

Update on High Flow Experiments Released from Glen Canyon Dam

Jack Schmidt

Grand Canyon Monitoring and Research Center

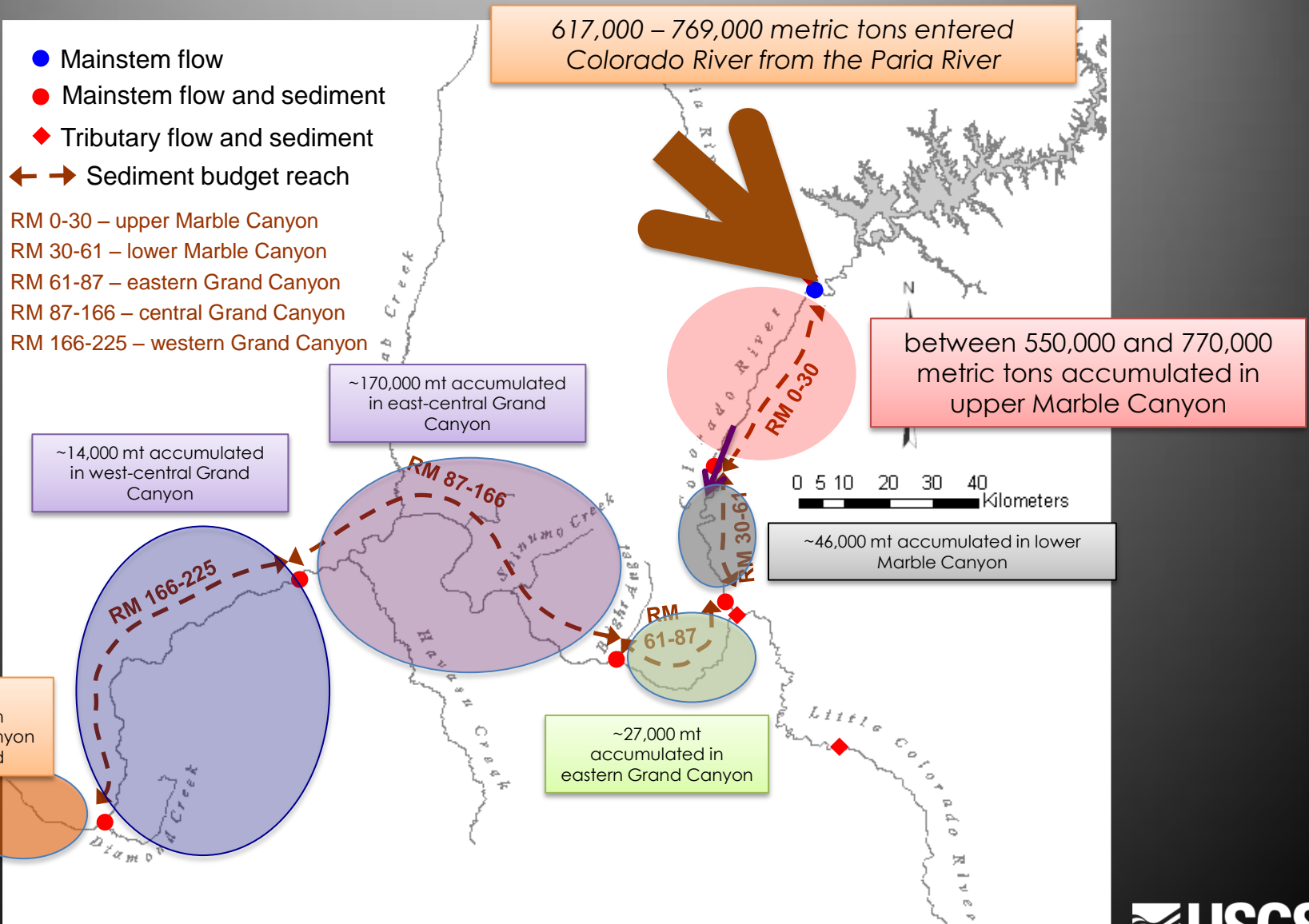
Southwest Biological Science Center

U. S. Geological Survey

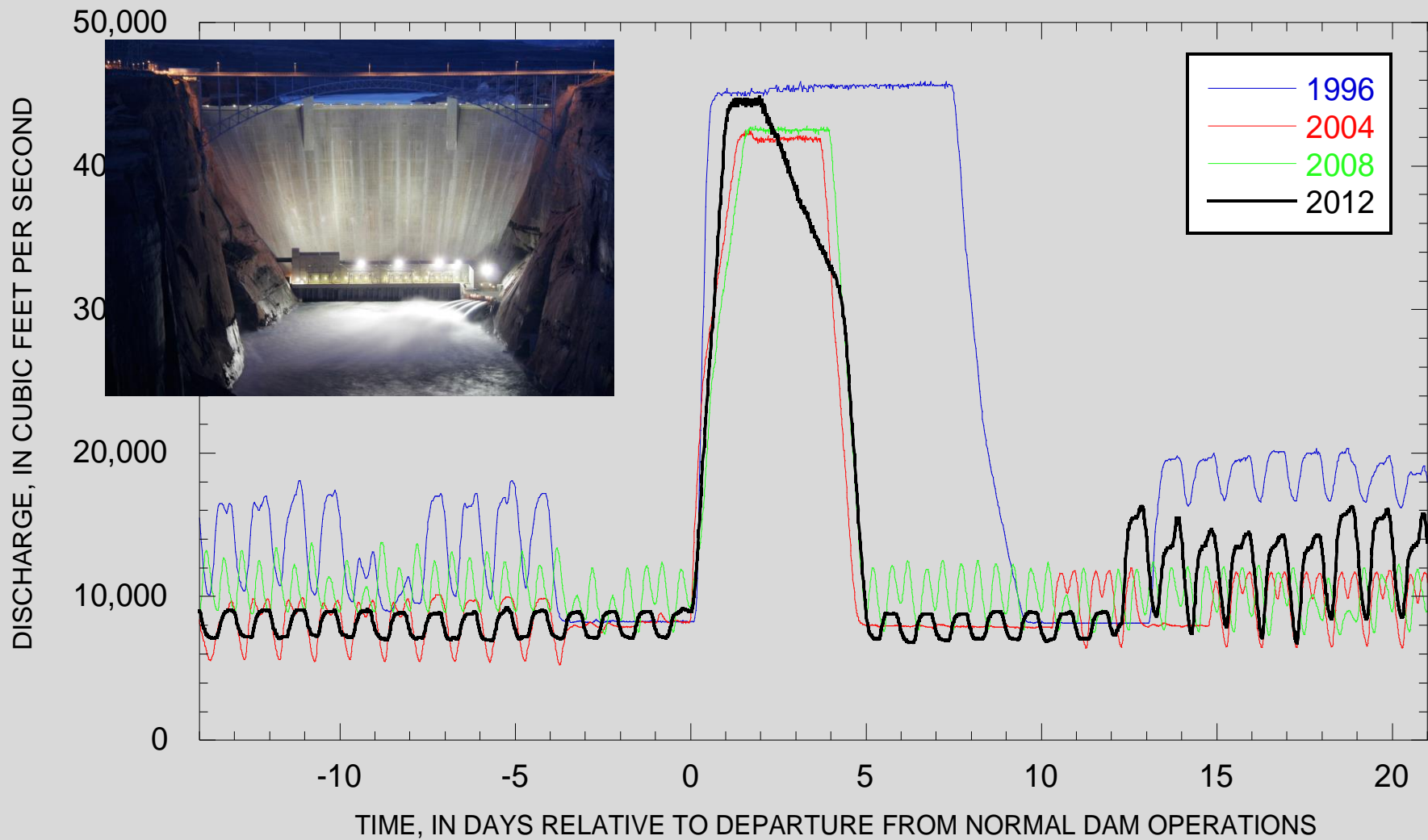
December 2013

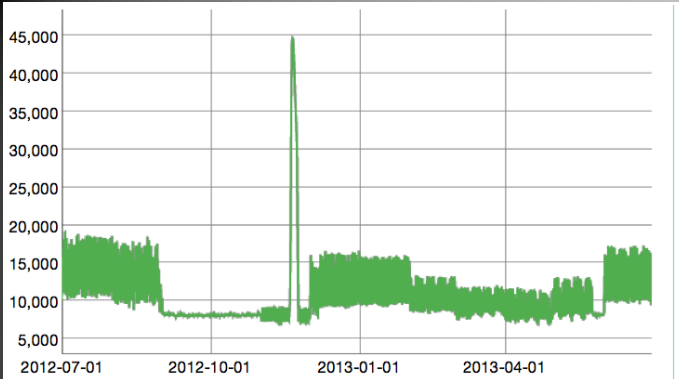


Between July 1 and November 17, 2012, ...



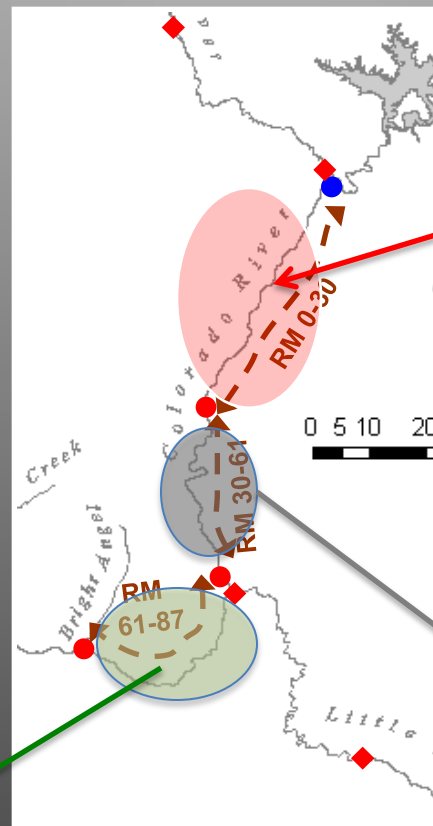
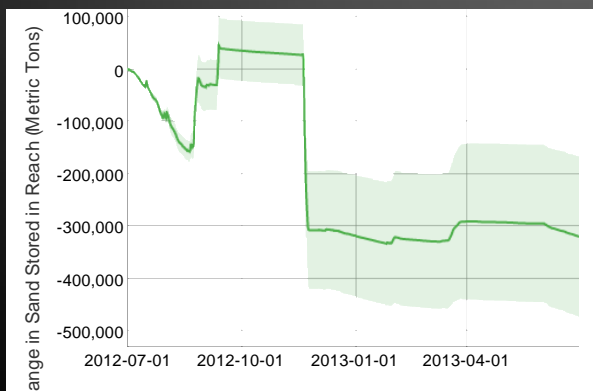
(Preliminary Data, Do Not Cite)



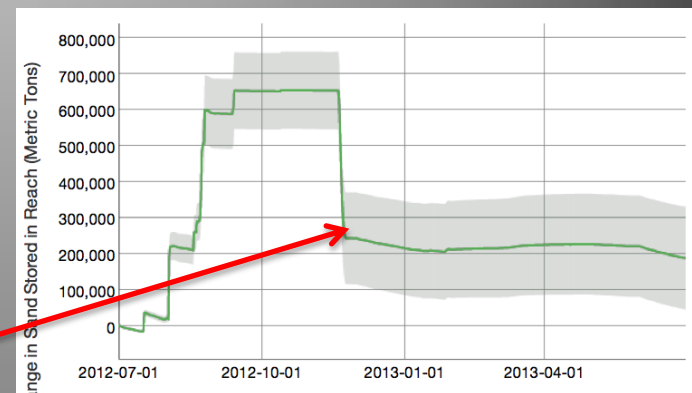


The 2012 HFE did not fully mobilize the sand available for redistribution

- 320,000 mt

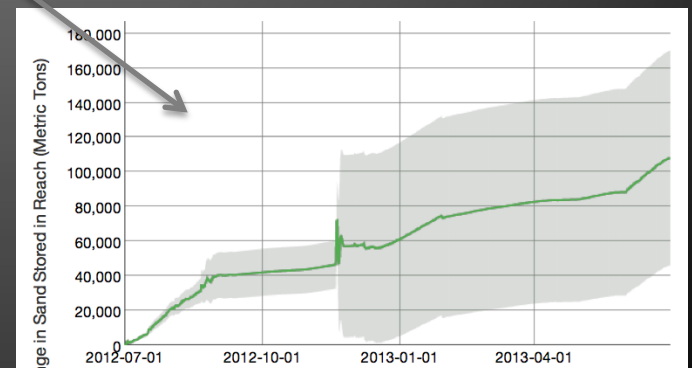


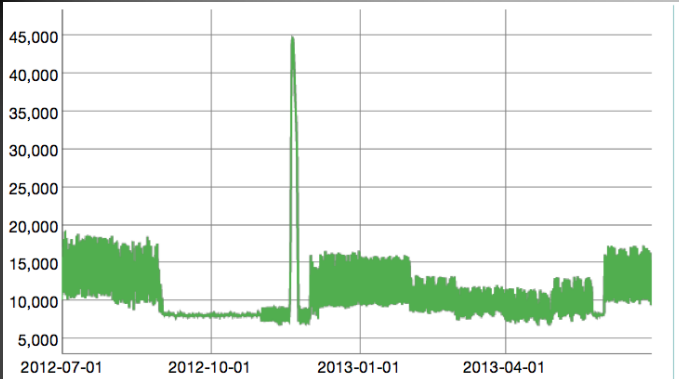
+ 190,000 mt



Sand mass balance
July 1, 2012, to June 30, 2013

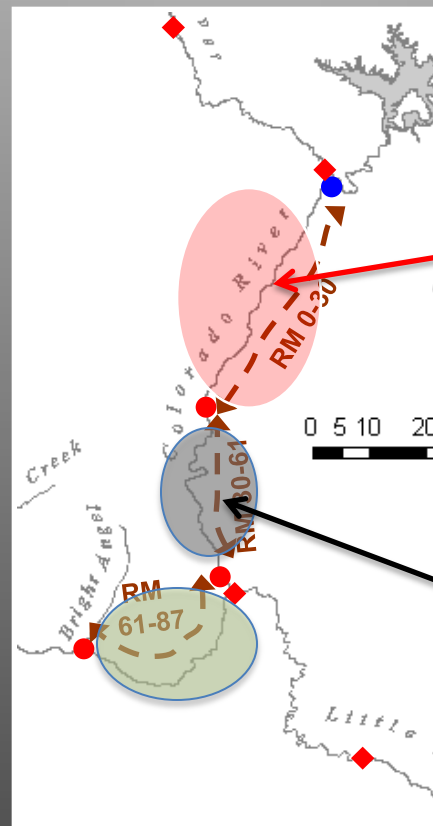
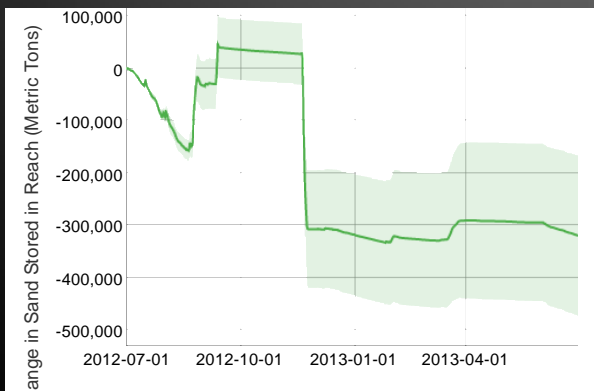
+ 110,000 mt



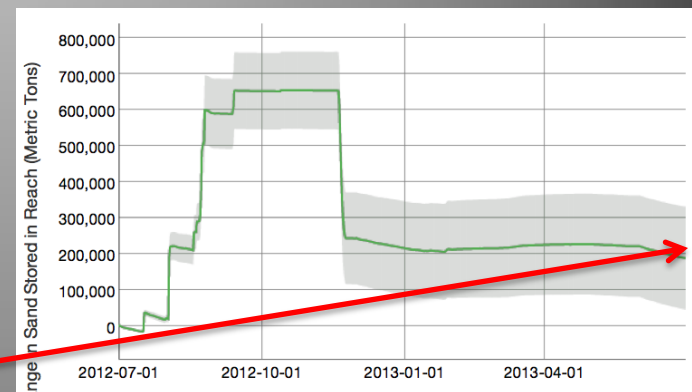


A small amount of the sand delivered during the 2012 fall season remained in Marble Canyon at the beginning of the 2013 accounting season

- 320,000 mt

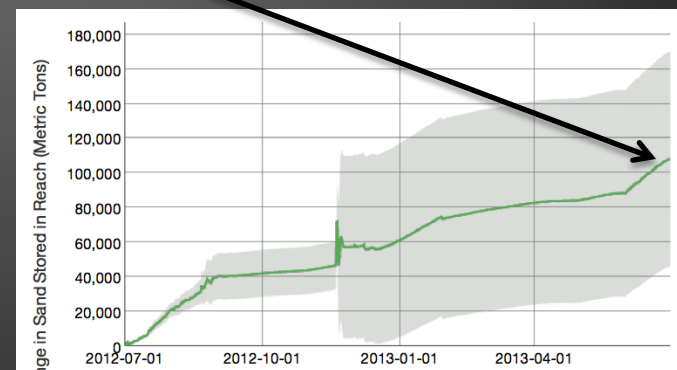


+ 190,000 mt



*Sand mass balance
July 1, 2012, to June 30, 2013*

+ 110,000 mt



Sandbar response to sediment-rich high flows

- November 2012 HFE
 - Images from remote cameras:
 - 52% (17 out of 33): noticeable gain
 - 39% (13 out of 33): no substantial change
 - 9% (3 out of 33): noticeable loss
 - Sandbar surveys: 54% of sites (27 out of 50) larger in Oct. 2013 than in Oct. 2011

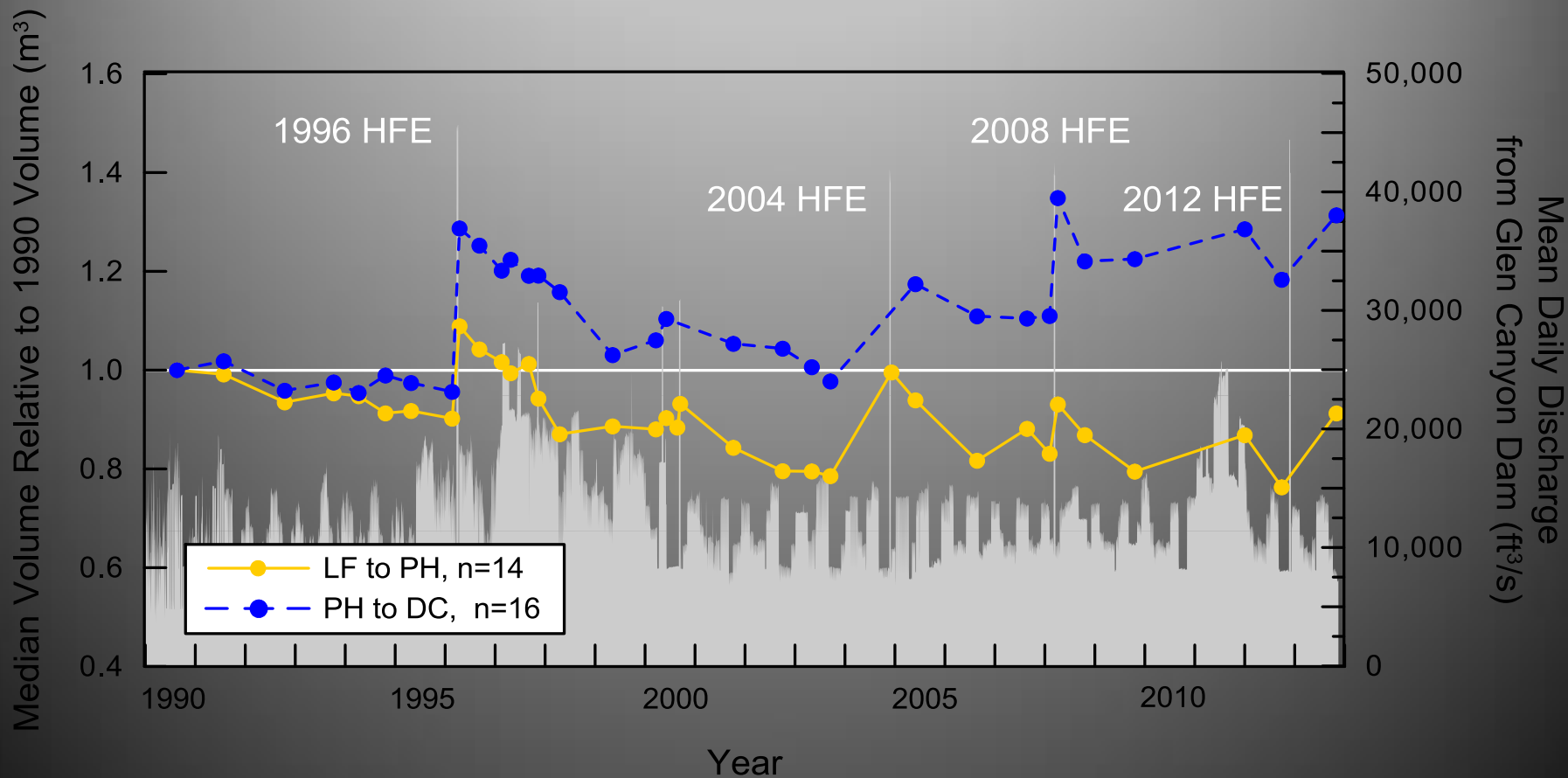


RM 65 R (Carbon)

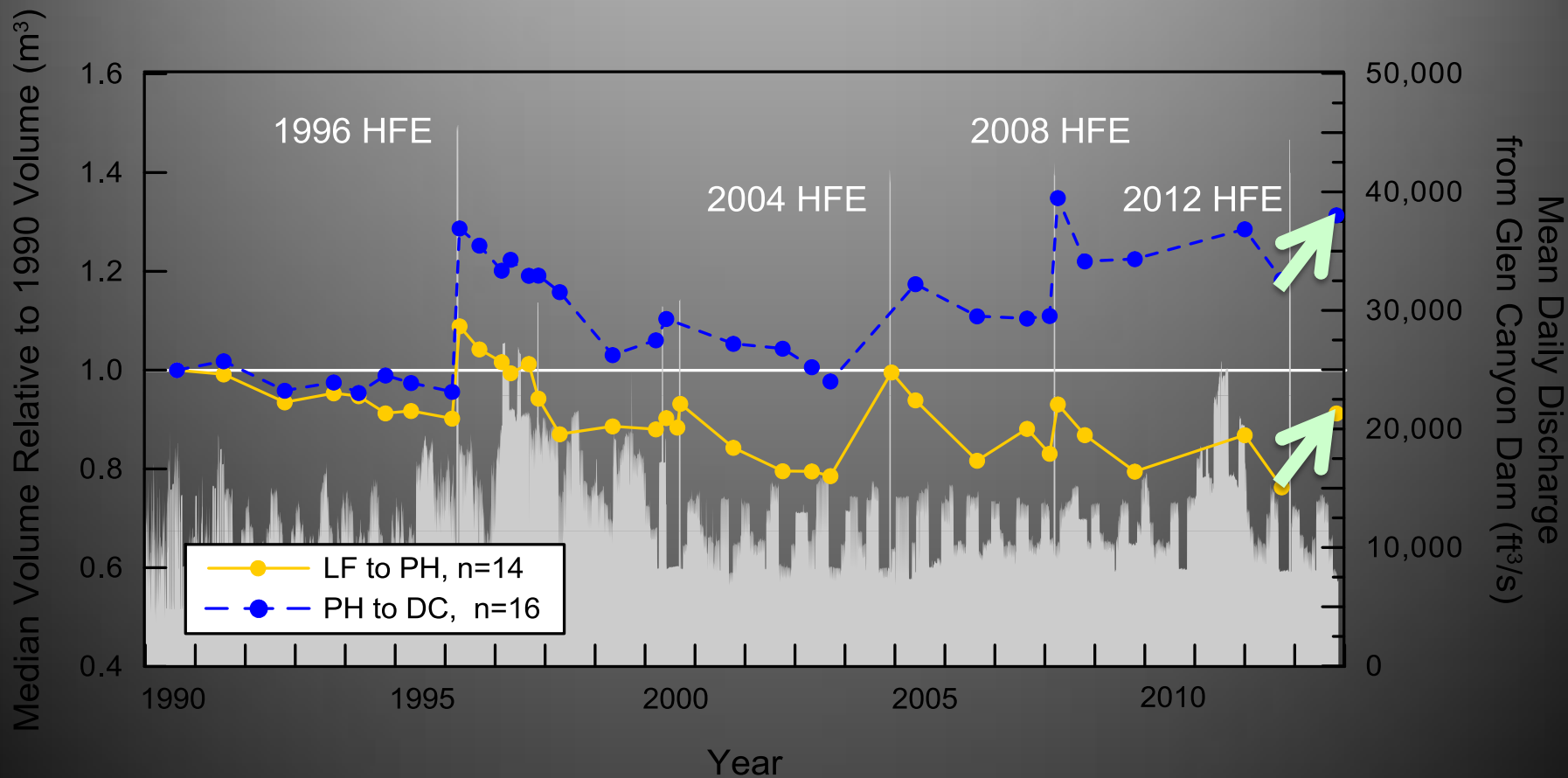
Newly deposited eddy bars are eroded by intervening flows



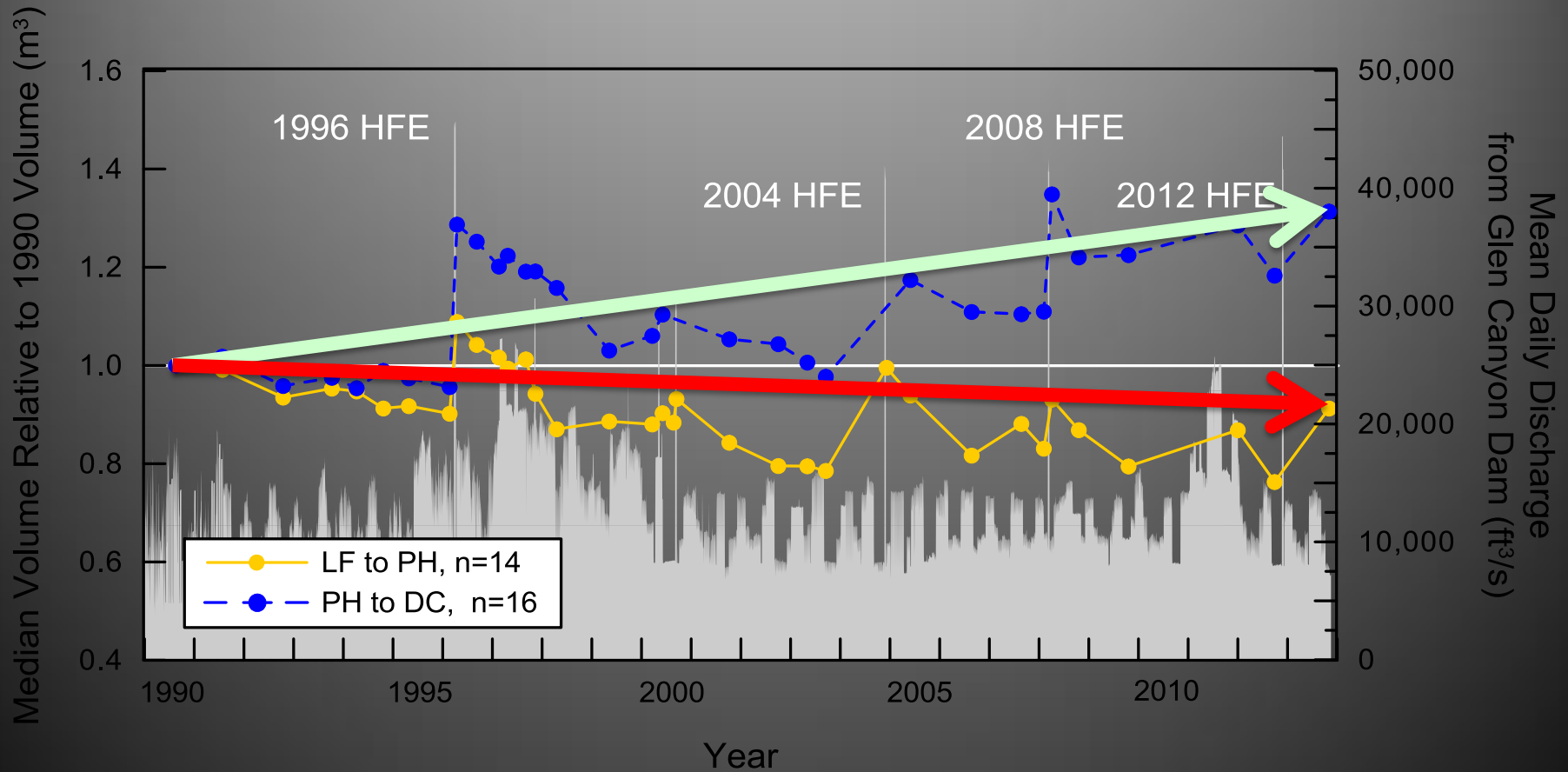
Long-term changes in sandbar volume in Marble and Grand Canyons, 1990-2013



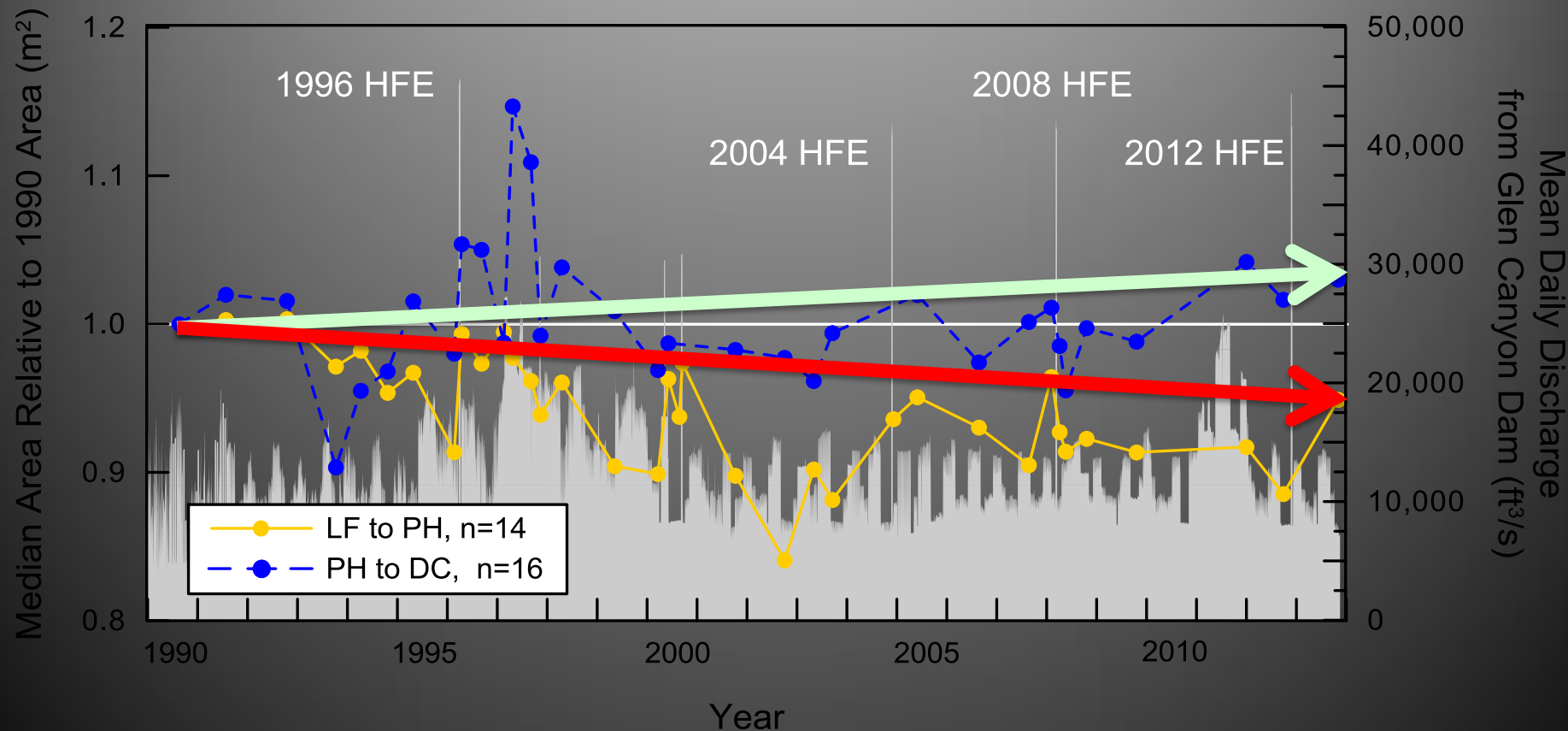
Net change in eddy sandbar volume was increased by the 2012 HFE



These changes improved the long-term trend

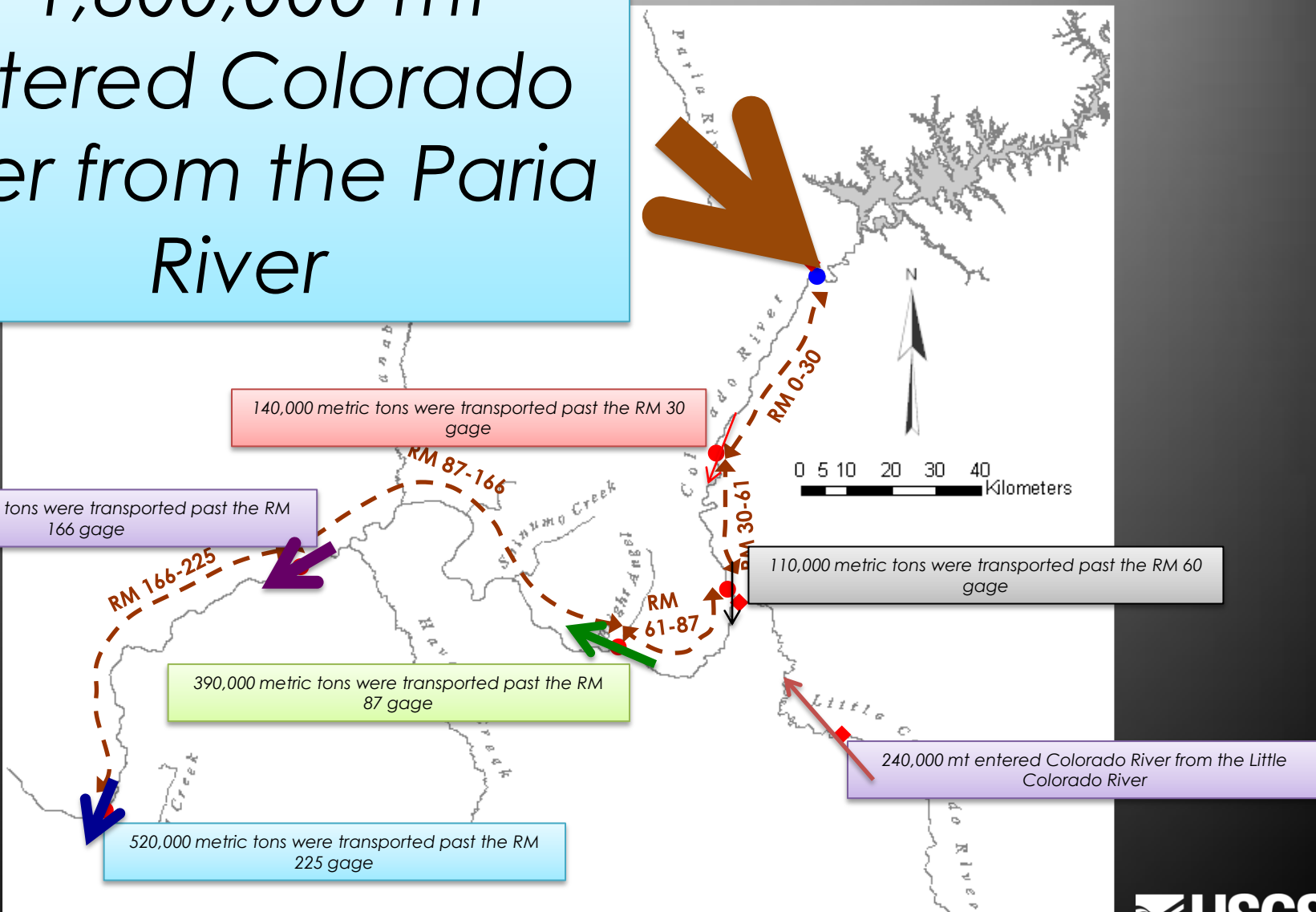


The same pattern is observed for area of eddy sand bars

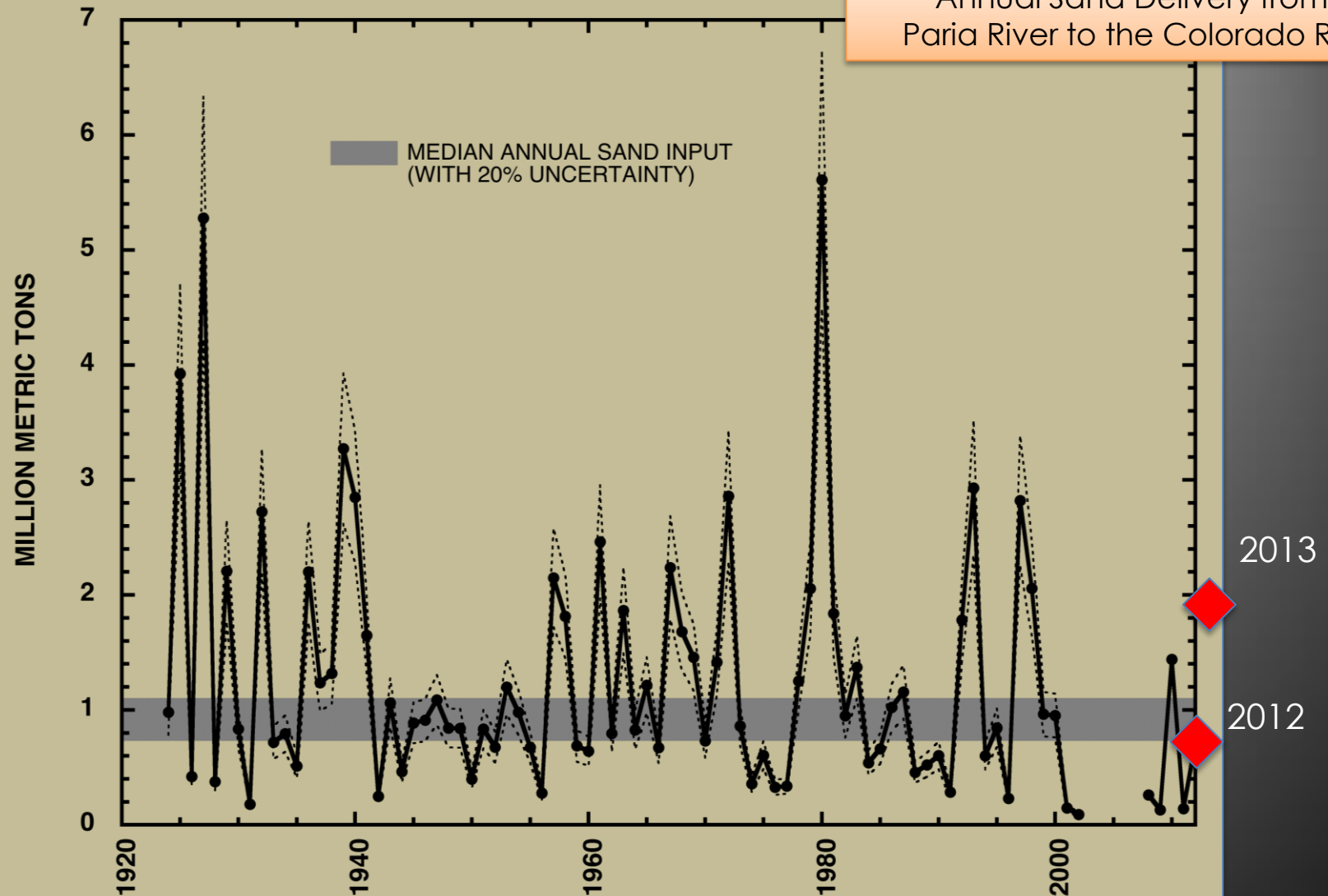


Between July 1 and November 10, 2013, ...

*~1,800,000 mt
entered Colorado
River from the Paria
River*

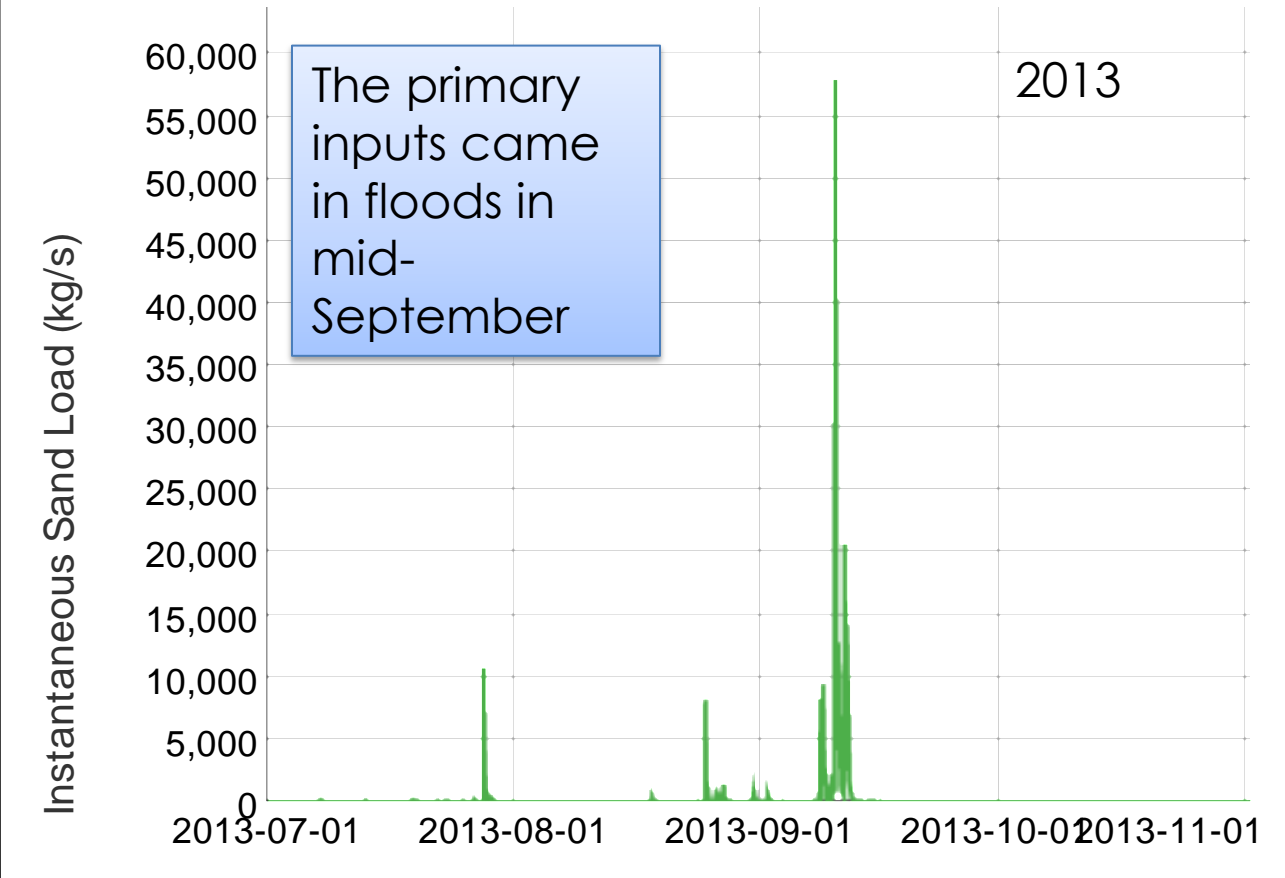
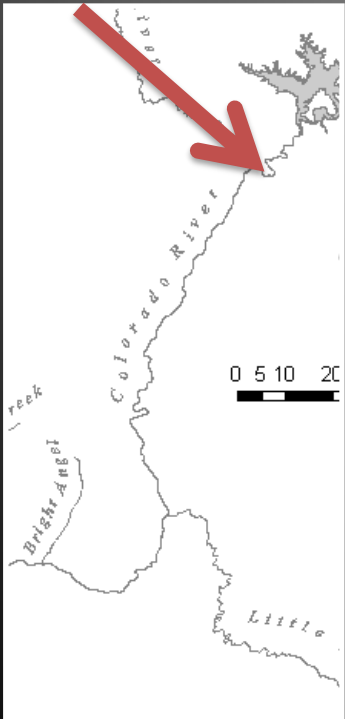
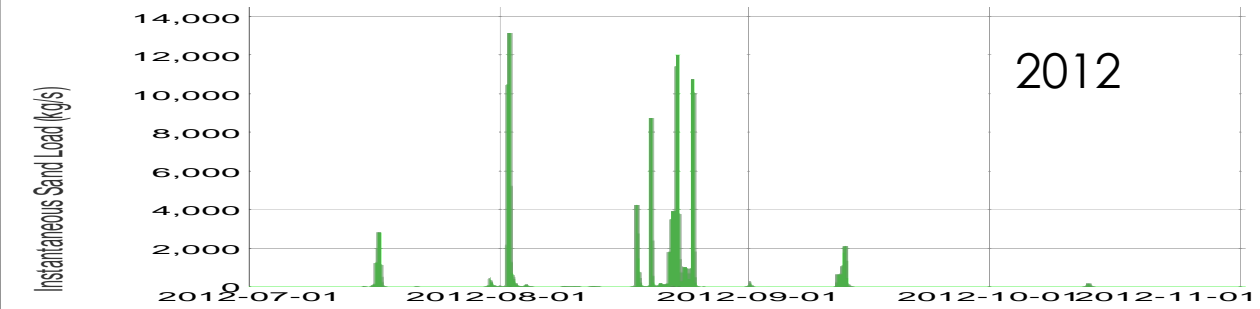


Annual Sand Delivery from the Paria River to the Colorado River



2012 was a typical year for sand inputs; 2013 was an unusually large input year

(Preliminary Data, Do Not Cite)



(Preliminary Data, Do Not Cite)

Between July 1 and November 10, 2013, ...

- Mainstem flow
- Mainstem flow and sediment
- ◆ Tributary flow and sediment

Between 1,300,000 and 2,300,000 mt accumulated in upper Marble Canyon

160,000 mt accumulated in west-central Grand Canyon

120,000 mt accumulated in east-central Grand Canyon

540,000 mt accumulated in western Grand Canyon and Lake Mead

64,000 mt accumulated in lower Marble Canyon

22,000 mt was eroded from eastern Grand Canyon

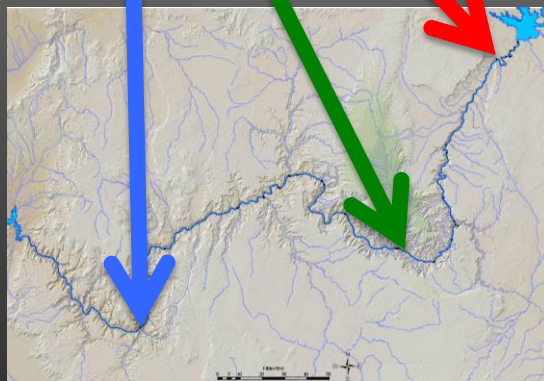
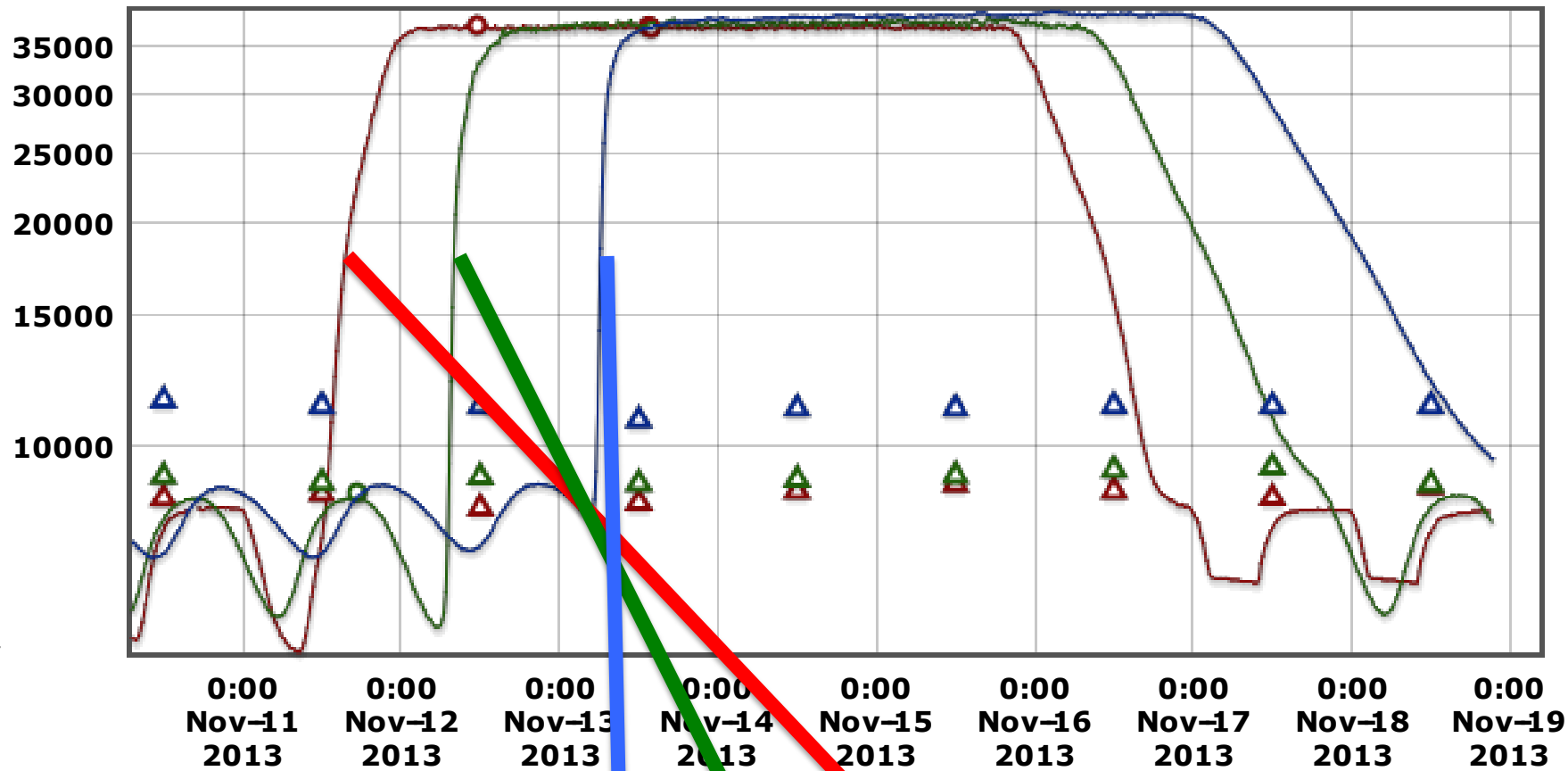
Upper Marble Canyon mass balance prior to other HFEs

July 1 to November 19, 2004: 350,000 – 560,000 mt

July 1, 2006 to March 3, 2008: 890,000 – 1,700,000 mt

July 1 to November 17, 2012: 550,000 – 760,000 mt

(Preliminary Data, Do Not Cite)



2013 Controlled Flood release



2012



RM 9



2013



RM 65 R (Carbon)



2012



2013



Sandbar response to sediment-rich high flows

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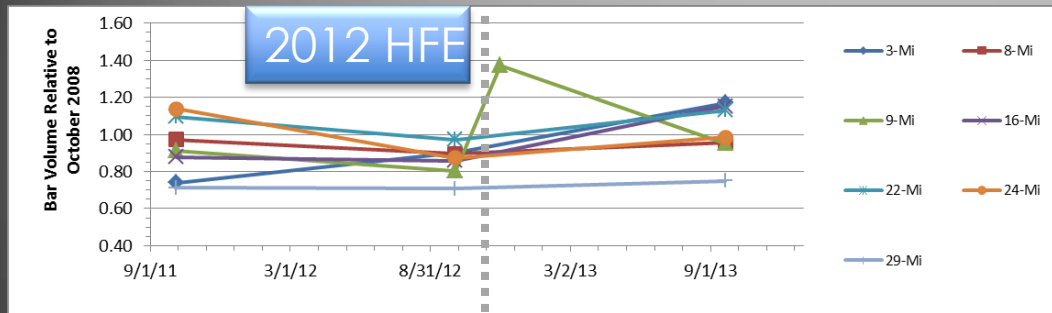
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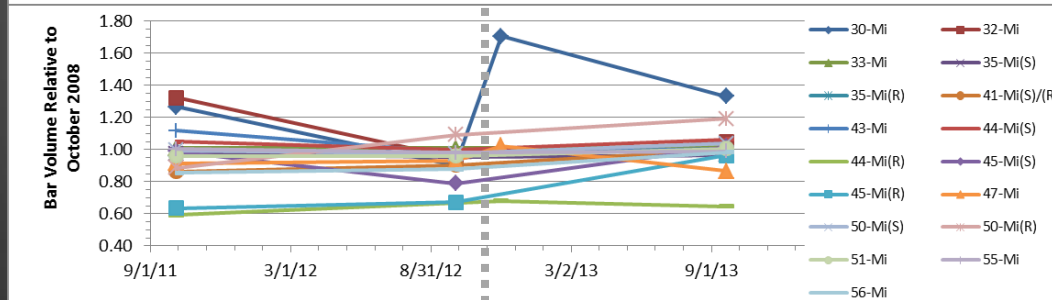
Sandbars 10 months following 2012 high flow



Upper Marble Canyon (RM 0-29)

5 of 7 sites larger than Oct. 2011

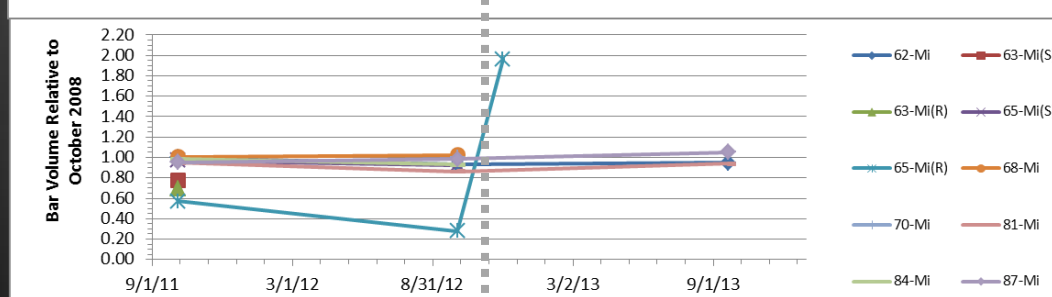
3 of 7 sites larger than Oct. 2008



Lower Marble Canyon (RM 30-62)

11 of 16 sites larger than Oct. 2011

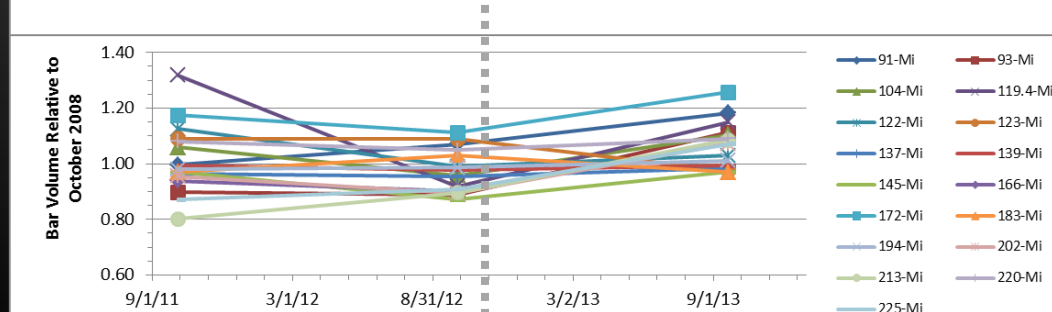
9 of 16 sites larger than Oct. 2008



Eastern Grand Canyon (RM 62-87)

1 of 3 sites larger than Oct. 2011

1 of 3 sites larger than Oct. 2008

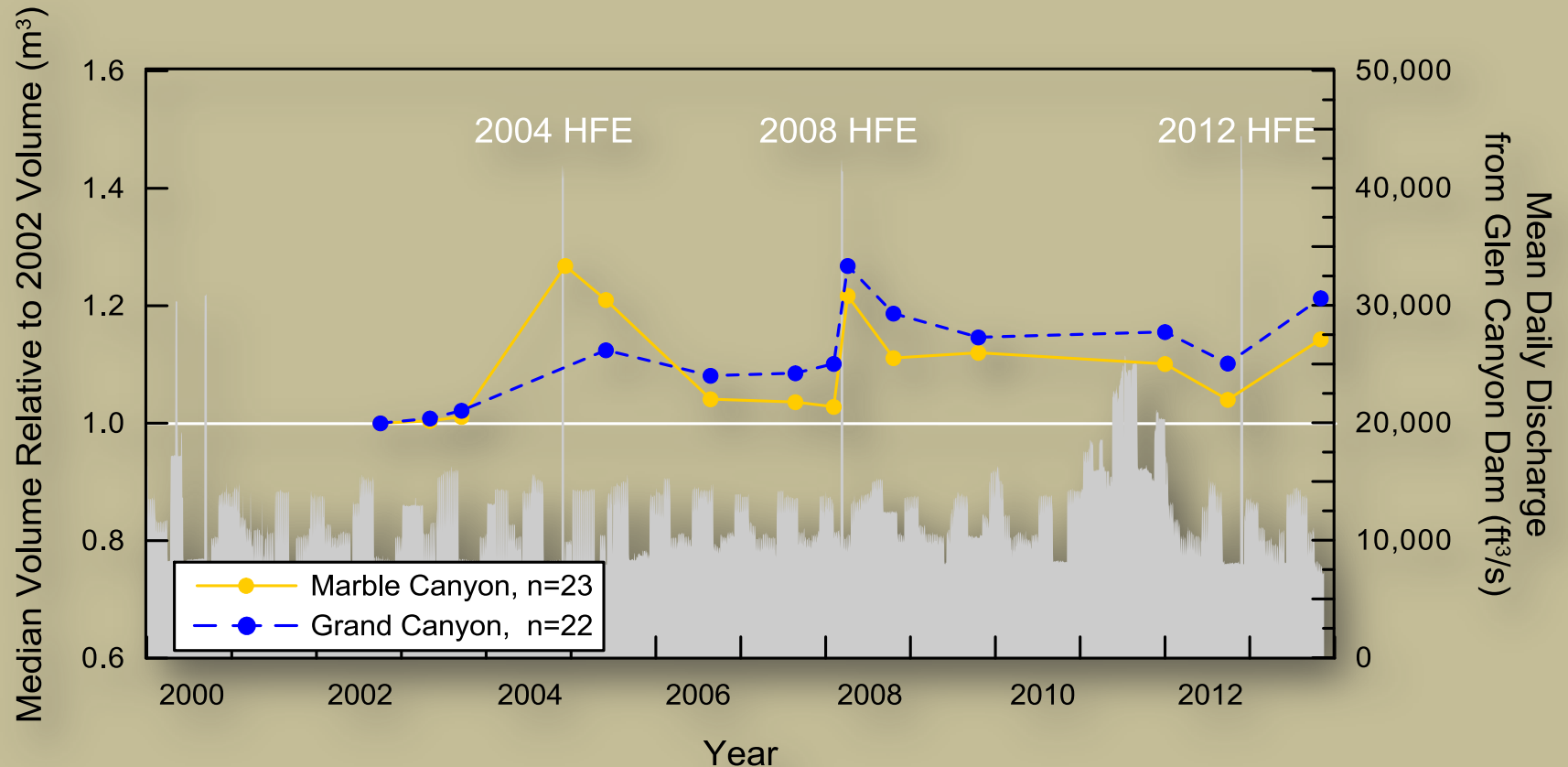


Grand Canyon (RM 88-225)

10 of 16 sites larger than Oct. 2011

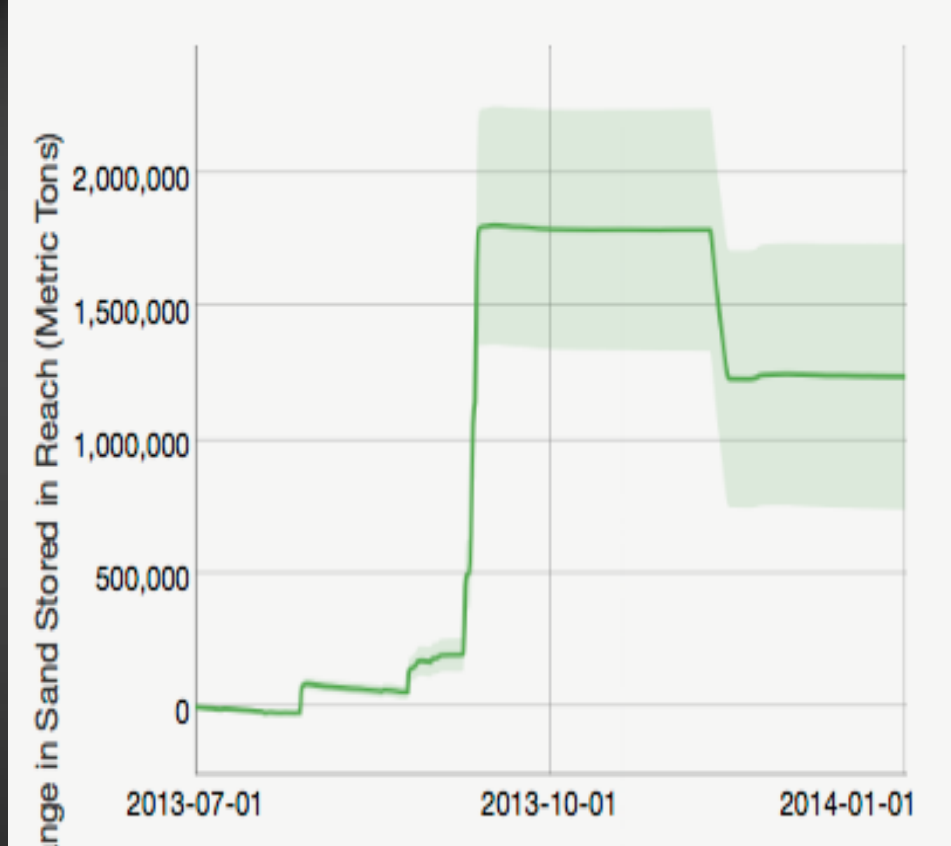
11 of 16 sites larger than Oct. 2008

Sandbars 10 months following 2012 high flow

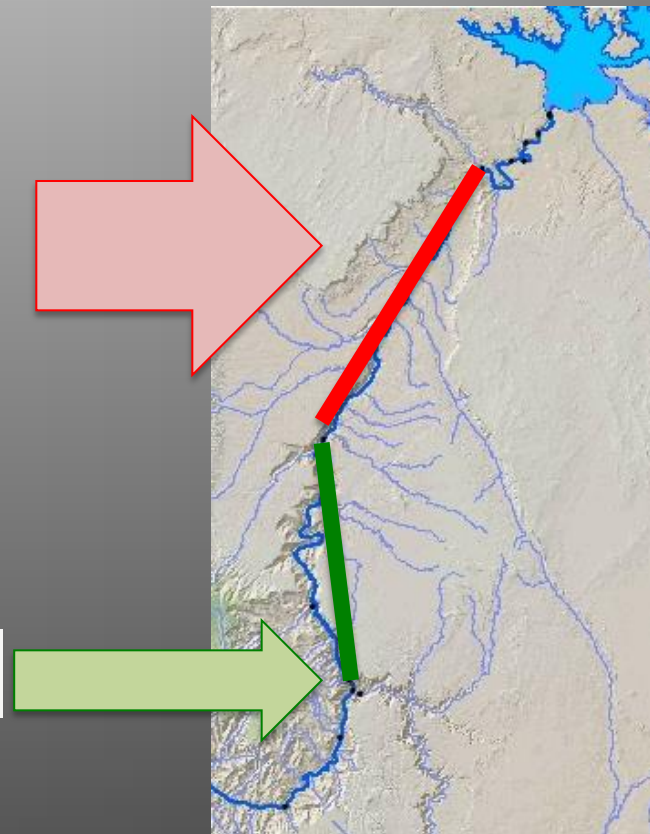
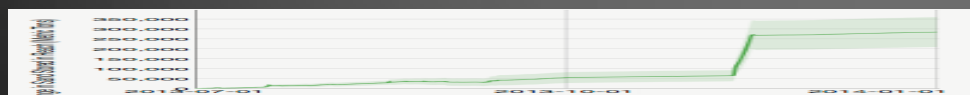


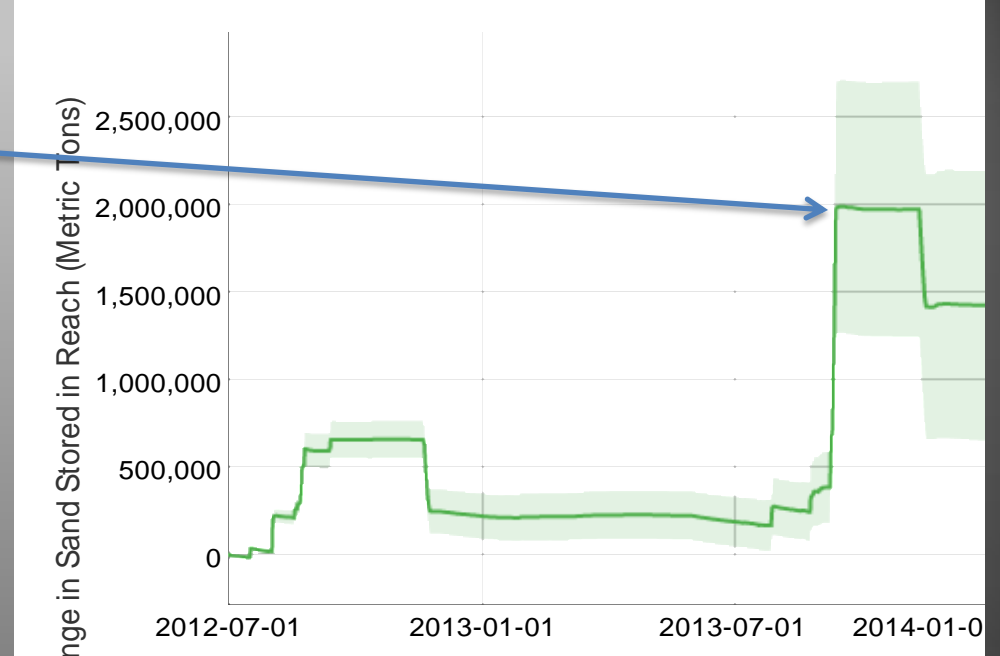
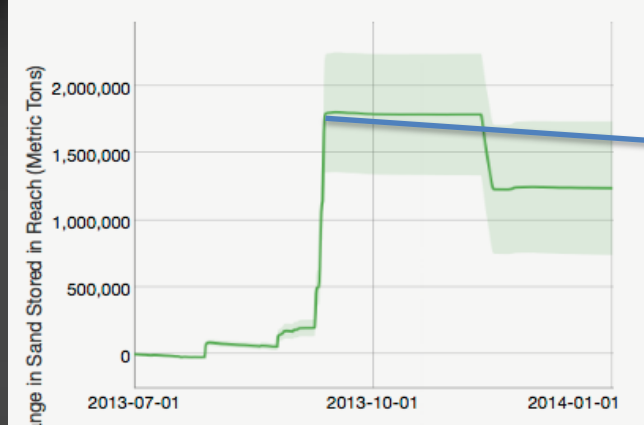
- Sediment enriched HFEs and relatively low release volumes
- → relatively large bars 10 months following HFE

Joe Hazel, NAU, unpublished data, do not cite

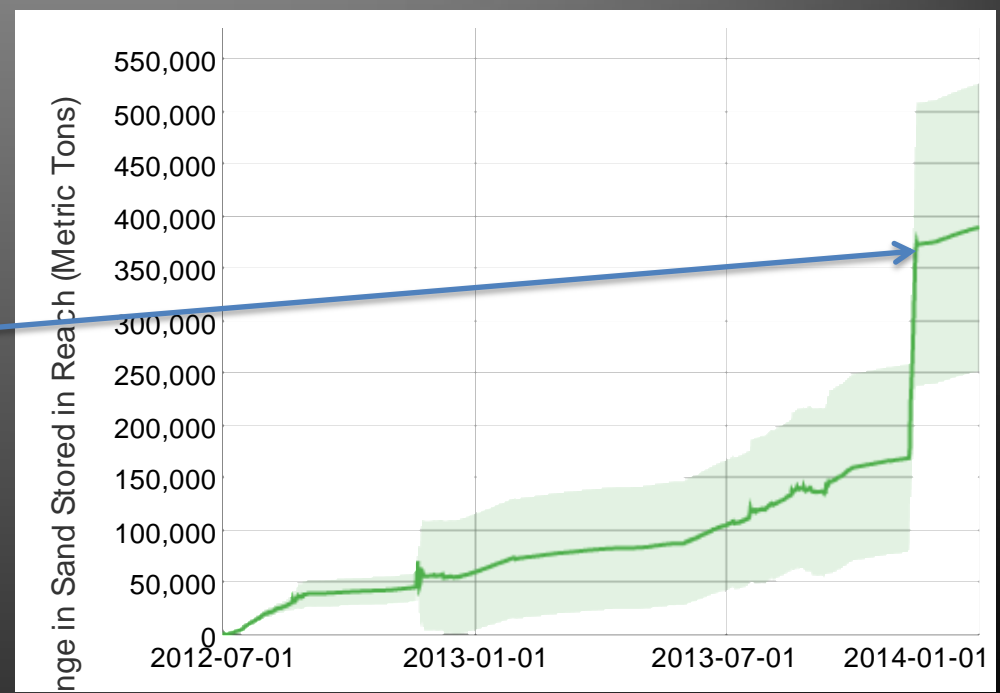
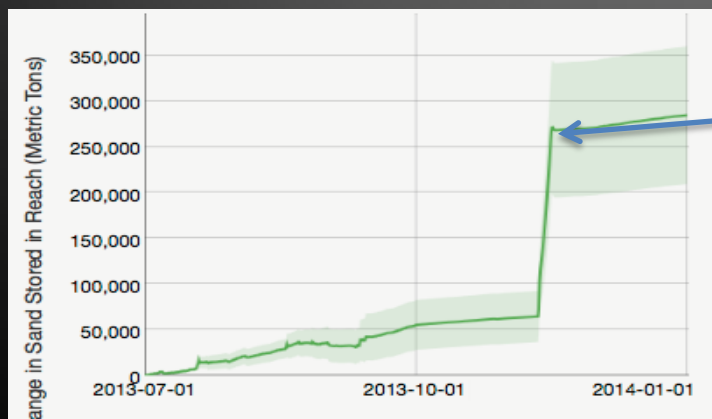


The 2013 HFE mobilized a small part of the supply that was available for redistribution



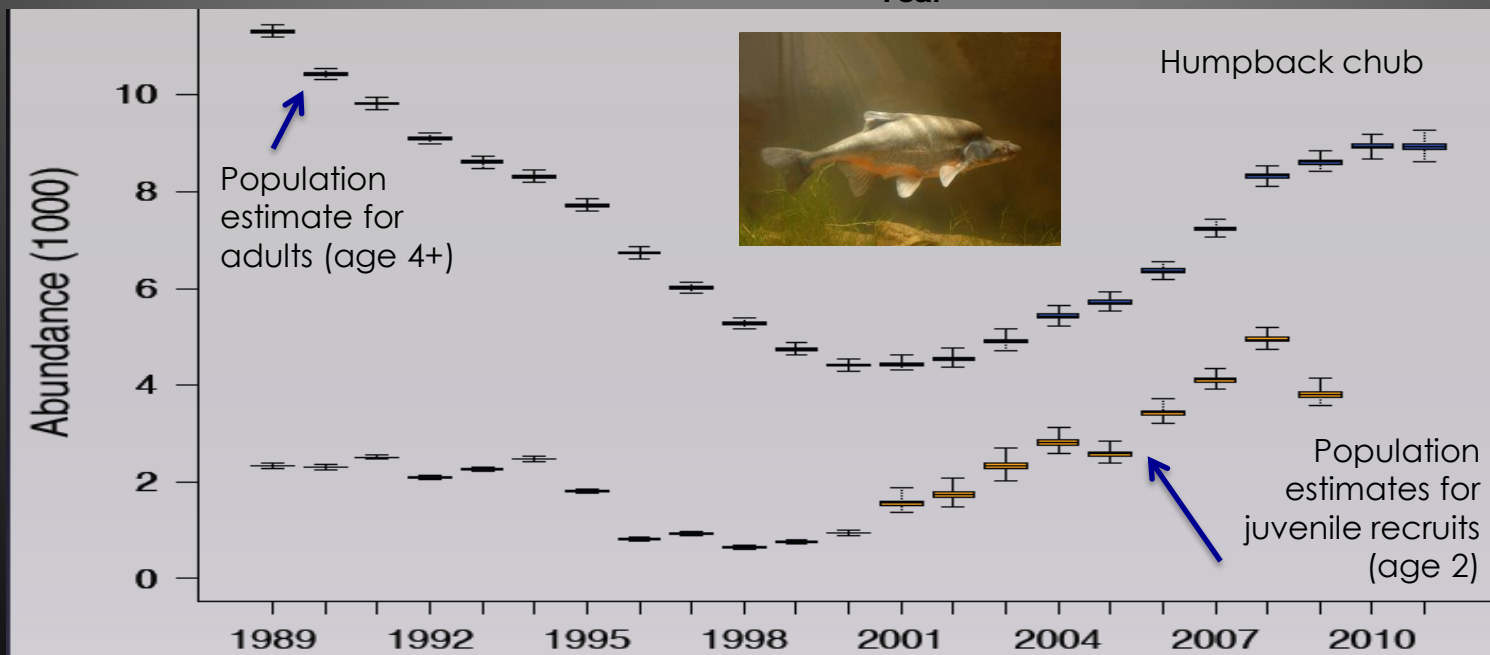
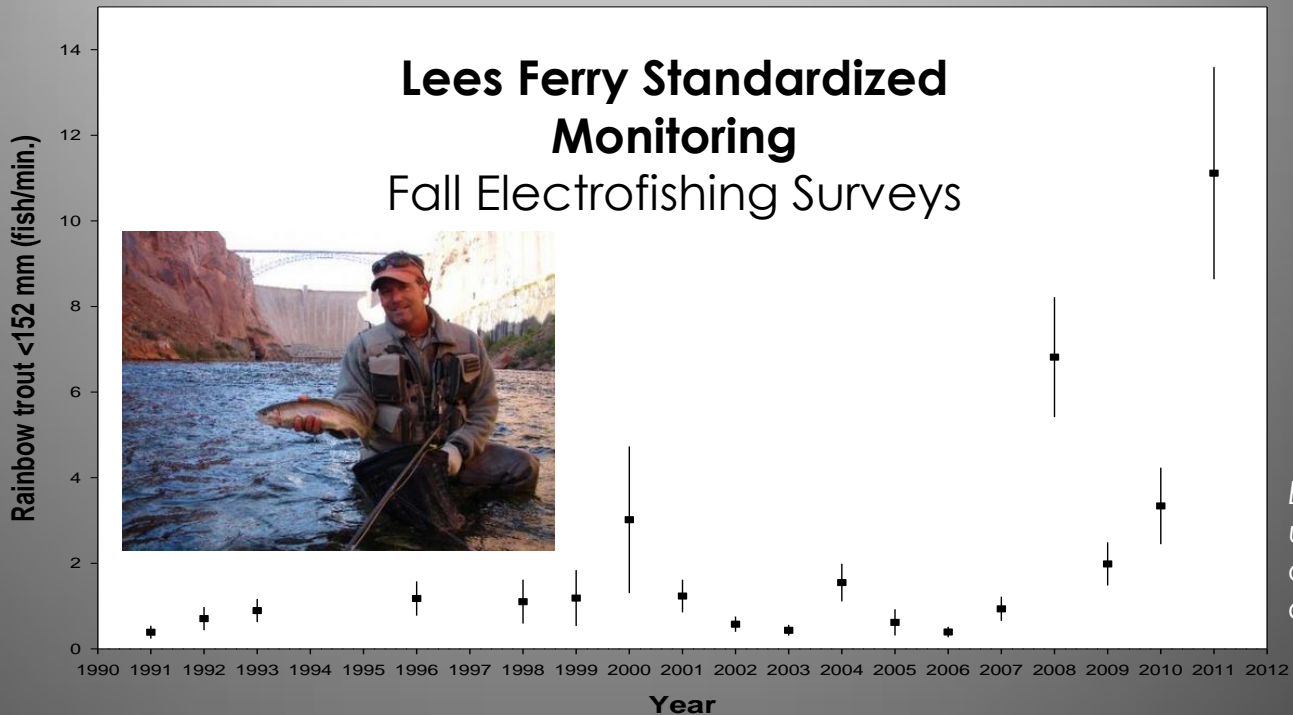


Sand on the bed has accumulated in upper Marble Canyon since July 1, 2012. We are not fully mobilizing the sand available for redistribution.



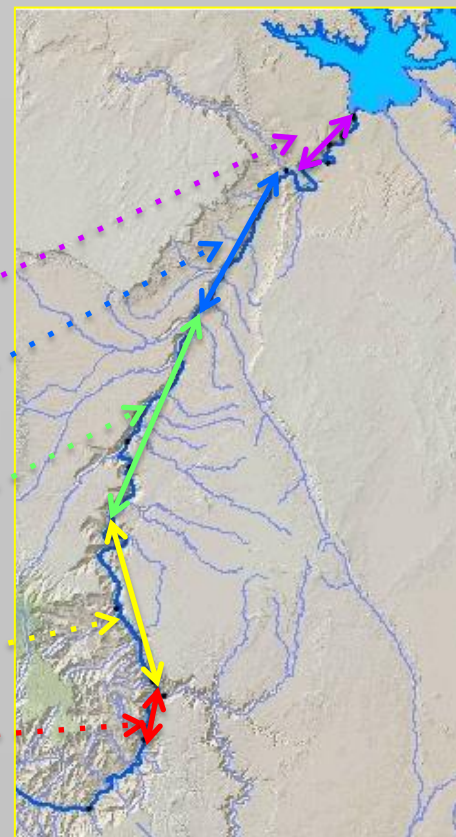
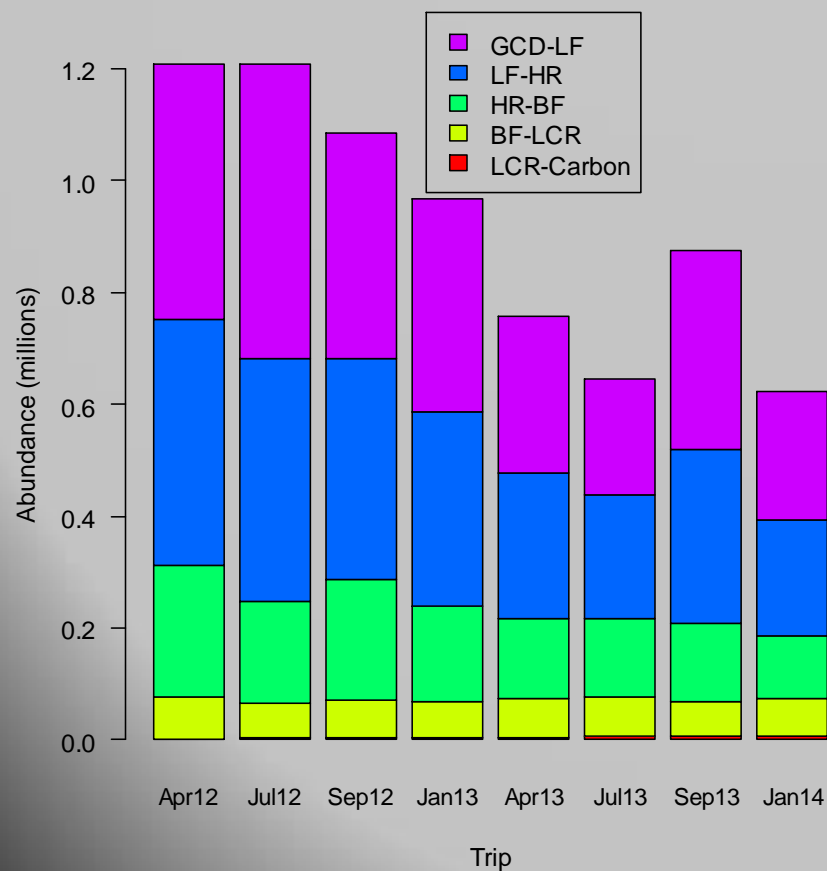
(Preliminary Data, Do Not Cite)

Rainbow trout were at unprecedented numbers in 2012. Humpback chub are stable or increasing,

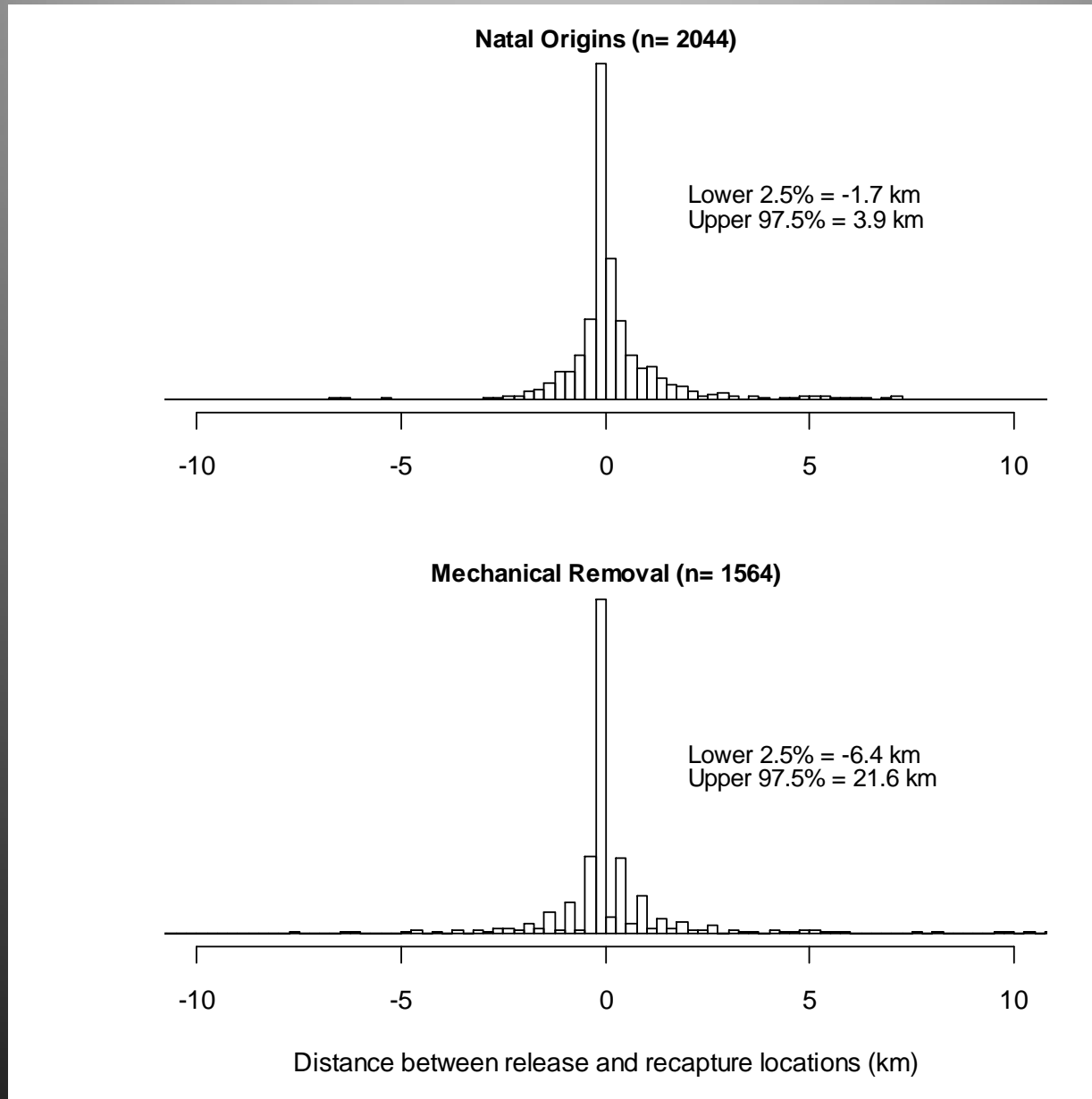


Trout populations are declining in Glen and Marble Canyons

Rainbow Trout (*Oncorhynchus mykiss*)



No evidence of trout being flushed downstream



(Preliminary Data from Yard and Korman 2013. Do Not Cite.)