.[1,2]
- Very low flows in the Lower Platte River can result in pallid sturgeon mortality.[3]
- PRRIP-related water activities will both decrease (withdrawals for retiming projects and new depletions) and increase (releases of new and retimed water) river stage and associated flow depth in the lower Platte River.[4]
- The magnitude of stage (and associated depth) change will be dependent on the magnitude of flow withdrawals/releases in the central Platte, flow losses and attenuation in Central and Lower Platte River, and Lower Platte River discharge.[4]

There is some (or conflicting) evidence that:

- Flow reductions (sub-daily to seasonal) reduce the overall capacity of the Lower Platte by reducing the availability of deep water habitat used by pallid sturgeon.
  - Pallid sturgeon are more frequently captured in deepest [1,2] and swiftest waters. [1] However, there is no established relationship between pallid sturgeon capacity and quantity of deepest and swiftest waters.
- Flow reductions during low flow periods may decrease physical habitat suitability related to channel connectivity and decrease pallid sturgeon mobility.
  - The Lower Platte channel (below Elkhorn) nears full connectivity at a flow of 8,000 cfs or greater. Connectivity declines quickly below 6,000 cfs with low connectivity at flows below 3,000 cfs.[3,4] However, there is no established relationship between pallid sturgeon use and connectivity.
- Flow reductions during low flow periods may contribute to increased water temperature
  - Pallid sturgeon mortalities reported in 2012 when discharge was less than 1,000 cfs and water temperature was > 86°F. [5]
  - Water temperature, air temperature, and discharge co-vary[7], but causal relationships are not well understood in the Central and Lower Platte Rivers.

Remaining uncertainties include:

- Limitations in sampling methodologies or analyses could affect aforementioned flow/species relationships. Factors not related to flow could also affect our understanding of flow/species relationships.

- The relationship between flow depth/velocity and pallid sturgeon habitat suitability and the relationship between habitat suitability and pallid sturgeon occurrence/condition.
- The relationship between discharge and channel connectivity and the relationship between channel connectivity and pallid sturgeon mobility.
- Strength of any relationships between discharge, stream temperature, stream turbidity and pallid sturgeon habitat suitability/condition.
- Strength of any relationships between discharge, pallid food resources, and pallid sturgeon habitat suitability/condition.

Our predictive ability would be enhanced if:

- Collaboration with pallid sturgeon experts identified key limitations in sampling methodologies or analyses, and through this collaboration, we develop a plan to address key limitations in future research/monitoring/analyses.
- We could improve understanding of pallid sturgeon food resources and flows needed to support these resources.
- We could improve understanding of the relationship between flow and temperature exceedances detrimental to pallid sturgeon.
- We could improve our understanding of flow-related variables and pallid sturgeon capacity in the Lower Platte River.
- We could improve our understanding of pallid sturgeon movements in relation to channel connectivity in the Lower Platte River.

Effects of Hydrologic Change on Pallid Sturgeon Spawning, Embryos and Larvae in the Lower Platte River

There is **no evidence** specific to the Lower Platte to support understanding of effects on these life stages.

Remaining uncertainties include:

- Factors not related to flow could also affect our understanding of flow/species relationships.
- Relationship between discharge and spawning habitat availability.
- If flow-related variables in the Platte River influence spawning cues and spawning occurrence, and if so, what is the relationship between flow and spawning cues/occurrence.
- Relationship between flow-related effects to habitat and spawning success
- Relationship between flow-related effects to habitat and egg incubation success

Our predictive ability would be enhanced if:

- Collaboration with pallid sturgeon experts identified key limitations in sampling methodologies or analyses, and through this collaboration, we develop a plan to address key limitations in future research/monitoring/analyses.
- We could improve our understanding of flow-related variables that affect spawning cues, pallid movement, and access to spawning habitat in the Lower Platte River during the spawning period.
- We could improve our understanding of whether spawning cues, movement, and access to spawning habitat affects spawning occurrence, spawning success, and/or egg incubation success.

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