The Need for Constructing Endangered Fish Habitats that Conform to Climate-Driven Flow Changes in a Western U.S. River

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Razorback Sucker (RBS)

Colorado Pikeminnow (CPM)

Illustrations by Joseph Tomelleri

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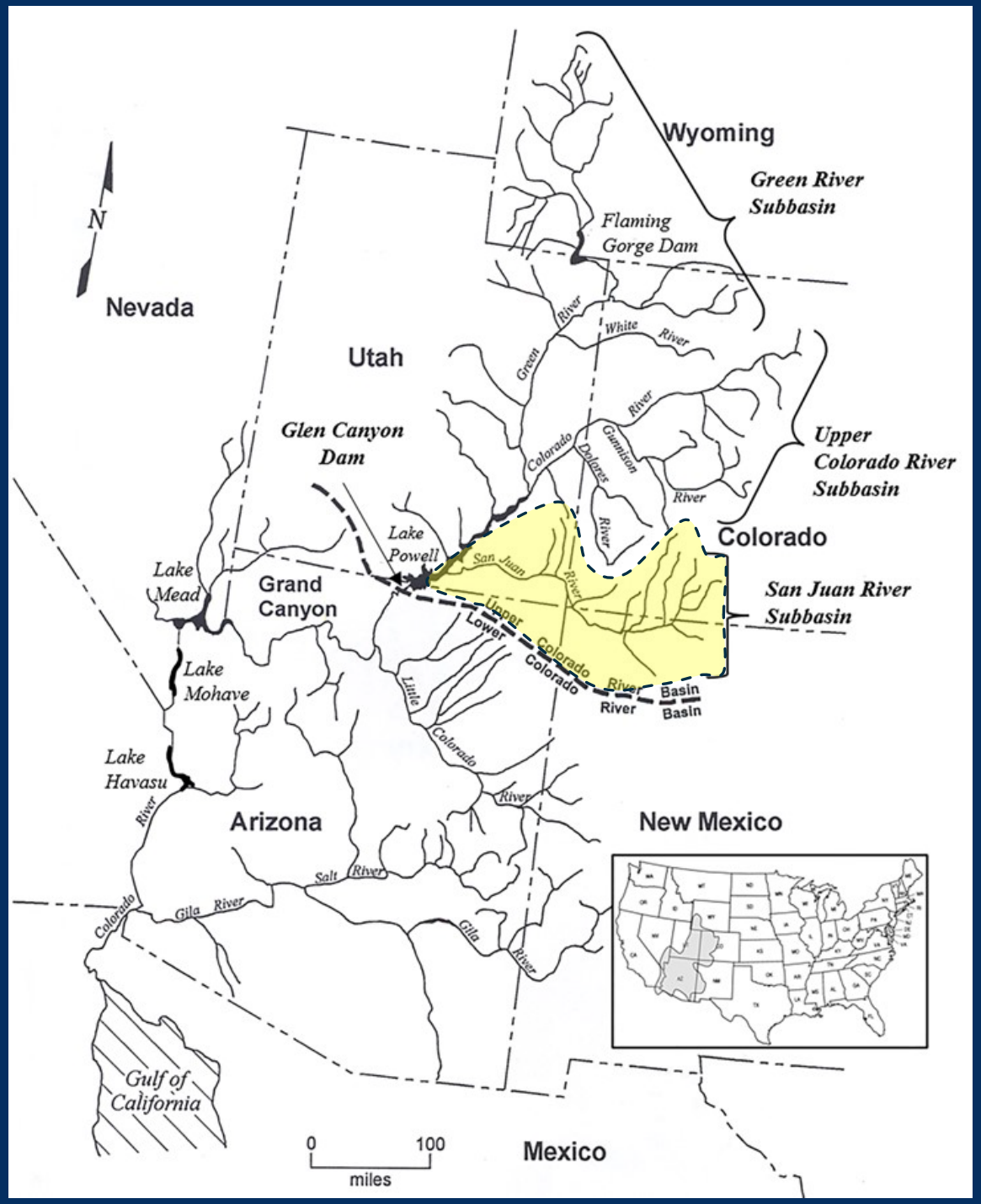
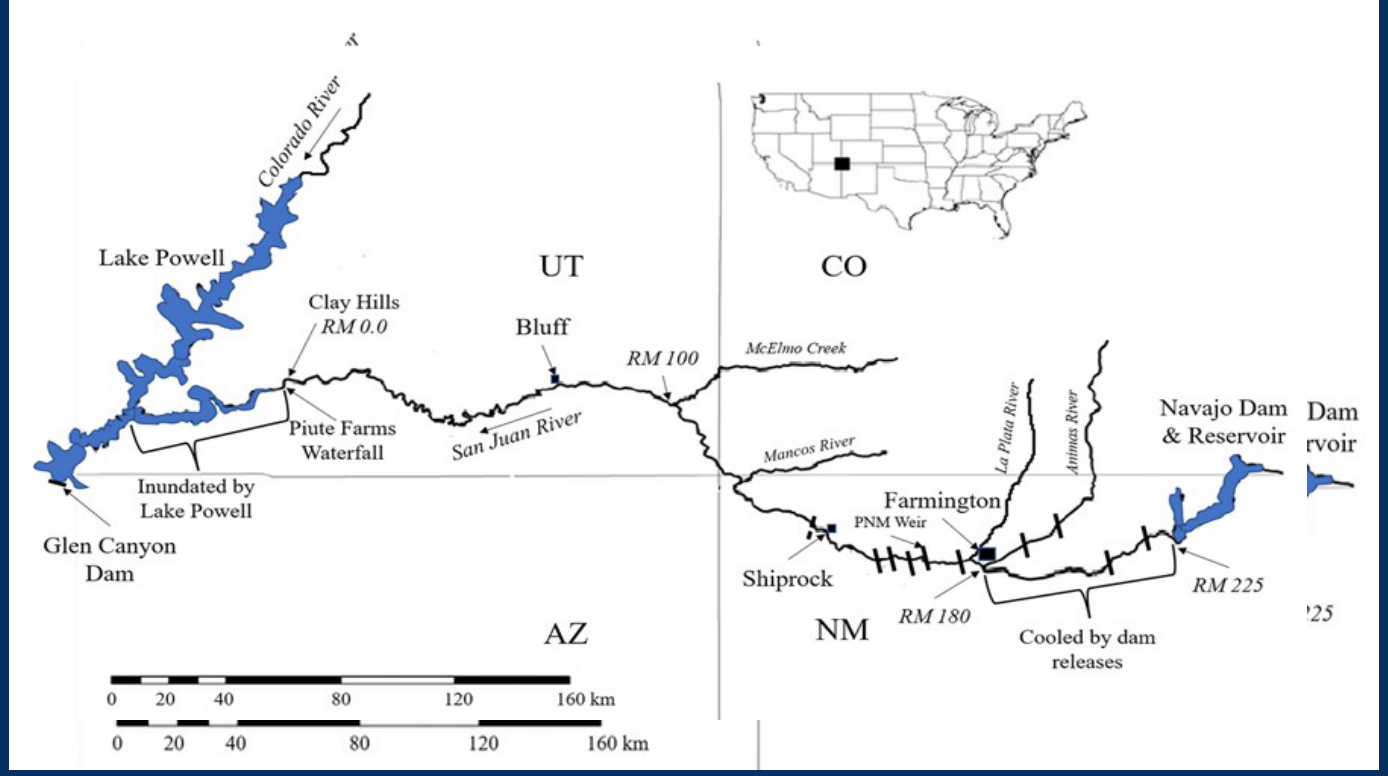


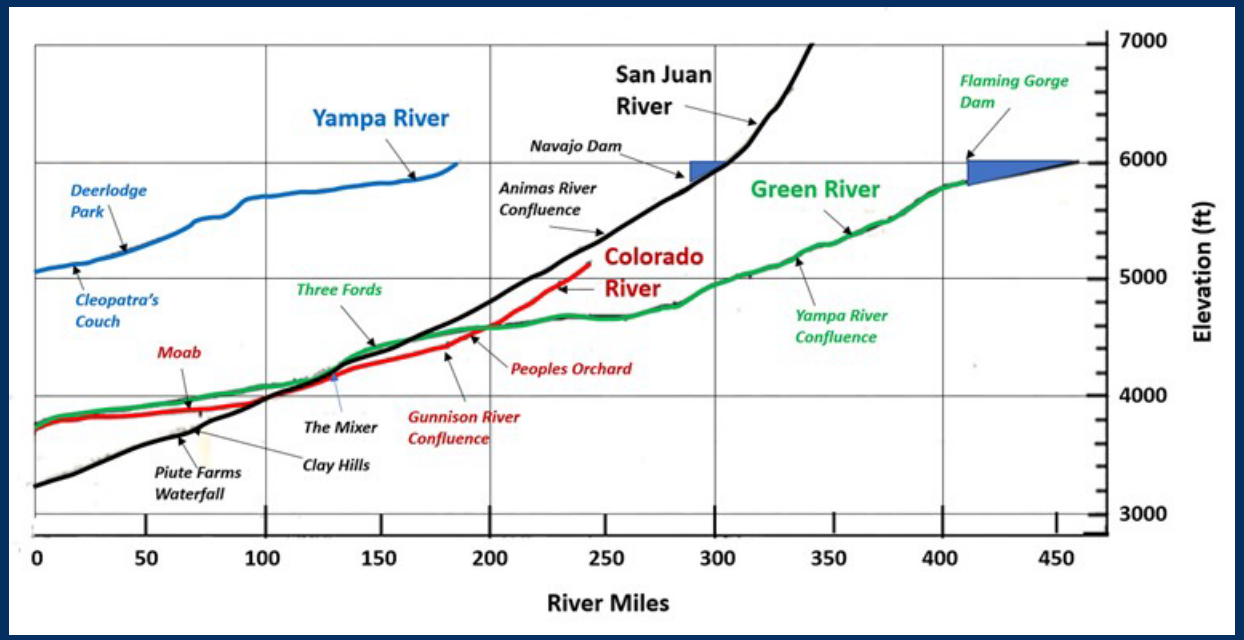
SAN JUAN RIVER

- ✓ Medium desert river 616 miles in CO, NM, UT to Lake Powell
- ✓ Smallest of three major subbasins of the Upper Colorado River Basin (UCRB)
- ✓ Contributes ~15% flow of UCRB (<2 maf)
- ✓ One of muddiest rivers in NA (25 m tons/yr)

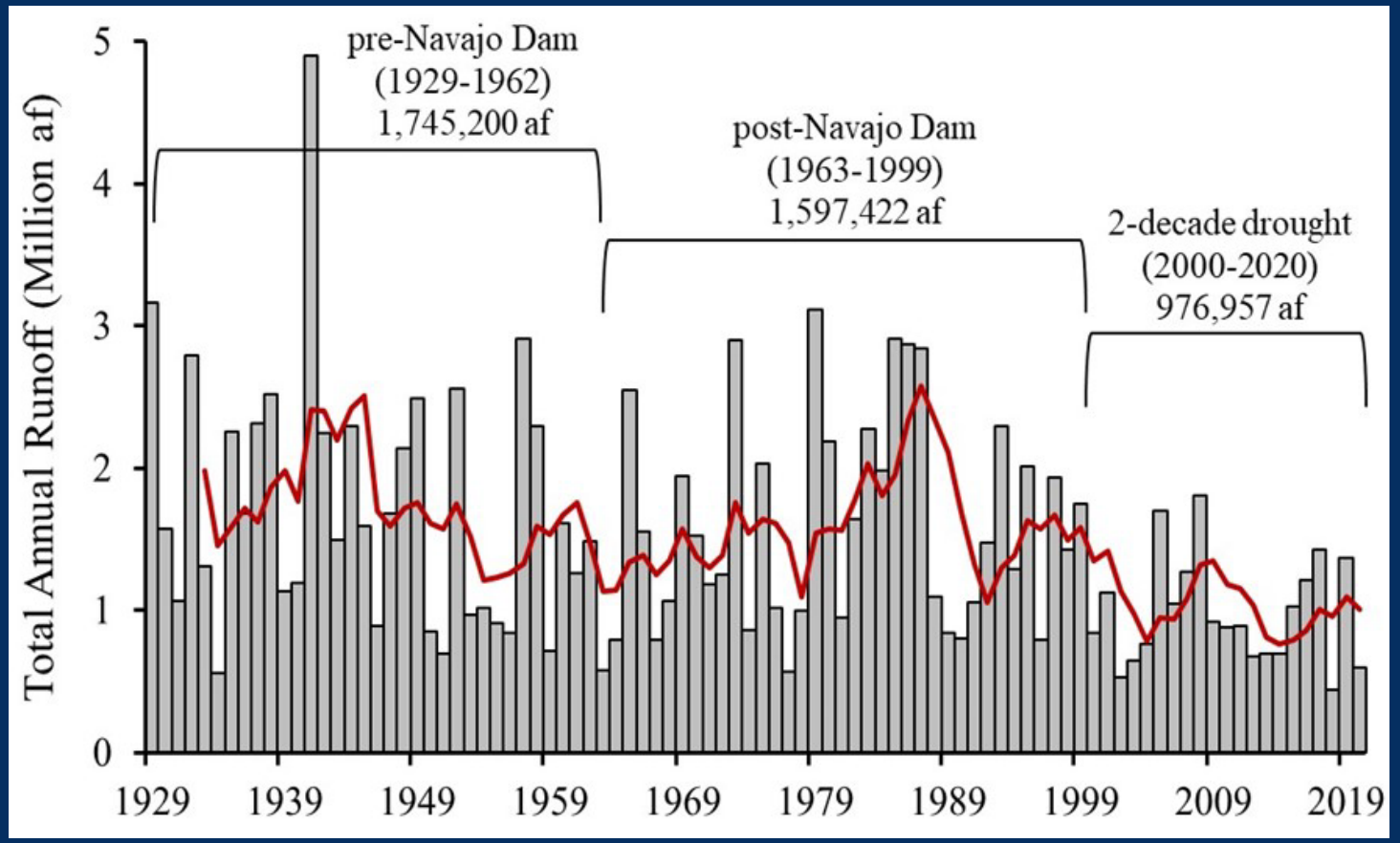
FISH HABITAT

- ✓ 362 of 523 km (~69%) of habitat left
  - ➢ Up to 87 km inundated by Lake Powell
  - ➢ 43 km inundated by Navajo Reservoir
  - ➢ 69 km cooled by Navajo Dam releases
- ✓ Remaining river habitat: Animas River to Lake Powell inflow near Clay Hills
- ✓ Steepest of occupied rivers (1.9 vs 1.3 m/km)

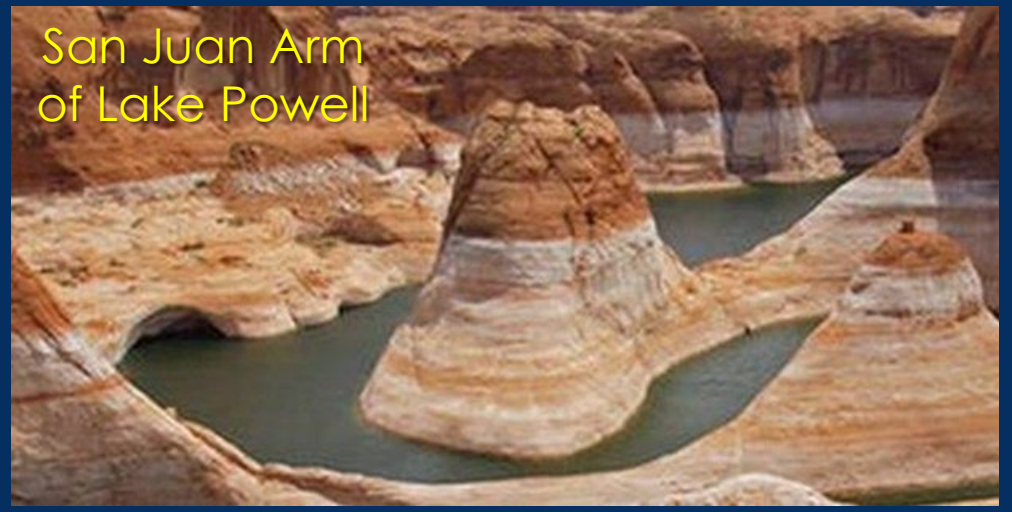




SAN JUAN RIVER HYDROLOGY

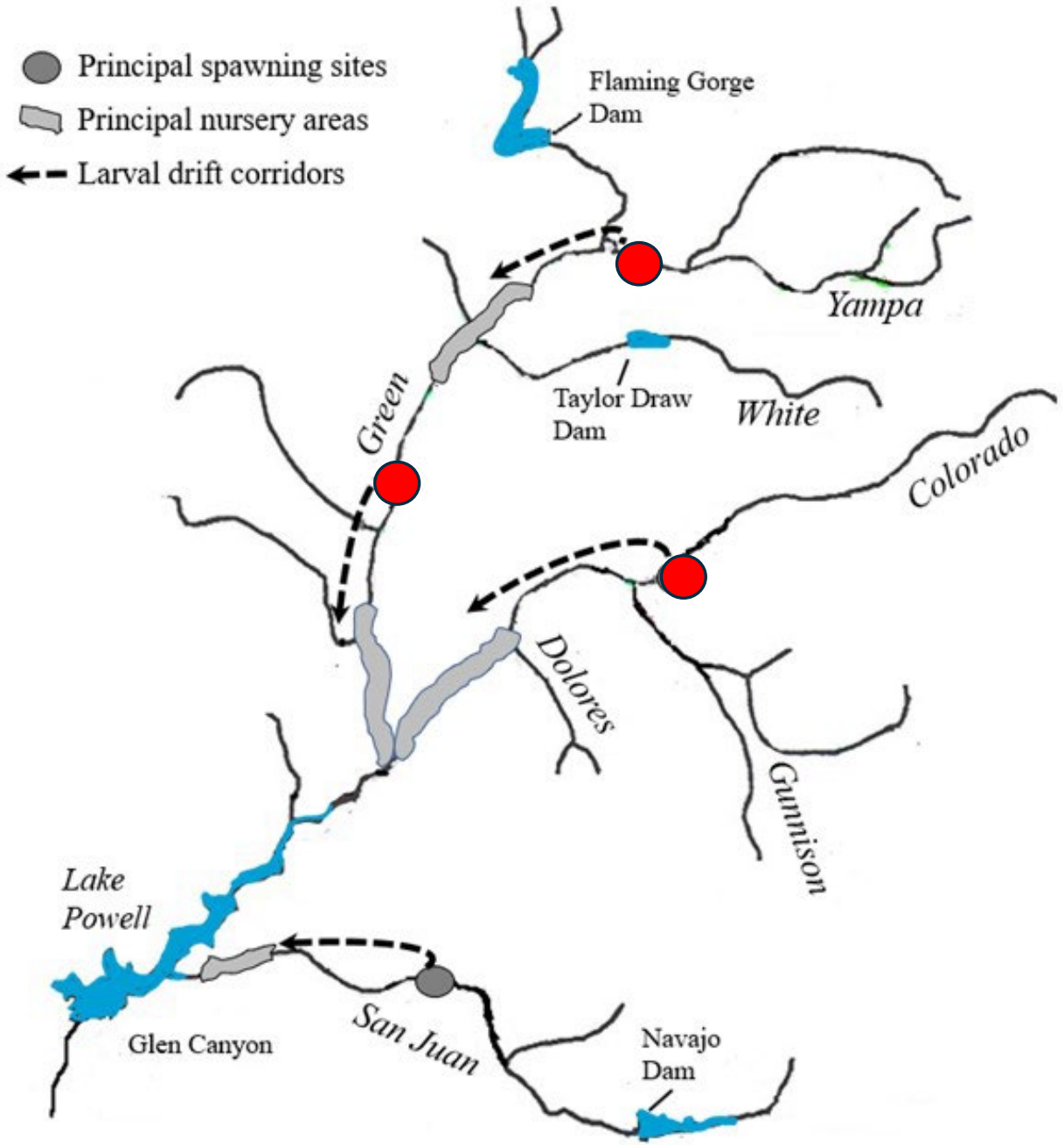


- ✓ Historical mean 1.745 af/yr.
- ✓ Post-dam: ~1.6 maf/yr.
- ✓ Last 2 decades: <1 maf/yr.
- ✓ 2000-2020: driest 21-yr period in 100 yrs, one of driest in 1,200 yrs.
- ✓ Flow reduced ~30% by diversions and climate change reduced flow



HISTORY OF SAN JUAN FISH RECOVERY

- 1991: BO for Animas-La Plata Project RPA to recover CPM and RBS on SJR
- 1992: San Juan River Basin Recovery Implementation Program (SJRIP)
- 1991–1997: Seven years research found few wild CPM and no RBS in SJR
- 1994–2020: Stocked ~6 million hatchery CPM and 200,000+ RBS
- 1999: Flow Recommendations, dam releases to mimic natural hydrograph
- 2013-2022: CPM and RBS reproducing but little survival and no recruitment; self-sustained populations have not become established



Colorado Pikeminnow (*Ptychocheilus lucius*)

- ✓ Highly migratory species, high fidelity to spawning sites in canyon areas
- ✓ Larvae drift to sandy nursery backwaters
- ✓ Four populations of upper basin metapop
- ✓ Likely spawned in SJR, larvae drifted to backwaters in Glen Canyon

Photos courtesy of U.S. Fish and Wildlife Service

Drea Markos

Razorback Sucker (*Xyrauchen texanus*)

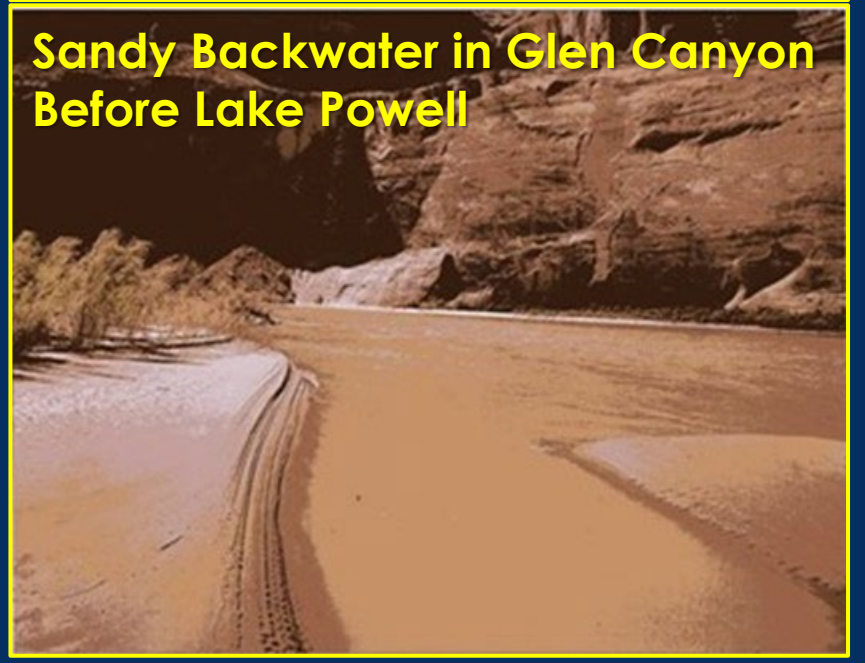
- ✓ Highly migratory, high fidelity to spawning sites
- ✓ Larvae drift to riverside floodplains
- ✓ Genetic evidence shows that RBS evolved in Lower Basin in lakes
- ✓ Likely spawned in SJR, larvae drifted to floodplains and arroyo mouths in Glen Canyon

Photos courtesy of U.S. Fish and Wildlife Service

PAUCITY OF NURSERY HABITAT

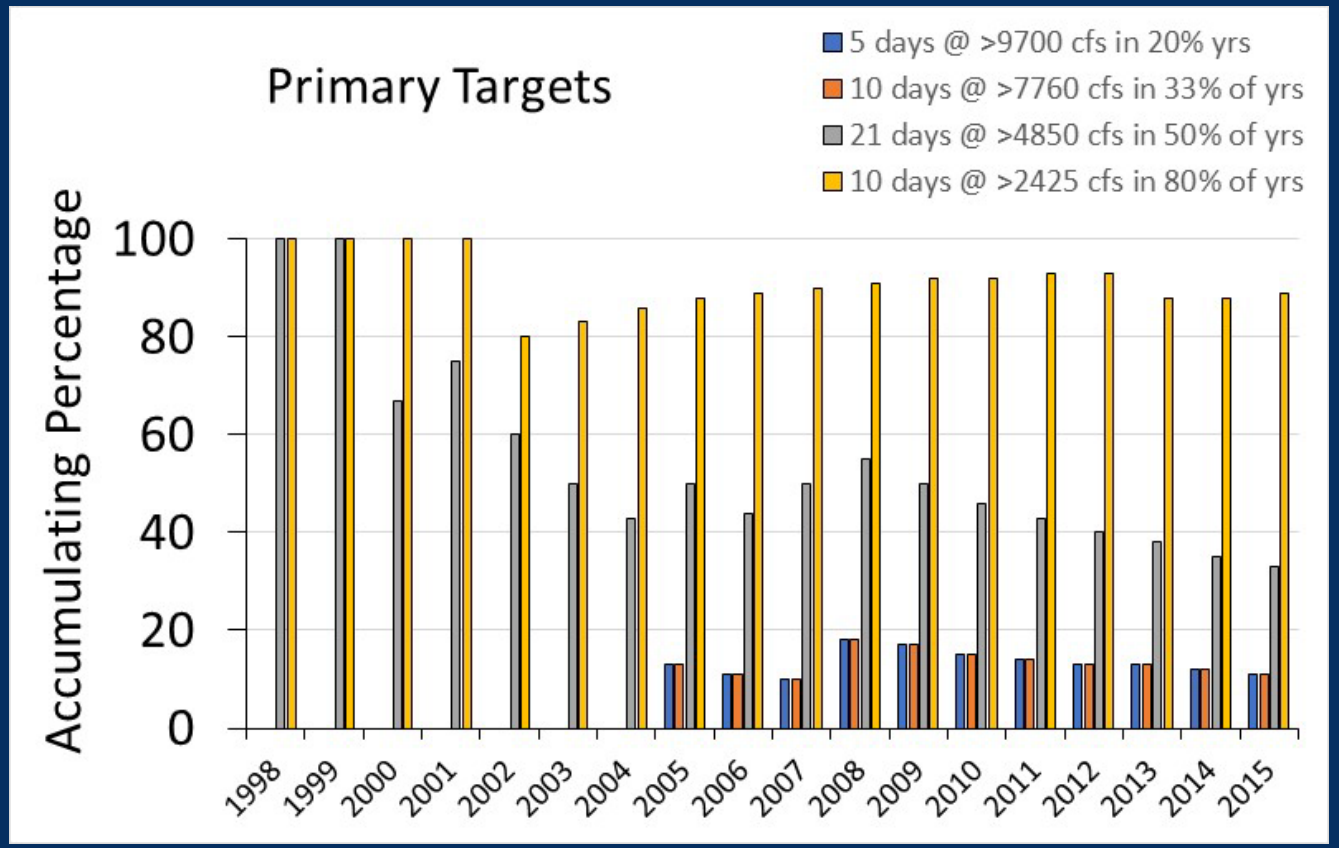
Ho: Contemporary San Juan River not suitable for recovery of CPM and RBS due to paucity of nursery habitat

- ✓ Narrower, steeper, and shallower than Green, Colorado
- ✓ Non-native vegetation anchors shorelines, limits CPM habitats
- ✓ Steep, confined channel lacks floodplains for young RBS



Photos by Bureau of Reclamation

FLOW RECOMMENDATIONS ANALYSIS (1998-2015)*



- ✓ Flow Recommendations (Holden 1999)
- ✓ Only **Primary Target** achieved: lowest flow of >2,425 cfs for 10 days in 80% of yrs. (orange bars)
- ✓ Higher flow target of 4,850 cfs for 21 days achieved only ~40% of the time
- ✓ Highest flow targets not achieved due to inadequate annual water supply
- ✓ **Secondary Targets** showed the same

SJRIP analysis concluded that FRs were unlikely to be achieved

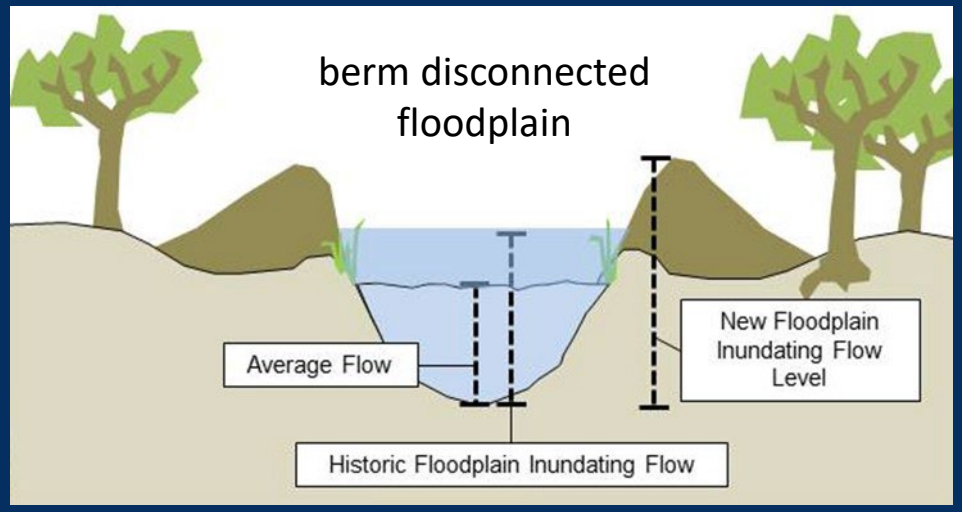
**Revised Navajo Dam operating procedures for the 1999 San Juan River Flow Recommendations, Final Approved, May 31, 2018 The San Juan River Basin Recovery Implementation Program (SJRIP)*

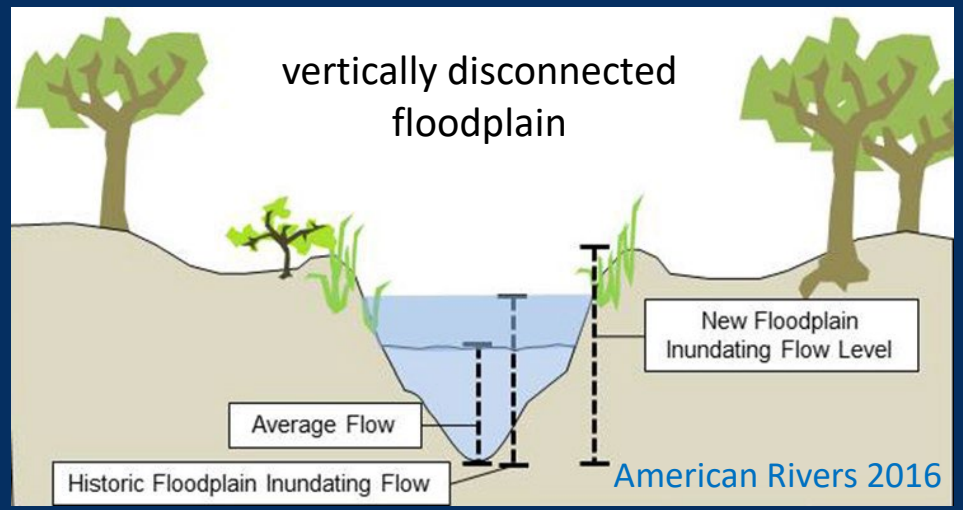
SUPPORT FOR HABITAT CONSTRUCTION IN SJR

- **2021 SJRIP Optimization and Sensitivity Analysis Modeling Exercises**
  - Only a few operational scenarios able to improve Flow Target performance without increasing water supply shortage risks.
- **2022 Assessment and Review of the San Juan River Basin Recovery Implementation Program's Progress Toward Recovery (Sufficient Progress Report)**
  - *"…we recommend the SJRIP conduct habitat construction and restoration projects at the appropriate spatial and temporal scale to complement flow management in the San Juan River as part of efforts to identify and ameliorate impediments to recovery. "*

MECHANICAL CONSTRUCTION OF NURSERY HABITATS

Common Theme: Floodplain disconnection is common in western U.S. rivers



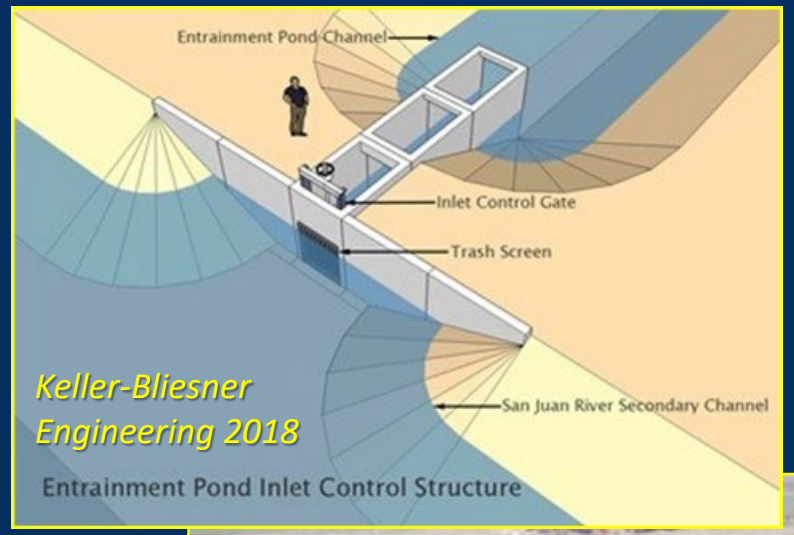


Examples of Mechanical Habitat Restoration in Western U.S. Rivers

CHALLENGES WITH HABITAT CONSTRUCTION IN SJR

Habitat construction in SJR challenged by:

- ✓ Highly variable flow
- ✓ Heavy sedimentation
- ✓ Monsoonal storms
- ✓ Sudden floods erode structures



Photos by Bureau of Reclamation

CONCLUSIONS

- **Construction of specific habitats is needed in the SJR**
  - Contemporary SJR is not suitable for recovery of CPM and RBS due to paucity of nursery habitat
  - Flow management alone cannot provide and enhance native fish habitats
- **We advocate for a more concerted effort to design and construct nursery habitats through the SJRIP to complement the Flow Recommendations**
  - Conform with available flows to offset effects of reduced or variable flows (climate change hydrology)
  - Design of constructed habitats is complex, and these habitats will need "tweaking" and maintenance