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Trout Management Flows

A Literature Review and
Stranding Risk Modelling Component
Project H

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Trout Management Flows

Background

- DOI LTEMP and Biological Opinion 2016
  - Experimental treatments to manage fish populations
    - Chapter 2.2.1) Experimental Trout Management Flows (TMFs) could be used to control annual rainbow trout production in the Glen Canyon reach for the purposes of managing the rainbow trout fishery and for limiting emigration to Marble Canyon and the Little Colorado River reach.
    - Basic premise – Dropping water level to induce stranding (mortality event) of young-of-year trout
      - Multiple ways to do this
  - TWP Project Element B.6.6 – Trout Management Flows

    LTEMP Resource Goals

    9 – Rainbow Trout Fishery
    10 – Non-native Invasive Species
    3 – Humpback Chub
    5 – Other Native Fish

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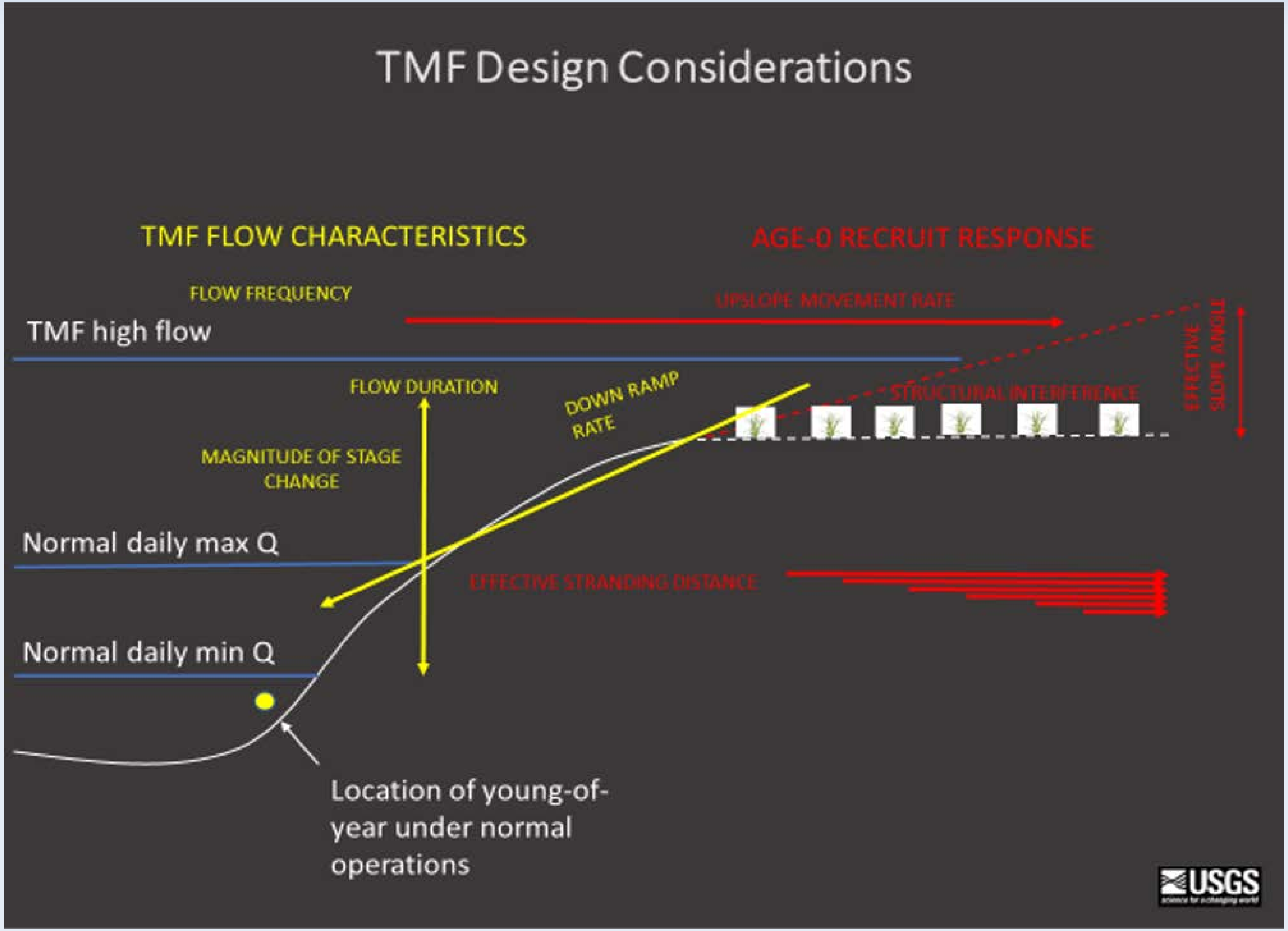

From: Yard and Korman, June 2019

TMF design uncertainties:

- How high does the max flow (Q) need to be?
- Duration at the max flow and min flow?
- How fast does the down-ramp rate need to be?
- What kind of habitat induces more stranding? And what proportion of Glen Canyon comprises that habitat type?
- How many cycles of TMFs need to be implemented in one season?
- What is the overall population abundance response to TMFs?
- Will this work for Brown Trout? If so, what differences need to be considered?

Literature Review – Main Findings

Stranding is not an established management tool for fish population control

- One study conducted on reservoir to control invasive Bluegill population (Heman and others, 1969)
- Stranding studies are primarily focused on reducing stranding mortality events for salmon and trout populations

Site-specific and key factors influencing stranding are inter-dependent

Literature Review – Main Findings

Fish size

- Small Fry and Parr are more vulnerable to stranding (<50mm FL)
- Glen Canyon = May-July

Diel Cycle (day vs. night)

- More stranding if flows decreased during daytime
  - Concealment behavior
- Glen Canyon = Increased air temperature

Channel Morphology

- Shallow lateral slope leads to more stranding
  - <4% slope
- Habitat complexity
  - Aquatic vegetation
  - Isolated pools

-4mile bar (TRGD sub-reach 1C) at ~4,000cfs PC: M. Giardina

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Literature Review – Main Findings

Flow Factors

- Faster down-ramp rate leads to more stranding
  - Dependent on geomorphology
  - Exact rate unknown

- Duration of ‘wetted history’ prior to drop in flow
  - Determines extent that small fish occupy shoreline habitat
  - Duration unknown, widely varied between studies
    - Glen Canyon trout tend to remain at lower water level in predictable hydropeaking regime (Korman and Campana, 2009)

- Magnitude of stage change/ range of flows
  - Flow drops with same magnitude of stage change induced more standing at lower elevation thresholds of riverbed

For example: A stage change of 4,000 cfs
Dropping flows from 8,000 cfs to 4,000 cfs can lead to more
stranding than 16,000 cfs to 12,000 cfs

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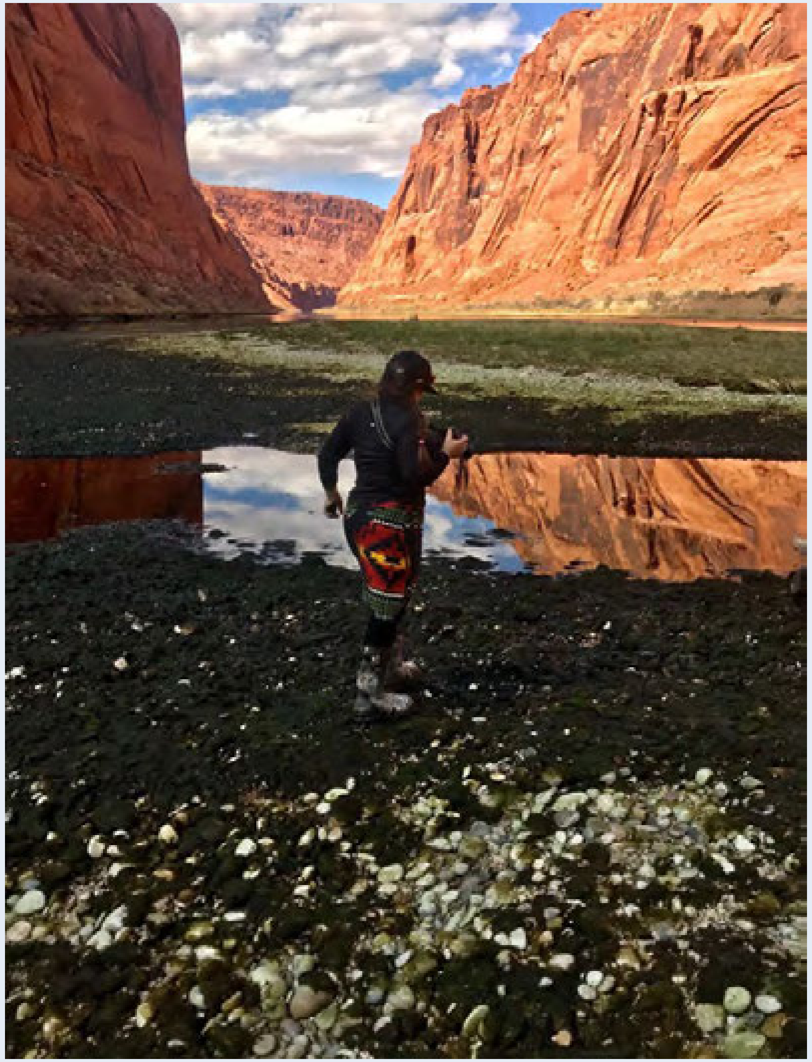
Literature Review – Main Findings

Population effect of stranding mortality rate

- Compensatory survival response
  - Repeated cycles = decline in abundance
  - Number of cycles and timing between, unknown



-4mile bar at ~4,000cfs PC: M. Giardina

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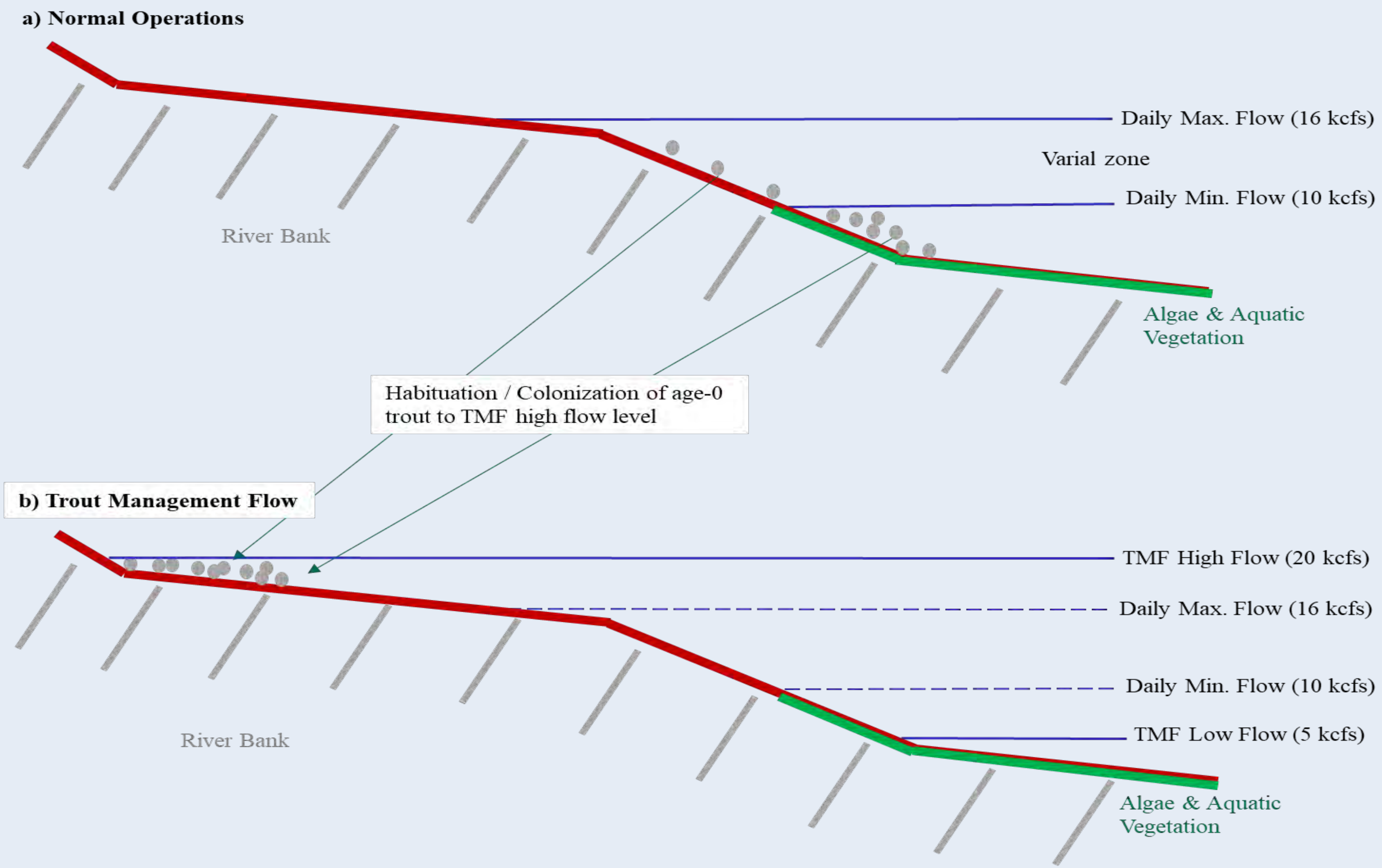
Fry Shoreline Use in Relation to Discharge



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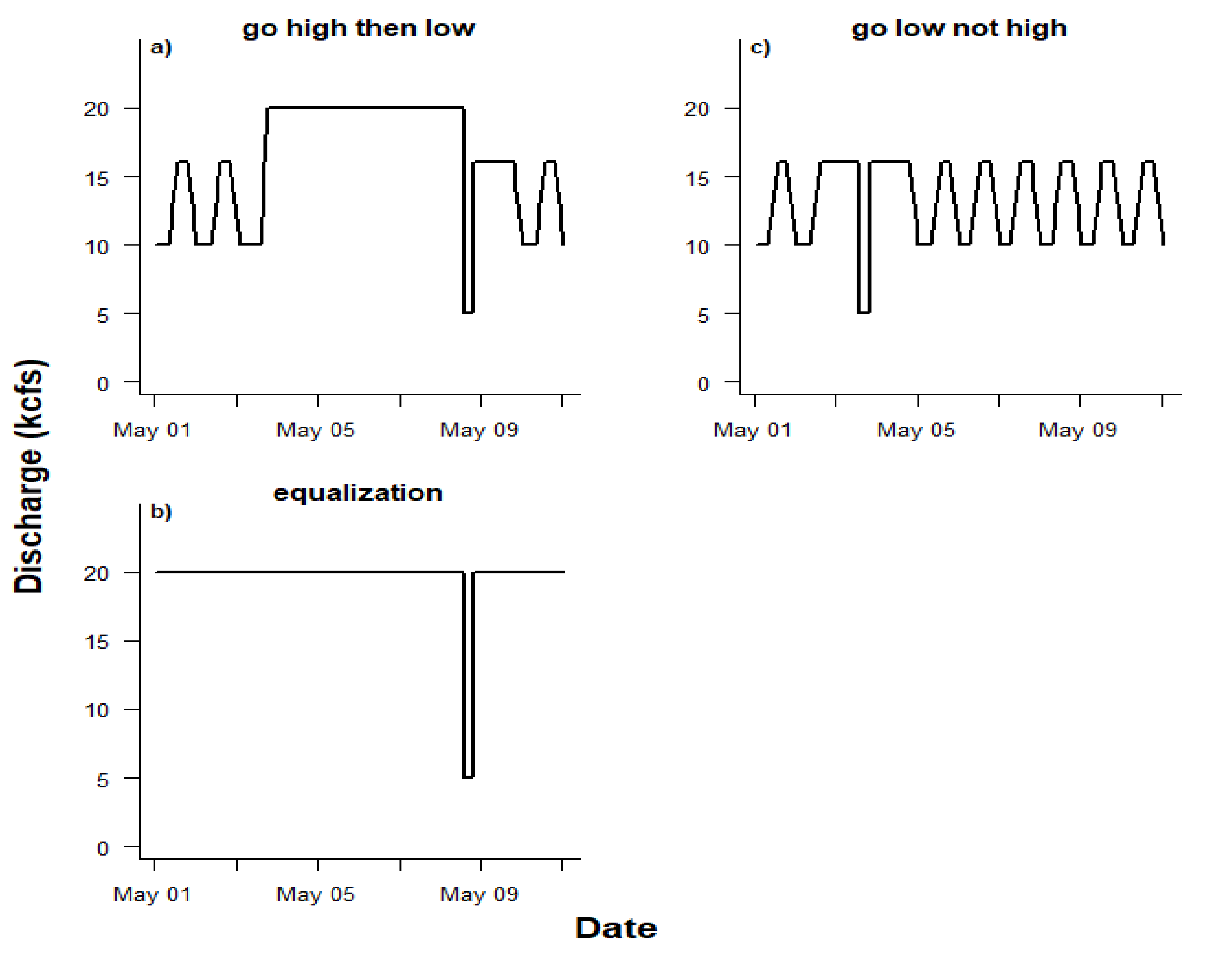
Preliminary, do not cite

Three Potential TMF Flows



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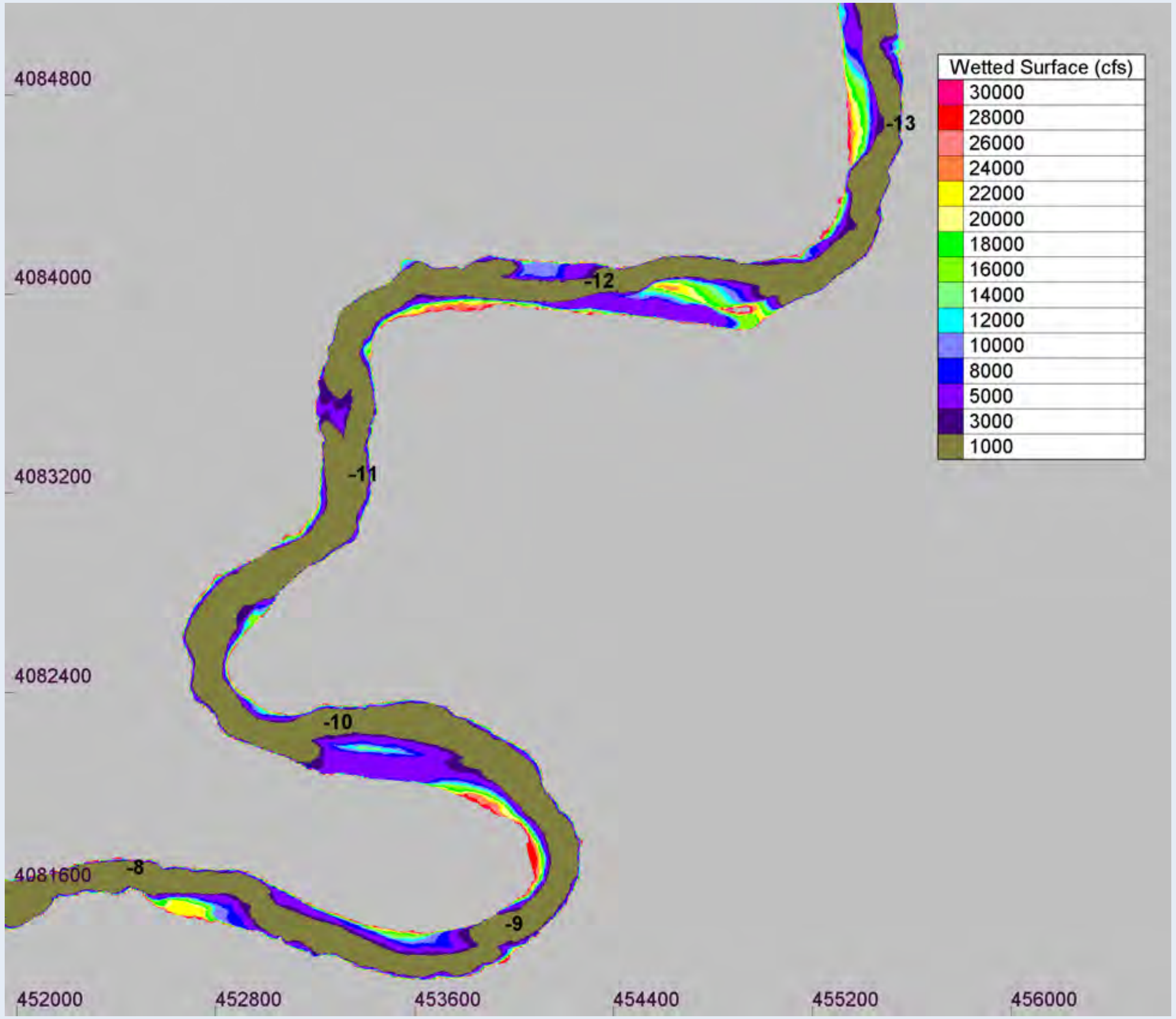
Predicted Wetted Area



Large areas exposed between 26-18 kcfs

- Stranding fry over this flow range requires sustained high flows of ~ 26 kcfs (option a).
- Only feasible in equalization years (e.g. 2011, option b)

Large areas exposed between 5-3 kcfs

- Dropping flows from normal daytime highs of ~ 16-18 kcfs to 3 kcfs is feasible given constraints on release volume (option c)

Majority of shoreline in Glen Canyon is steep

- TMFs have to occur when young fry (< 50 mm) are using low angle shorelines
- Not all young fry will be using habitats that are vulnerable to stranding

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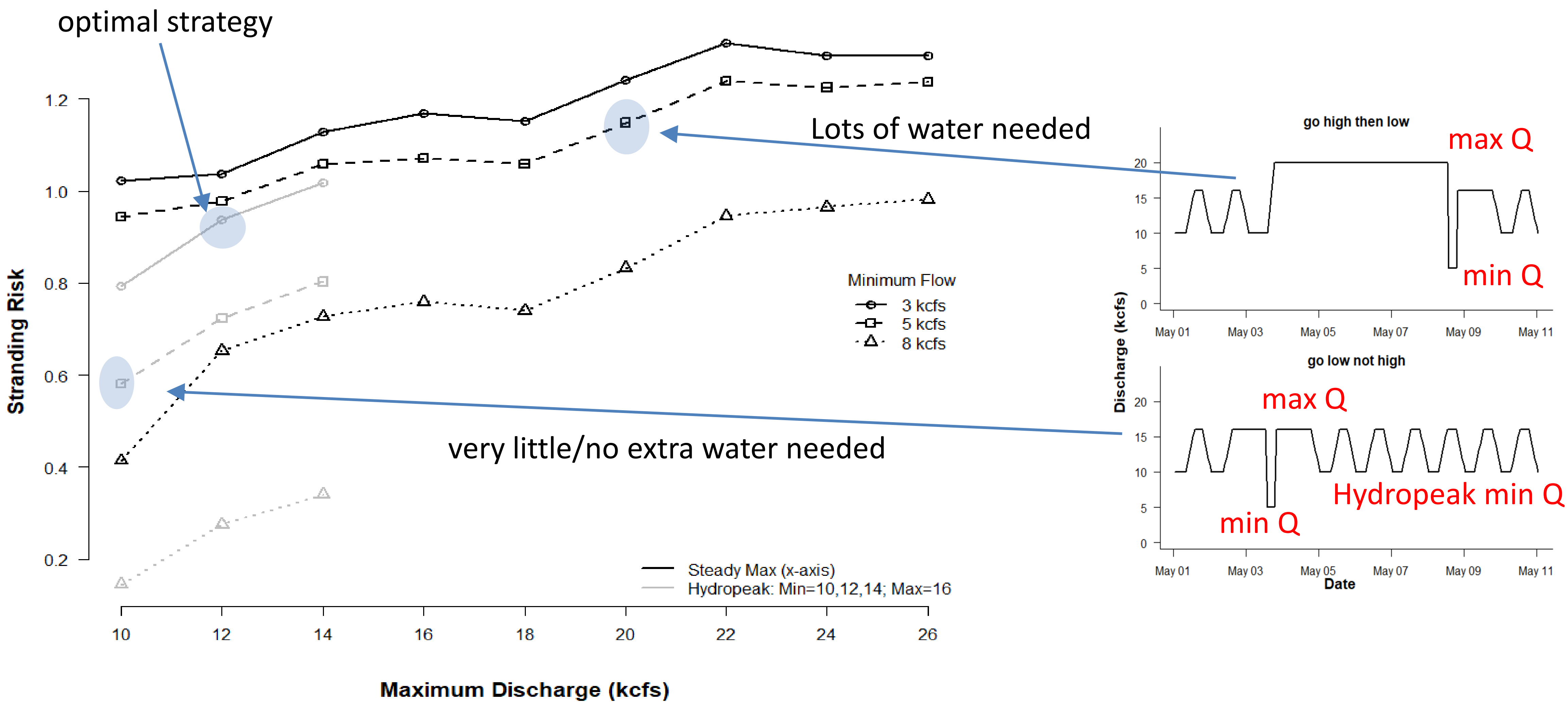
Predicted Stranding Risk as a Function of Discharge



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Conclusions

Remaining unknowns:

- Proportion of YoY population removed per TMF cycle.
- Number of TMF cycles to overcome compensatory response and achieve a substantive population-level effect (I think just saying # of cycles is all that is needed, as that will dictate time between cycles).
- Duration of low flow element of TMF
- Duration of high stable flows to maximize YOY trout colonization if implementing TMF option a (Note for fig 11 options b) and c) we don't need to know this. And given that a) is not feasible with low Powell elevations, this isn't really a critical uncertainty, so consider removing

Key considerations:

- Models predicting RBT recruitment, to determine if TMF is needed, have moderate predictive power. However, this is not a relevant issue for BNT.
- Current rainbow trout recruitment levels are low, and further reductions through TMFs will harm fishery and possibly lead to further increases in brown trout abundance. Again, not a relevant issue for BNT.

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