STATUS OF SAND SUPPLIES IN THE COLORADO BELOW GLEN CANYON DAM

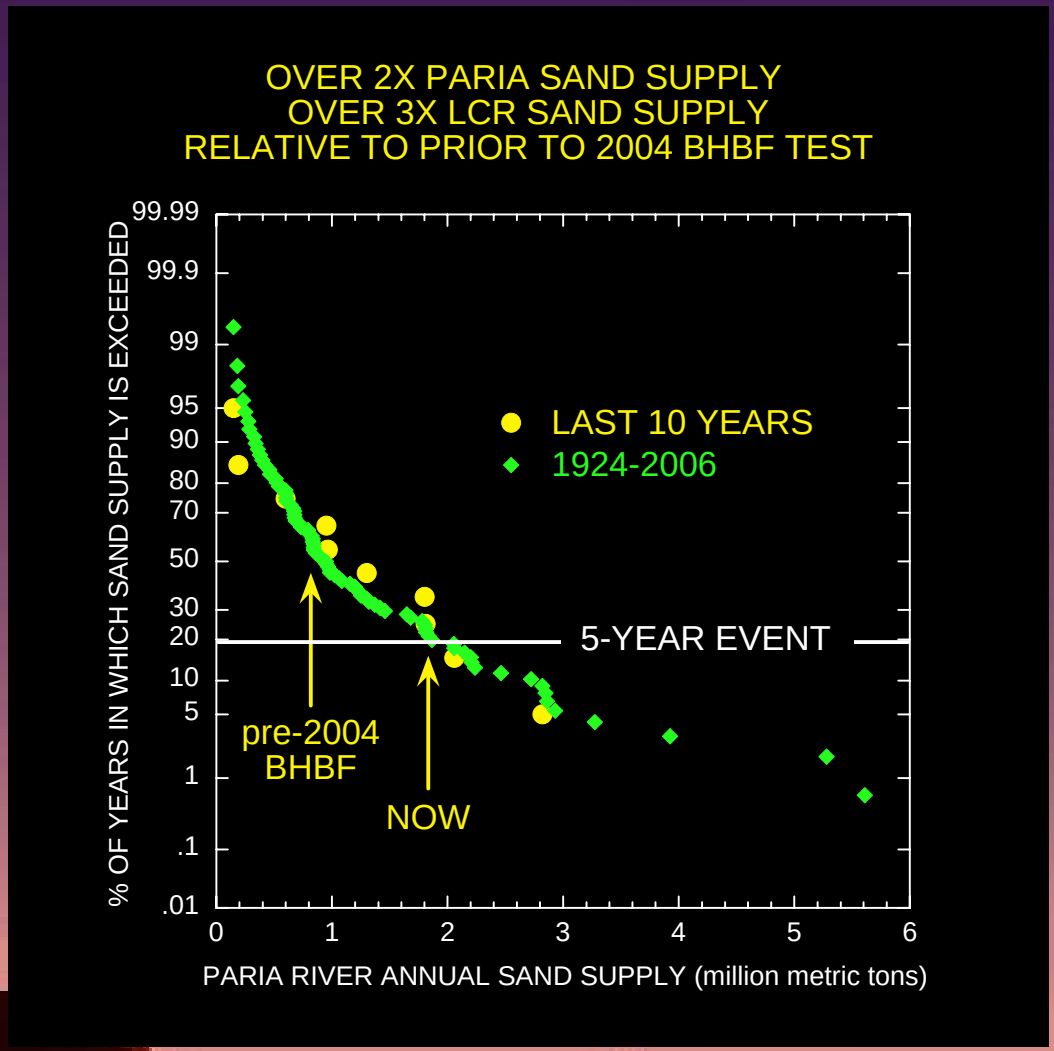
BHBF Discussion: Sediment inputs and Science Planning – technical presentation: 08:45-09:45

Presented to the GCD-AMP's Technical Workgroup

NOVEMBER 9, 2006

STATUS OF SAND SUPPLIES IN THE COLORADO BELOW GLEN CANYON DAM

Tributaries Have Delivered 1.7 – 2.6 Million Metric Tons of SAND



Experimental research opportunities to study beach habitat building flows

The Paria River inputs are now equal to five-year recurrence interval

Sand Bars are Important Elements in the River Restoration Program Because...

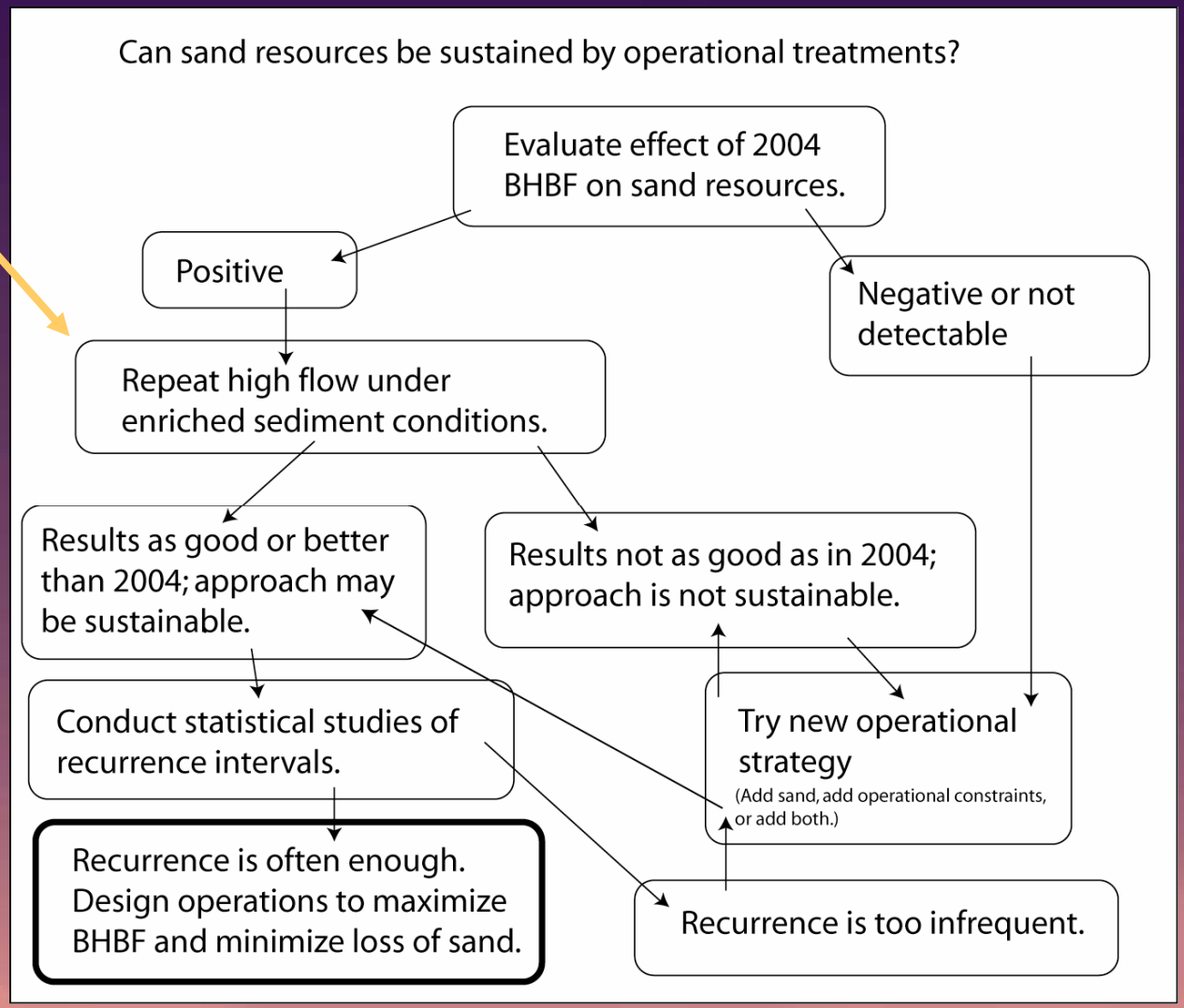
- **Geomorphic Framework** – fundamental part of the pre-dam river
- **Terrestrial Habitat** – substrate for riparian vegetation & assoc. fauna
- **Aquatic Habitats** – nursery habitats that may support native fish
- **In-Situ Preservation** – most archeological sites buried in sand/silt
- **Recreational Campsites** - for boaters and backpackers

USGS science for a changing world

Can Colorado River Sand Bars be Restored/Maintained by Downstream Sand Inputs + Managed GCD Flows?

Taking a Strategic, Science Based Approach to the Question of BHBFs

Scientists Currently Recommend



1996

- Channel was sand-depleted.
- Bar growth was minimal or negative.
- Not a sustainable plan.

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Pre-1996 Flood

Post-1996 Flood

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2004

- Channel was moderately enriched.
- Bar growth was more substantial.
- Promising, but additional sand is needed. (Requires more frequent floods, exploiting bigger inputs, adding sediment, or constraining flows between floods.)

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Pre-2004 Flood

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2004

Channel was moderately enriched.

Bar growth was better.

Promising, but more sand is needed. (Requires more frequent floods, exploiting bigger inputs, adding sediment, or constraining flows between floods.)

2006

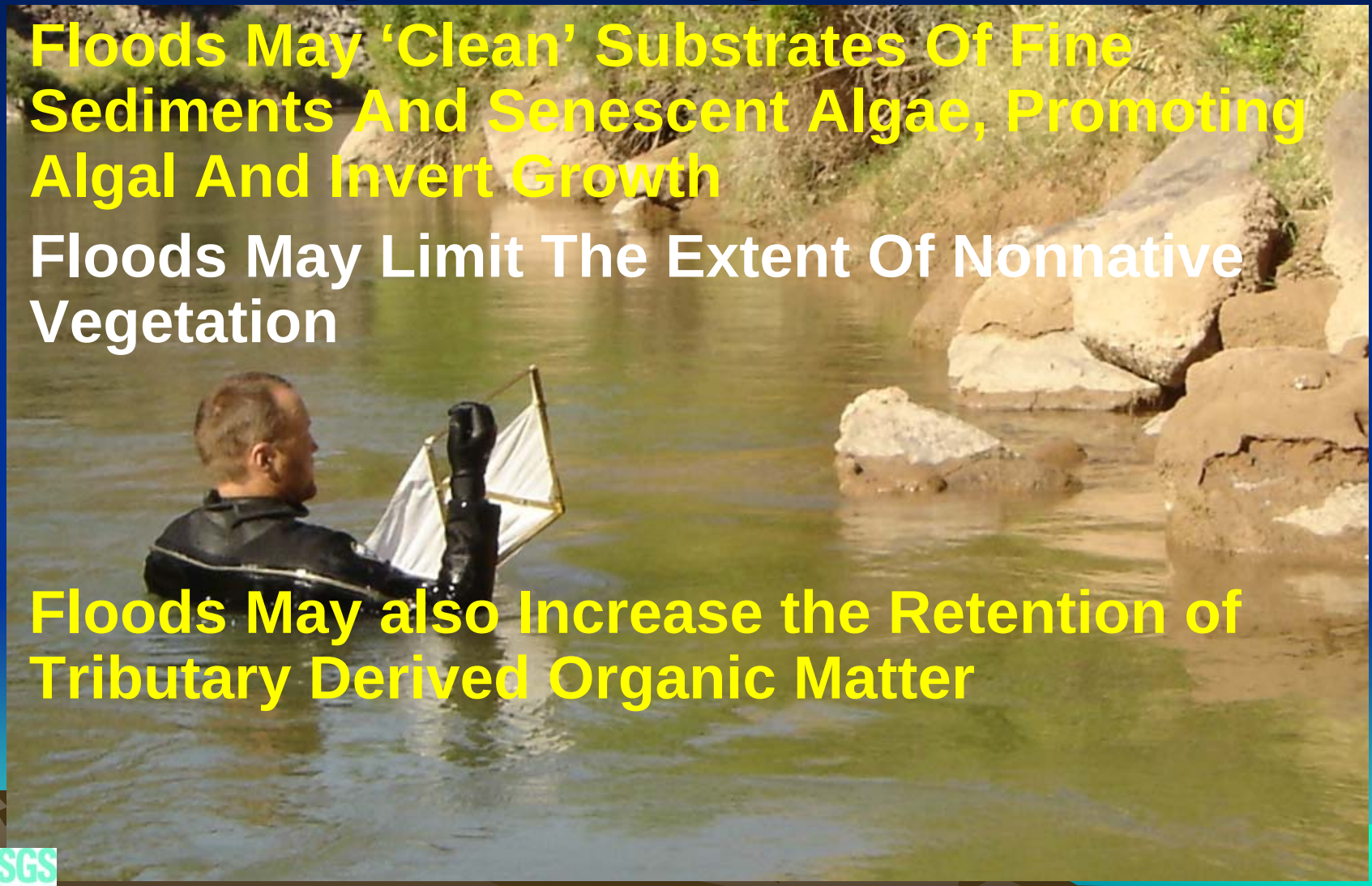
- Channel is a factor of 2 to 3 times more sand-enriched than in 2004.
- Potential to increase bar size and suppress subsequent sand export, while testing flow-only treatment.

Native Fishes

Sand Bars And Backwaters May Benefit Native Fishes, Especially Young Fish

Floods May Displace Nonnative Fishes

Aquatic Food Base and Riparian Vegetation

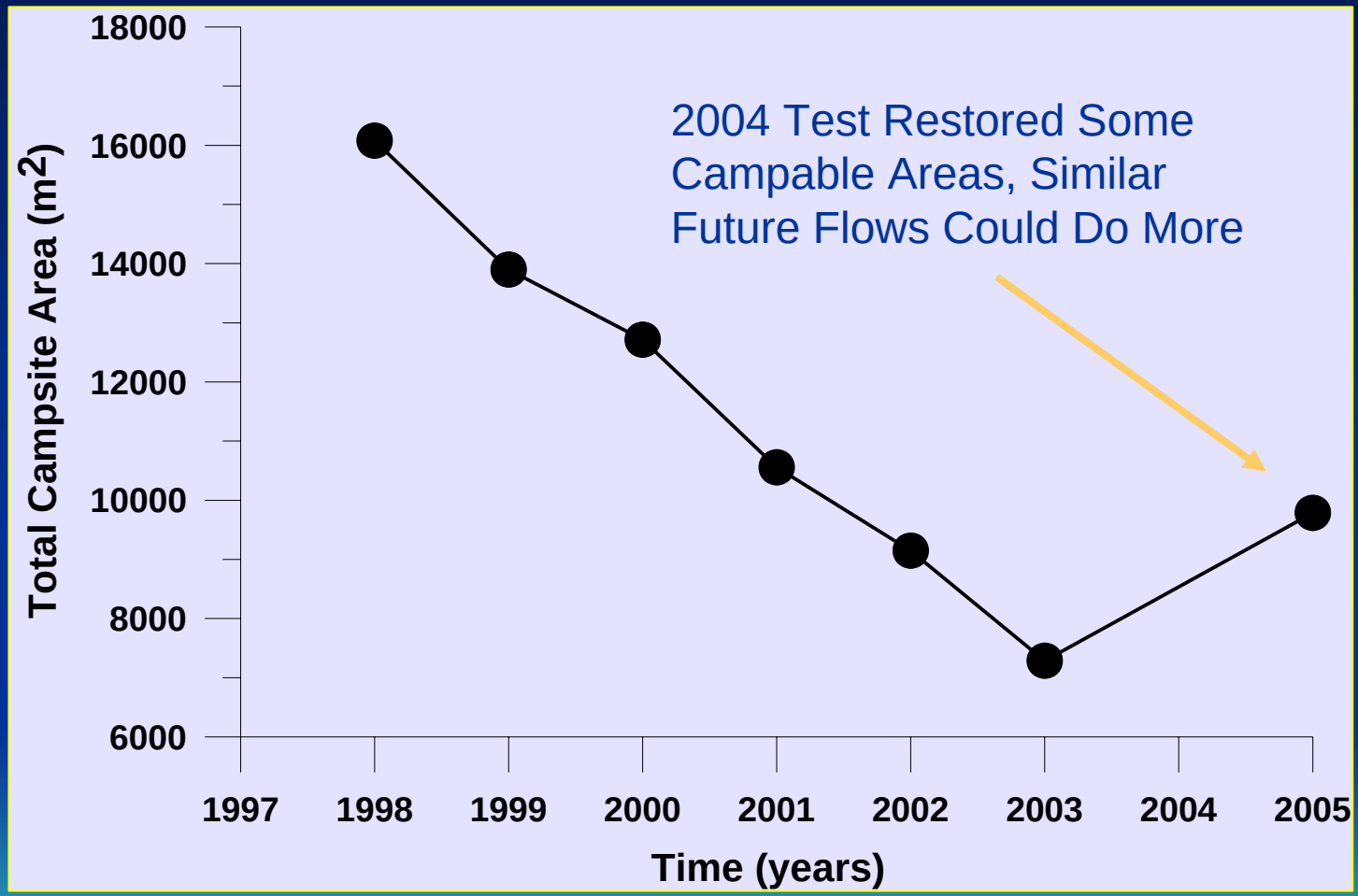


- Floods May 'Clean' Substrates Of Fine Sediments And Senescent Algae, Promoting Algal And Invert Growth
- Floods May Limit The Extent Of Nonnative Vegetation
- Floods May also Increase the Retention of Tributary Derived Organic Matter

Carbon Inputs to Downstream Ecosystem

Source 	Annual Production/Inputs (metric tons)
Particulate Organic Drift from LF (Kennedy, unpublished data)	10,000
Litter inputs from riparian zone (Ralston, unpublished)	520
Algal Production Downstream (estimated from Stevens et al. 1997)	2000
Paria River on Oct 6-7, 2006 (Kennedy, unpublished data)	33,000

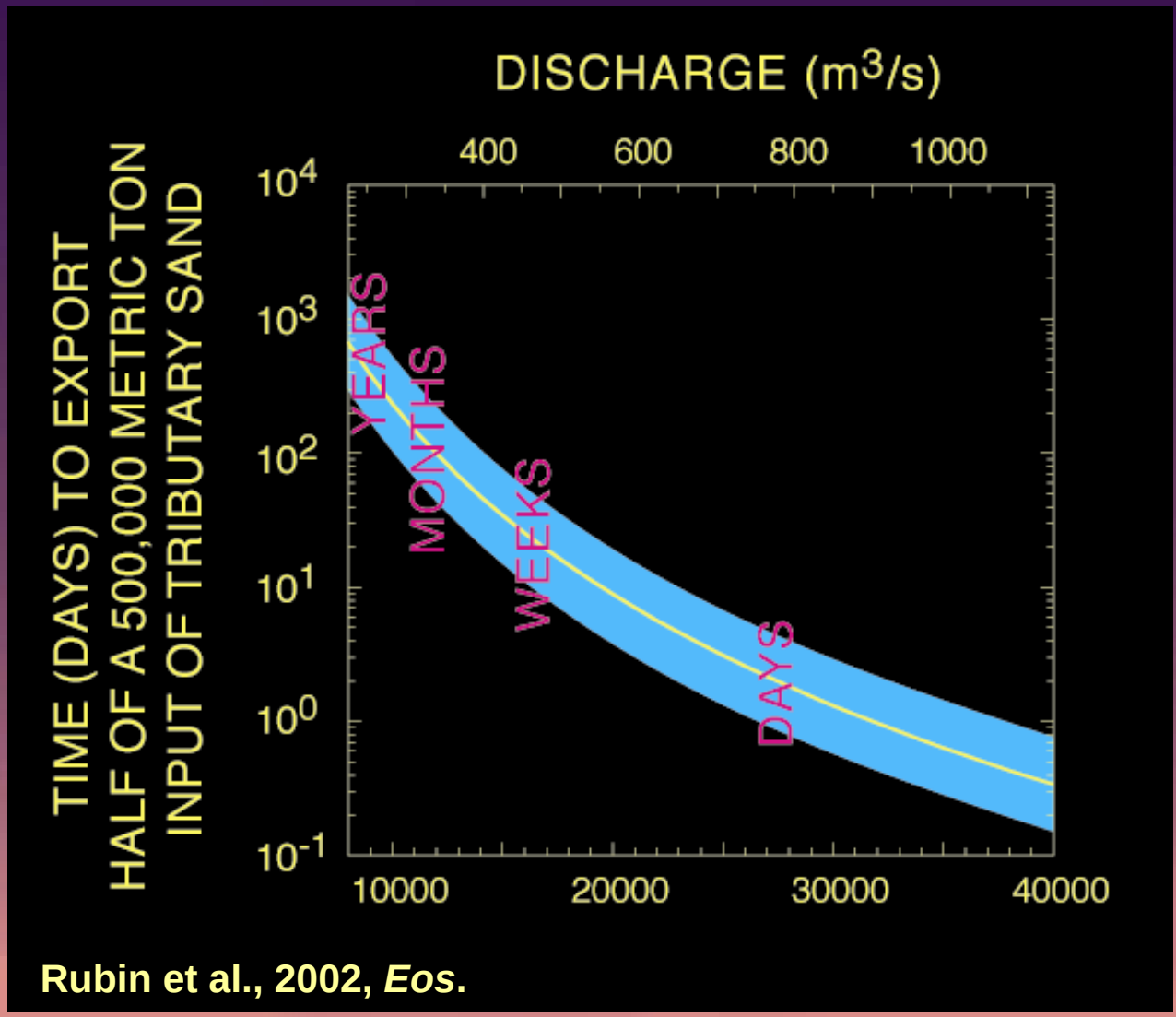
Sand Bar Erosion Linked to Recreation Campsite Loss



Without Enriched BHBFs - Archaeological Sites In The Colorado River Ecosystem Continue To Deteriorate Owing To Combined Effects Of:

- **Ongoing loss of sediment from the system**
- **Insufficient high elevation sediment-replenishment**
- **Weather-induced erosion, and**
- **Continuing visitor impacts (social trails, artifact loss, vegetation damage, soil compaction, etc.)**

Limited Time To Exploit New Sand Inputs



Rubin et al., 2002, *Eos*.

Summary – Flows and Sand Transport

Flow Regime	Months	Volume (TAF)	Inputs	Export	Average retained
5 – 10	9	490	1.6 ± 0.40	0.2 ± 0.02	82 – 91%
7 – 13	18	610	1.3 ± 0.33	0.4 ± 0.04	55 – 78%
11 – 18	23	850	1.0 ± 0.25	2.4 ± 0.24	- (73 – 250)%

Based on data from August 1999 – February 2006

Low to moderate volumes/peaks retained sand.
High volumes/peaks exported more sand than came in.

Preliminary data subject to review and revision

Potential for Equalization Releases in WY 2007

- October Inflow Has Increased Probability That WY 2007 Annual Release May Include Equalization Flows From Glen Canyon Dam

- New Sand Supplies Will Be Exported Faster Under Higher Peak Flows Associated With Larger Summer Volumes

- Probability of Equalization Releases in WY 2007 is currently 50 %

  - 50 % Exceedance [A-J ~ 91 %] Avg Summer Releases ~ 13,000 cfs
  - 40 % Exceedance [A-J ~ 101%] Avg Summer Releases ~ 16,000 cfs
  - 30 % Exceedance [A-J ~ 114 %] Avg Summer Releases ~ 20,000 cfs
  - 20 % Exceedance [A-J ~ 131 %] Avg Summer Releases ~ 22,000 cfs
  - 10 % Exceedance [A-J ~ 155 %] Avg Summer Releases ~ 24,000 cfs*

* may not be achievable due to maintenance

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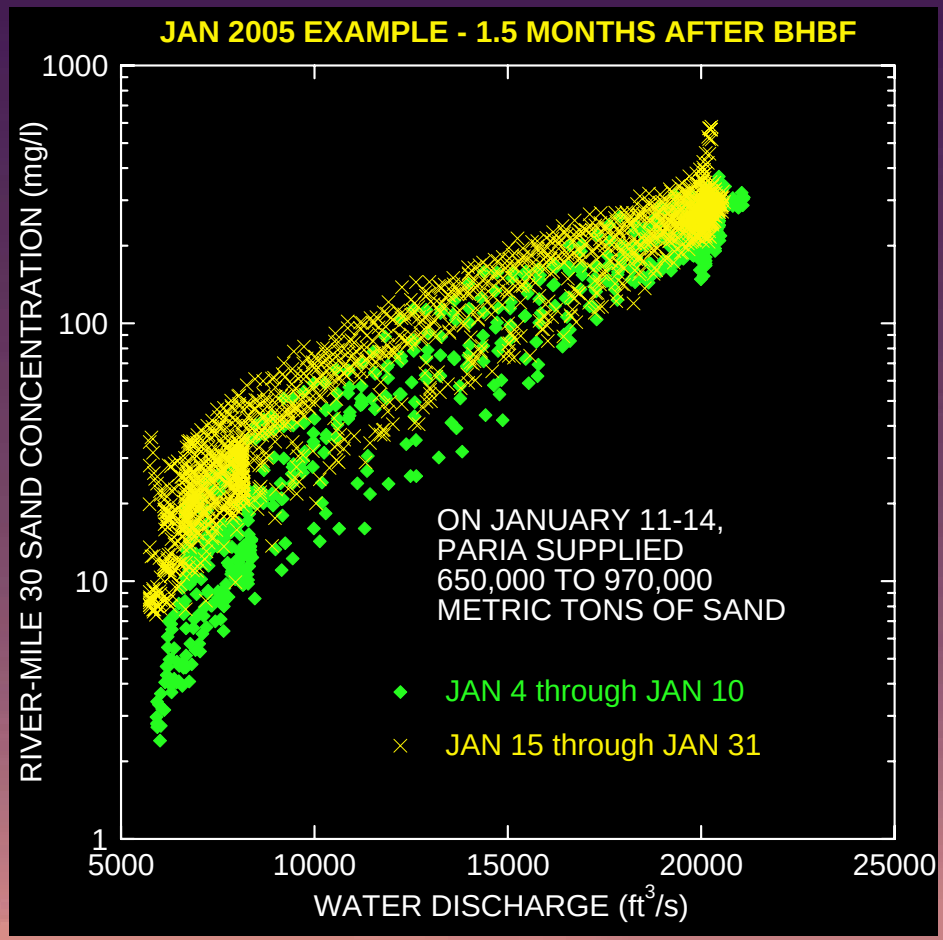
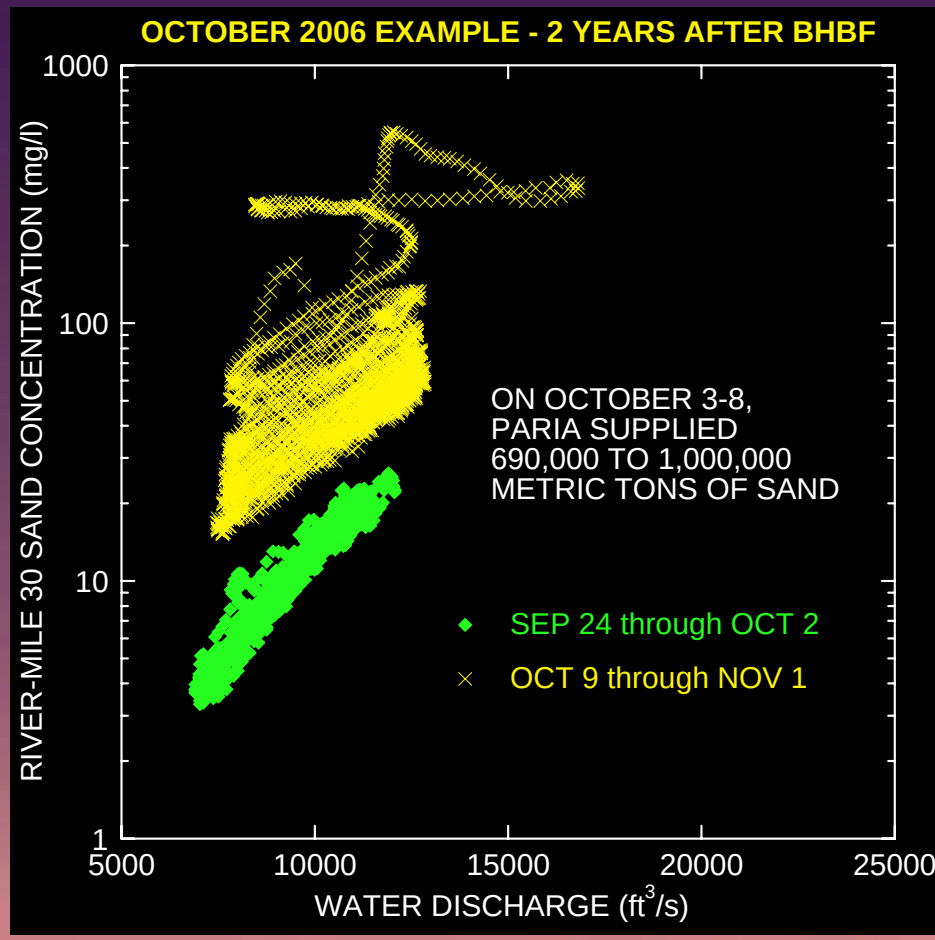
Additional Benefit: Suppression Of Sand Export By BHBF

• Coarsening of the channel bed and lower parts of bars during BHBFs can reduce the subsequent transport of sand in the Colorado River by about 80% over timescales of months (Rubin et al., 1998, *Geology*; Topping et al., 2000, *WRR*; Rubin and Topping, 2001, *WRR*; Topping et al., in press, *Sedimentary Geology*)

• Sand supplied by tributaries after BHBFs is retained longer than if no BHBF occurred.

TRIBUTARY SAND INPUTS FOLLOWING BHBFs ARE RETAINED MUCH LONGER





CONCLUSION

• Current sand enrichment makes 2007 an ideal opportunity to conduct an experiment and utilize limited sand resources to meet managers' goal.

• This situation occurs on average once every 5 years; the last time this level of tributary sand input from the Paria River occurred was 1998.

• Properly timed controlled floods from GCD are the only known flow option for sand bar habitat restoration.