Long Term Monitoring of Camping Beaches In Grand Canyon: A Summary of Results from 1996 – 2005, with an Emphasis on the Results of High Experimental Flow of November 2004

Annual Report of Repeat Photography
By Grand Canyon River Guides, Inc.[1]
(Adopt-A-Beach Program)

By
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June 15, 2007

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EXECUTIVE SUMMARY

The Adopt-A-Beach Program was implemented in 1996 as a means to assess and monitor changes in beach size and camping quality on the Colorado River in Grand Canyon, Arizona. Each year, volunteers take photographs of their "adopted" beach each time they travel on the river. These photos, acquired from pre-selected locations at each site, provide a series of repeat images that record changes to the beach throughout the year.

The photos, along with additional comments recorded by the volunteers, help investigators evaluate visible changes to the beaches resulting from regulated flow regimes, rainfall, wind and human impacts. The research also evaluates the longevity of beaches replenished by Beach/Habitat Building Flows (BHBF), also referred to as controlled floods, which occurred in 1996 and 2004. To date, more than 1750 repeat photos and related data sheets have been acquired, providing the most extensive visual record of beach change on the Colorado River in the Grand Canyon.

The selected beaches are located within four critical reaches of the river corridor. These are designated as: Marble Canyon, the Upper Granite Gorge, Muav Gorge and the Lower Granite Gorge. A critical reach is defined as an extended area in which camping beaches are small, sparse and/or in high demand.

In November 2004, a High Experimental Flow (HEF) of 41,000 + cfs was conducted in the Grand Canyon. Evaluation of the initial beach photos acquired the following spring conclude that the HEF did succeed in increasing beach campsite size through sand deposition. Indeed, the increased area on 54% of the beaches evaluated exceeds the 39% reported by Kaplinski and others (2006). However, only 40% of the beaches in this study were considered to have improved campability as a result of the HEF.

Change for the 2005 primary boating season show that 53% of the beaches improved by the HEF had degraded. The factors precipitating these changes are fluctuating flows from dam releases and rainfall resulting in gullies within the beaches. Also present, but considered very secondary causes of degradation, were human impacts and wind. This indicates short-term longevity for beach improvements by controlled floods unless other factors are mitigated.

When compared to Pre- 1996 BHBF photos, 40% of the beaches evaluated at the end of the 2005 season are considered to have improved. This still indicates an overall degradation of 60% of the beaches during the 10 years this program has been in existence.

As evidenced in the photo archive, vegetation encroachment above the 25,000 cfs level on the beaches is considered to be an increasing threat to camping area and influences recreational use preference. Some vegetation was scoured as a result of the 2004 HEF. Without physical removal, perhaps the only mechanism available to maintain camp areas above the 25,000 cfs level would be frequent high flow events. As recommended by Kaplinski and others (2006), high flow events should be implemented whenever enough sediment is available for redeposition.

INTRODUCTION

In 1981, the Glen Canyon Environmental Studies (GCES) began, under the administration of the Bureau of Reclamation, to study the effects of controlled flow releases from the dam on the downstream river ecosystem (U.S. Department of Interior 1987), including effects on sediment supply and recreational resources. Studies of sediment dynamics showed that fluctuating flow releases from the dam have a degrading effect on sand bar deposits (Hazel and others 1993, Schmidt and Graf 1990) since the closure of the dam. However, beaches can also be replenished by high flows adequate to entrain bedload sand and cause deposition to high elevation areas of beaches (Parnell and others 1997, Wiele and others 1999). Studies of campsite resources demonstrated that the impact to sand bars due to erosion decreases the carrying capacity and campable area available for river parties and backpackers (Kearsley and Warren 1993, Kearsley and Quartaroli 1997).

In 1992, the Grand Canyon Protection Act was passed by Congress to ensure that ecological and cultural resources downstream of the dam would be monitored for changing conditions imposed by operation of the dam states that the dam:

"….must be managed in such a way as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park….were established, including, but not limited to, natural and cultural resources and visitor use" (U.S. Department of Interior 1996).

The Grand Canyon Dam Environmental Impact Statement recommends that scheduled, high-flow releases of short duration be periodically implemented (U.S. Department of Interior 1995). Sand bars form when sediment carried by the river, either from bed load or suspended load, is deposited by the action of eddy currents in recirculation zones. This occurs primarily on the downstream end of debris fans, but also in areas along the river's channel margin (Schmidt 1990). Habitat Maintenance Flows (HMF) are within power plant capacity (31,500cfs), whereas those above this discharge are described as Beach/Habitat Building Flows (BHBF) and High Experimental Flows (HEF). The former were intended to maintain existing camping beaches and wildlife habitat; the latter to more extensively modify and create sand bars, thus restoring some of the dynamics that resulted from flooding in the ecosystem.

The Adopt-A-Beach Program (AAB) was begun in the Spring of 1996 as a means to monitor the condition of camping beaches along the Colorado River in Grand Canyon through repeat photography. Implemented by the Grand Canyon River Guides, Inc., (GCRG) a nonprofit, grassroots organization that represents the interests of the Grand Canyon river running community, this program is conducted by the volunteer efforts of river guides (including commercial, private and scientific groups) who travel by boat on the Colorado. Those who run the river are interested in observing how dam controlled flows, rain and wind created erosion, human use and other factors impact the camping beaches along the Colorado. These factors have been addressed throughout the continued period of this study, 1996-2005, as river runners have observed changes to the beaches and have recorded this information through repeat photography and written comments associated with each photograph.

Inception of Adopt-A-Beach was a result of the first BHBF of 45,000 cfs in the Spring of 1996. Specifically, the AAB program was launched by GCRG to document the effects of the high flow on camping beaches. River runners photographed and recorded information about changing conditions prior to the high flow, just after the high flow, and throughout the 1996 river season. The overall conclusion of that study demonstrated that the BHBF was highly effective in depositing new high-elevation sand, but that the post-BHBF high steady summer flow schedules caused rampant erosion of sand bars (Thompson and others 1997).

Camping beaches are an important resource for river parties conducting trips through Grand Canyon. Both commercial and private river trips, as well as backpackers, rely on wide sandy areas for camping and recreation. As a way to contribute to resource management, AAB now submits annual results to the Adaptive Management Program. The results and conclusions are synthesized through a representative that serves on the Technical Work Group (TWG) board. Professional river guides and other river runners make the program possible, contributing 100% of the manpower, the entire dataset of repeat photographs, and valuable input about the condition of beaches throughout each season and between years. Monitoring includes information on natural and human-induced impacts to beaches such as cutbank retreat, wind erosion and dune formation, rain gully formation and the effects of visitation and camping. The purpose of this report is to present the cumulative findings of data specific to this program through the commercial boating season of 2005. Furthermore, the documented observations by professional river guides for the spring through fall of 2005 are summarized.

During November 2004, an HEF of 42,000 cfs occurred. The river season of 2005 then witnessed a high daily fluctuating flow regime of 5000-20,000 cfs beginning January 3 and continuing into early April. This flow regime is known as the Winter High Fluctuating Flow (WHFF), or Trout Suppression Flow (TSF) for one of its intended aims. The remainder of the spring and summer received medium to low fluctuating flows. Specific research questions posed for this year target:

- How did the HEF of November 2004, almost immediately followed by the January through March WHFF, affect the beaches?
- How were the beaches effected by the subsequent low and medium fluctuating flows during the summer and early fall commercial boating season?
- Were there differences in these results per each critical river reach?
- What other processes may have caused decreased beach size throughout the summer?
- How do these results compare to the beaches immediately following the 1996 flood?
- Based on these results, what does the AAB program conclude about future resource management of campsite beaches?

Through analysis of photos and data sheets completed by the guides, this report attempts to answer these questions.

METHODS

Data Collection

The primary method of assessing camping beaches in this study is through analysis of repeat photography. During the summer months (April 1-October 31) volunteers (river guides, scientists, GCNP personnel) photograph a specific "adopted" beach every time they pass through the river corridor. Disposable waterproof cameras and data sheets, provided by GCRG, are distributed to all adopters of beaches. At the end of the commercial season (October/November), guides mail cameras and data sheets back to GCRG for analysis. A qualified scientist, who is active in Grand Canyon issues and is familiar with AAB study sites, is contracted from year to year to analyze photographs and data, draw up results and offer conclusions to resource managers concerned with recreational and cultural interests in Grand Canyon.

This project allows each participant to take stewardship of a site, and enables him or her to detect ongoing changes over the course of a season. During each visit, guides photograph their adopted beach from pre-established photo locations that provide different views of the beach: specifically, the beachfront and an overview of the camp. In sites where overviews are impossible, a photo location is selected to reveal as much of the camp as possible. In the last 6 years, however, thick tamarisk encroachment has led to recent re-establishment of many photo locations. Re-establishment of photo locations will be on-going as needed, in order to obtain the necessary photo angles.

A data sheet (Appendix A) accompanying each photographed visit allows the adopter to comment on changes to the condition of the beach and the possible causes of changes that are visible. Also included are site location, date, time, and approximate river flow. Photographed visits for each beach average 4 per season. The number of visits for each beach can range from one to eight. Many guides take the initiative to also photograph different episodic events such as debris flow or flash flooding that recently occurred on or near their beach. Such photos can be highly beneficial to many different researchers concerned with monitoring a particular resource at a given area.

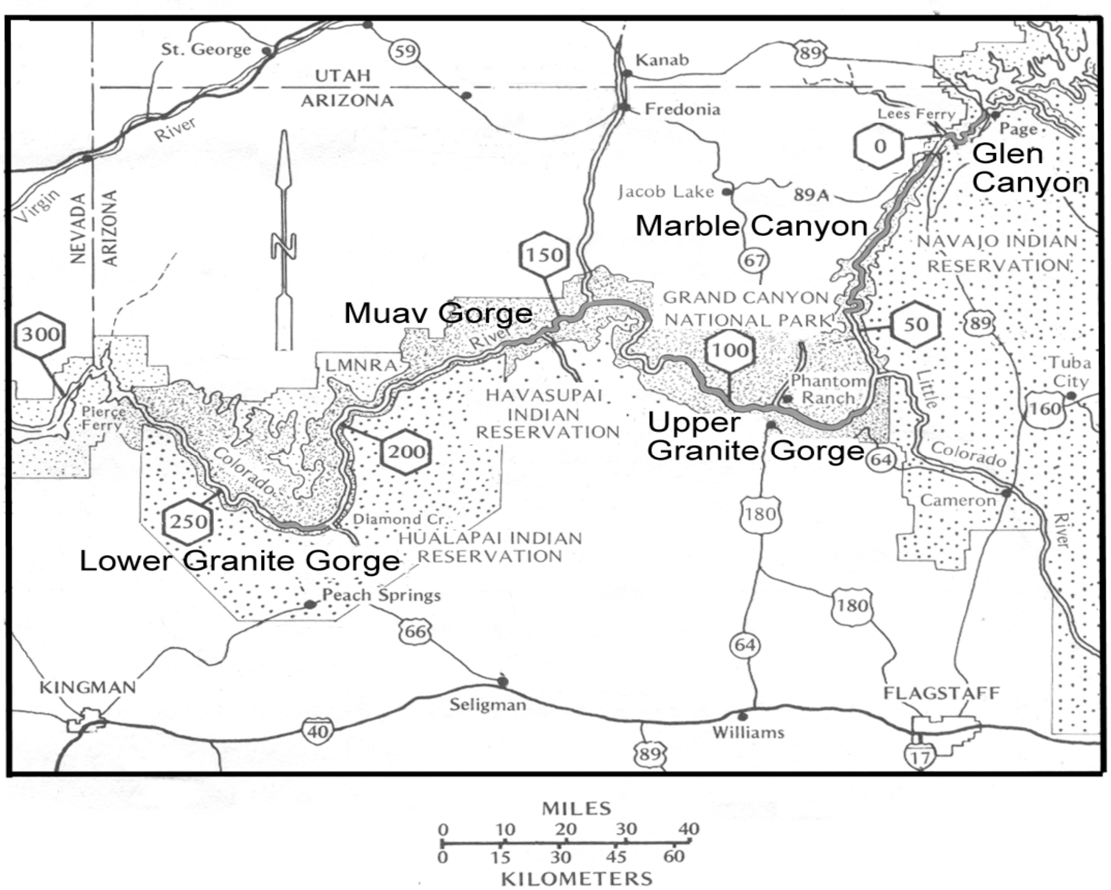
The photographs for all beaches of all years have been carefully labeled and are physically archived at the Grand Canyon River Guides office. Photographs from years 1996 through 2005 have been archived digitally onto compact discs which can be obtained from the GCRG office or the GCMRC library.

Information gleaned from photographs and from data sheets are entered into a master database using Access 2000. A cross check of the two different sources of information help to fill gaps in data and help to standardize changes from one visit to the next. For instance, if guide comments lack information about a site at the time a photograph was taken, the photo is used to assess the site for that visit. If the photo reveals little information and the guide's data sheet provides enough descriptive information about conditions throughout the site, the comments receive priority. The current Access database contains over 1,700 records of assessed changes and guide comments throughout monitoring years 1996-2005.

Study Locations

Since 1996 the AAB program has studied an average of 38 beaches per year from within three *critical reaches* of the river corridor (Figure 1). The practice of assessing camping beach resources within critical reaches was first developed by Kearsley and Warren (1993), and modified for the 1996 Adopt-a-Beach study by Thompson and others (1997). A critical reach is defined as a section of the river where camps are in high demand and few in number. The same reach system has been in use for all years of study, 1996-2004. They are as follows: 1) Marble Canyon, river miles 9-41; 2) Upper Granite Gorge, river miles 71-114; and 3) Muav Gorge, river miles 131-165.

Two new critical reaches were added for the 2003 monitoring season. The purpose is to increase the sample set of beaches in order to more widely represent the effects of beach erosion and building throughout the whole river corridor below Glen Canyon Dam. These new reaches included Glen Canyon, from the dam to Lees Ferry (river mile 0), and Lower Granite Gorge, from Diamond Creek (river mile 226) to Gneiss Canyon (river mile 236). Unfortunately, no data was available for the Glen Canyon reach for this report, but the Lower Gorge reach is included.



Defines a critical reach for campsite beaches along the Colorado River

Figure 1. Locations of five critical reaches in Grand Canyon National Park.

Table 1 shows popular campsites (n = 45), many of which were originally inventoried in 1996, and include beaches added in 2000 and 2001. Every beach in the inventory has an established photographic location that shows an optimum view of the beachfront and as much of the actual camping area as possible. Each year, GCRG motivates guides to adopt as many beaches as possible. To encourage a relatively complete data set from year to year, GCRG encourages adoption of high-priority beaches (n = 27) first. These beaches have been adopted for most of the study years. Usually, they are camps that can be used year after year by the river community, and thus are continually in high demand. The remaining beaches are adopted once high-priority beaches have been claimed.

The number of adopted beaches with useable data in 2005 totaled 37. Four beaches from the 2004 dataset were not adopted in 2005. Each record in the data base represents an individual visit to a beach where each beach has 1-5 photos associated with it. As encouraged by other Grand Canyon researchers, several adopters took extra snapshots of various episodes such as flash flooding in Schist Camp (August 2002) and Last Chance Camp (August 2001) and debris flows at Hot Na Na (July 2000). These documented events and data are available to any interested researchers through Grand Canyon River Guides or Grand Canyon Monitoring and Research Center. Part of the Adopt-A-Beach program is to provide photos of unusual natural events in Grand Canyon to interested parties.

The time-series photos taken within study locations allow assessment of relative change over the course of each season and between monitoring years. Assessment is standardized according to the highest average fluctuating flow of the season and to a zone of 20,000 cfs when comparing 1996 photos (determined by Kaplinski and others 1994). From year to year GCRG assesses the number of beaches that change in size and evaluates campsite space up to the 45,000 cfs zone, the level of the 1996 BHBF.

Table 1. Sample set of camping beaches inventoried that lie within five critical reaches.

Glen Canyon		Marble Canyon		Upper Granite Gorge		Muav Gorge		Lower Granite Gorge	
Mile	Camp	Mile	Camp	Mile	Camp	Mile	Camp	Mile	Camp
-13.0	Dam Beach	11.0	Soap Creek	15.6	Below Nevils	131.1	Below Bedrock	235.1	Travertine
-8.0	Lunch Beach	12.2	Salt Water Wash	76.6	Hance	132.0	Stone Creek	240.0	Gneiss
		16.3	Hot Na Na	81.3	Grapevine	133.0	Talking Heads		
		19.1	19 Mile	84.0	Clear Creek	133.5	Race Track		
		19.9	20 Mile	84.5	Zoroaster	133.7	Lower Tapeats		
		20.4	North Cyn	91.6	Trinity	134.6	Owl Eyes		
		23.0	23 mile	96.0	Schist	137.0	Back Eddy		
		29.3	Silver Grotto	96.7	Boucher	143.2	Kanab		
		34.7	Nautiloid	98.0	Crystal	145.6	Olo		
		37.7	Tatahatso	99.7	Tuna	148.5	Matkat Hotel		
		38.3	Bishop	107.8	Ross Wheeler	155.7	Last Chance		
		41.0	Buck Farm	108.3	Bass	164.5	Tuckup		
				109.4	110 Mile	166.4	Upper National		
				114.3	Upper Garnet	166.6	Lower National		
				114.5	Lower Garnet				

Analysis

Data are analyzed according to the particular research questions asked for that year. For this study, the data are grouped into two temporal categories, the first beginning with the November 20-24, 2004 HEF and ending with the first available photo for the particular beach taken in 2005. The second category begins April 1st and ends on October 31st.

When comparing the photos for the post HEF evaluation, 8 criteria were used to gather the empirical data used for the evaluations. These included estimating the river flow in each of the photos, usually confirmed by flow data available through the Grand Canyon Monitoring and Research Center (GCMRC) website, and standardizing the beach configuration to the highest dam release summer flow, just over 15,000 cfs. Also considered was any evidence of any flattening, mounding or scouring of sand in the photos, a change in area of sand cover between 2004 and 2005, vegetation covered or possibly removed as a result of the HEF, rocks covered/uncovered by the HEF that would indicate a change in camping area, a change in the loading/unloading areas used by river parties who stop to lunch or camp at the beach, and comments made by the AAB photographer on the datasheet when the photo is taken. Due to the variety of river flow levels between the comparison photos, change in the 'parking' at a particular beach was usually difficult to evaluate, and was considered only when recorded by the AAB observer. Using these criteria, the beaches were given classifications indicating sand deposition resulting from the HEF as Increase, Decrease or No Change. Knowledge of the study sites by this investigator were also considered, though this did not determine the final classification used for any particular beach. If 2 or 3 of the criteria, depending on the significance of the observation, indicated a change in the beach condition between the 2004 and 2005 photos, the beach was classified as either "Better camping", or "Worse camping". Otherwise, a classification of "Same" was used for that beach, indicating that the HEF did not effect the beach relative to its recreational usability.

For the second category analysis, beach photos and comments were evaluated to determine changes from any factors beginning with the initial 2005 photo through the course of the 2005 boating season. This evaluation resulted in beach classifications of No Change (Same), an Increased Desirability for Camping (Better) or Degraded Desirability for Camping (Worse). The 'Degraded' classification was then subdivided by perceived cause.

Finally, the beaches were also compared to their pre-1996 BHBF status. Since the current study includes the first time a "beach building event" has taken place since 1996, the results are being used to establish a new baseline for determining beach sustainability.

RESULTS

HIGH EXPERIMENTAL FLOW BY INDIVIDUAL BEACH

The objectives for both the 1996 Beach/Habitat Building Flow (BHBF) and the 2004 HEF were to "redistribute accumulated sediments from the channel bed to eddies" and related beaches (Topping 2006, Kaplinski 2006). The first consideration made by this study was the accomplishment of this objective. Of the 37 beaches under consideration, 20 (54%) showed an increase in the amount of sand present after the 2004 flood event (Chart A). In some instances this increase was marked and usually commented on by the photographer. However, because the photos collected by AAB cannot presently provide quantifiable information, it must be sufficient to simply classify these beaches as having increased in mass, but not necessarily surface area. Of the 37 beaches, 16 (43%) did not show a perceptible increase when compared to the pre-flood. One beach, Buck Farm, RM 41.0, showed a decrease in the sand/beach area. This was supported by comments by the guide photographer. In other words, only 3% of the study sites showed a decrease in sand as a result of the 2004 HEF. (Fig 1).

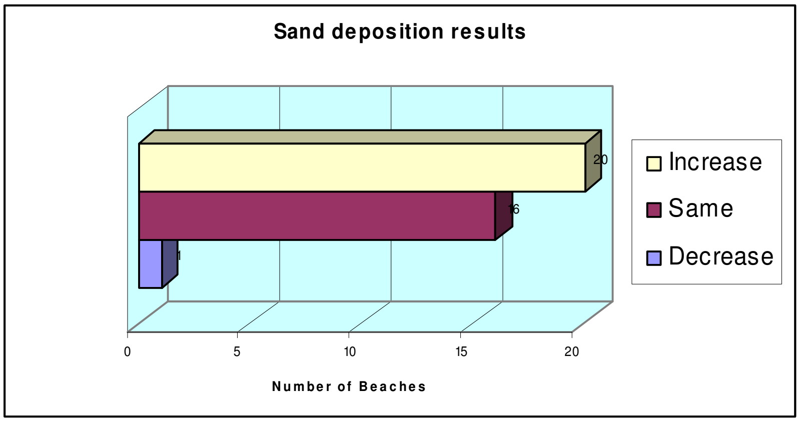


Figure 1. Sand Deposition per Beach.

Regarding the increase of areas for suitable camping as a result of increased sand deposit, there is not a direct 1 to 1 correlation. Of the 20 beaches in the study that showed an increase, 15 (75%) are considered to have changed to a "Better" campability classification, 4 (20%) remained the same, and 1 (5%) actually degraded in respect to camping acceptability. Bass camp, RM 108.3, received a considerable increase in sand deposited from the flood, but no perceptible change in the overall camp area was seen, and the resulting cutbanks and poor loading/unloading conditions that persisted on the subsequent photos resulted in a "Worse" designation for the beach. Other considerations that may have resulted in a "Same", or unchanged designation for a beach after the event, despite an increase in sand deposit, included mounding of sand in camp as a result of the eddy "vortex", scouring of previously used areas by return channels, or an increase in the slope and elevation of the sand at landing areas. (Fig 2). These factors are addressed further in the Conclusions portion of this report.

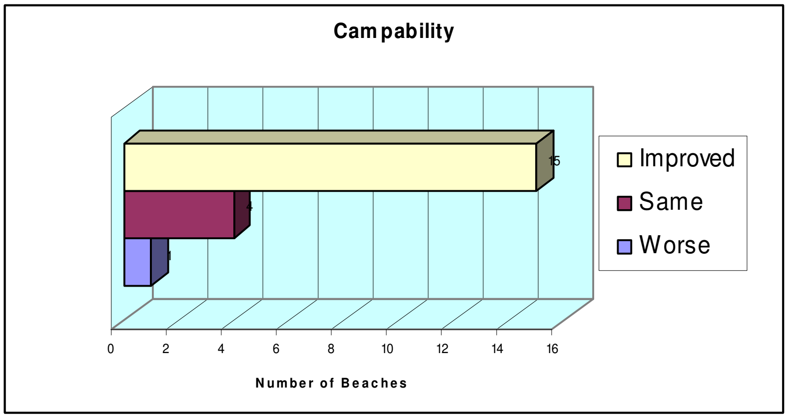


Figure 2. Change in Campability per Beach.

In the 16 instances where the sand deposit remained the same, 15 resulted in classification as having experienced no change overall from the flood event. One beach, 110 Mile camp at RM 109.4, was classified as degraded in its camp acceptability because of a huge deposit of driftwood throughout the camp, creating less sleeping area as well as hazardous walking around the beach and, especially, on the trail to the usual toilet location. Admittedly, the addition of driftwood at a camp could be perceived as a bonus to people using the campsite in the colder months of the year. But, for consistency in this evaluation, it was designated as a degraded camp.

In *Campsite Area Monitoring from 1998 to 2005: The Effects of the November 2004 High Experimental Flow on Recreational Resources in the Colorado River Ecosystem,* (Kaplinski et al 2006) it is noted that eroded sediment from beach areas and increased vegetation are the two main factors in loss of campsite area. In this AAB study, the covering of previously visible rocks by new sand deposition was noted frequently. The covering or removal of vegetation at the beaches was also noted. At 12 (80%) of the 15 beaches considered as campsites in which conditions improved, the covering of rocks and/or the removal of vegetation was a predominant factor. This usually consisted of low cobble bars being covered in the middle or rear areas of the camps, and the removal of baccharis or other bushy plants in landing and potential activity areas. In one instance, a tamarisk (?) tree, 5-6 feet in height, was noticeably absent in the 2005 comparative photo.

HIGH EXPERIMENTAL FLOW BY REACH

Another interpretation for the results of this study is the effect the flood had per reach in the river corridor. Of the 11 beaches considered that are located in Marble Canyon, 9 (82%) showed an increase in sand, 1 (9%) remained unchanged and 1 (9%) degraded. In the Upper Granite Gorge, the 11 beaches sampled resulted in 6 (55%) showing sand increases, 5 (45%) unchanged, and none were designated as being degraded from the flood event. In the Muav Gorge, 13 beaches had photographic comparisons in which 5 (38%) increased in sand deposition, 8 (62%) remained the same, and none was degraded. Down stream in the Lower Granite Gorge, 2 beaches were sampled and both showed no appreciable change. These results support the quantitative findings of Kaplinski et al

(2006) which found that sand deposition on beaches from the November 2004 HEF decreases in magnitude the further downstream the beach is from the dam. (Fig 3).

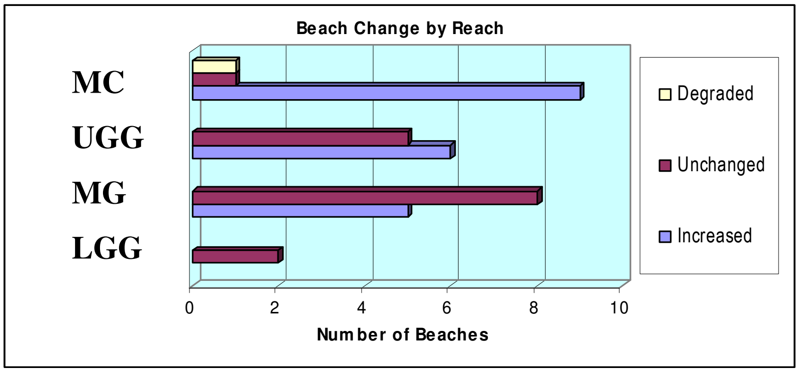


Figure 3. Beach Change by Reach

One comparison not addressed by this study is that of the results relative to beach sizes. To say that a smaller beach, like Owl Eyes for example, changed more or less than Backeddy beach, is not possible with the information collected.

RESULTS OF THE 2005 WINTER HIGH FLUCUATING FLOWS (JANUARY 3 TO APRIL 8, 2005)

Analysis regarding the effects of the Winter High Fluctuating Flows (WHFF) of 5,000-20,000 cfs cannot be parsed from the previous analysis regarding the HEF. No specific documentation was collected between the November HEF and the end of the WHFF for comparison.

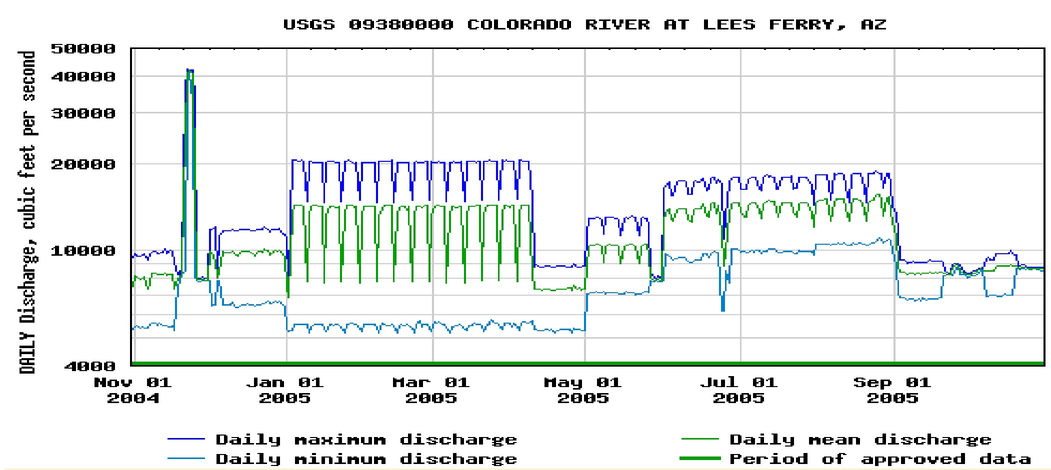


Figure 4. Hydrograph of Colorado River in Grand Canyon from November 2003 through October 2005. Graph downloaded from USGS website.

CHANGE THROUGH THE 2005 SEASON

During the summer season of 2005, April 1 through Oct 31, photo documentation was available for 35 of the 37 beaches considered earlier in this report. While all of the 37 beaches were adopted for the season, two cameras were not returned as of the time of this analysis. Hopefully this information can be acquired and included in the next Annual Report.

Of the 35 beaches considered, only one (3%) could be classified as having improved through the 2005 season. This beach, Lower Bass (RM 108.3R) was the only beach that received a classification of Sand Deposition Increase creating “Worse” campability as a result of the HEF. Initial photos of this beach in April displayed a severe cutbank at the boat parking area, so severe that loading and unloading of the boats was nearly impossible early in the season. Throughout the summer of 2005, this beach face graded to a more accessible and user friendly slope and was therefore reclassified accordingly.

The number of beaches that did not change significantly during the summer, and received a classification of “Same”, were 19 (54%). More importantly, 7 of these 19 beaches were classified as “Better” after the HEF. In other words, 7 of the 15 beaches (47%) that were improved by the HEF maintained this “Better” status throughout the 2005 season. One beach, Silver Grotto (RM 29.3L) was documented early in the 2005 season and was classified as “Better” as a result of the HEF. However, this beach was not subsequently photographed during the summer and could not be included in the seasonal change evaluation.

A classification of “Worse”, indicating both a decrease in camp size and a degradation of campability during the summer season, was given to 15 (43%) of the beaches inventoried. This includes 6 (40%) of the beaches previously classified as “Better” as a result of the November 2004 HEF.

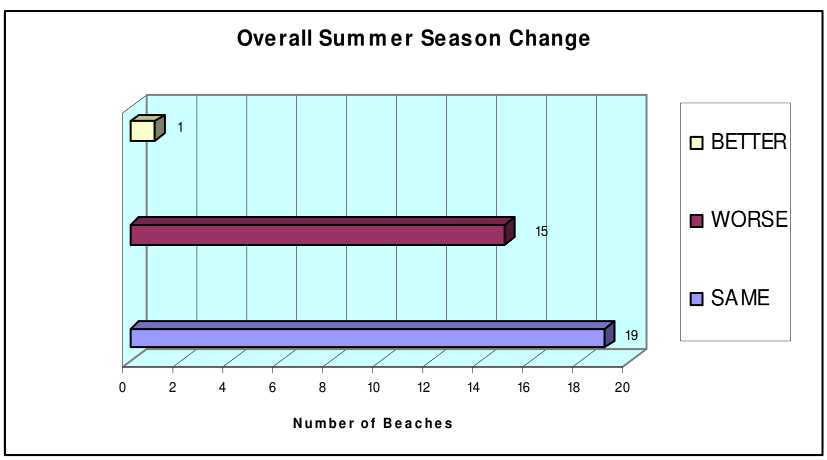


Figure 4. Overall Beach Change through Summer Season.

Regarding the processes that result in a decrease in beach size and less acceptable campability, the predominant cause listed by the guides and observed from the photo documentation is the daily and monthly flow fluctuation. Beach retreat from erosion by fluctuating flows reduced the available camping area in very few instances, but was far more often cited as creating poor boat parking by revealing rocks and by making beach faces steeper and harder to negotiate. This was particularly notable at beaches which had seen an increase in sand deposition from the 2004 HEF. Beach morphological change from rain/drainage flooding was also cited. Most significantly, Olo beach, river mile 145.6L, was removed from the post HEF sample set due to a catastrophic flood which devastated the campable beach area. Three other beaches, Schist (RM 96.0L), Lower Garnet (RM 114.5R) and Kanab Creek (RM 143.2R) were also impacted by flood events that degraded their campability. Erosion from human impacts and Aeolian action was also noted in the data, but did not directly result in a reclassification of any beach. The encroachment by vegetation, thereby reducing campable area, is also considered a factor, and will be addressed in more detail in the conclusions section of this report.

2005 SEASONAL CHANGE BY REACH

For the 35 beaches considered in the 2005 seasonal analysis, in the Marble Canyon Reach, 3 (9%) displayed no change and 6 (17%) degraded through the summer. It should be noted that one of the beaches, Buck Farm (RM 41.0R), was considerably degraded as a result of the HEF and continued to deteriorate throughout the summer. In the Upper Granite Gorge, 7 (20%) remained unchanged through the summer, 3 (9%) became Worse, and 1 (3%), the unique beach at Lower Bass improved as the summer progressed. Of the 14 beaches considered in the Muav Gorge, 8 (23%) are classified as Same through the summer and 6 (17%) obtained a Worse rating. The only beach in the Lower Granite Gorge for which data was available, Travertine Falls (RM230.0L), showed no appreciable change.

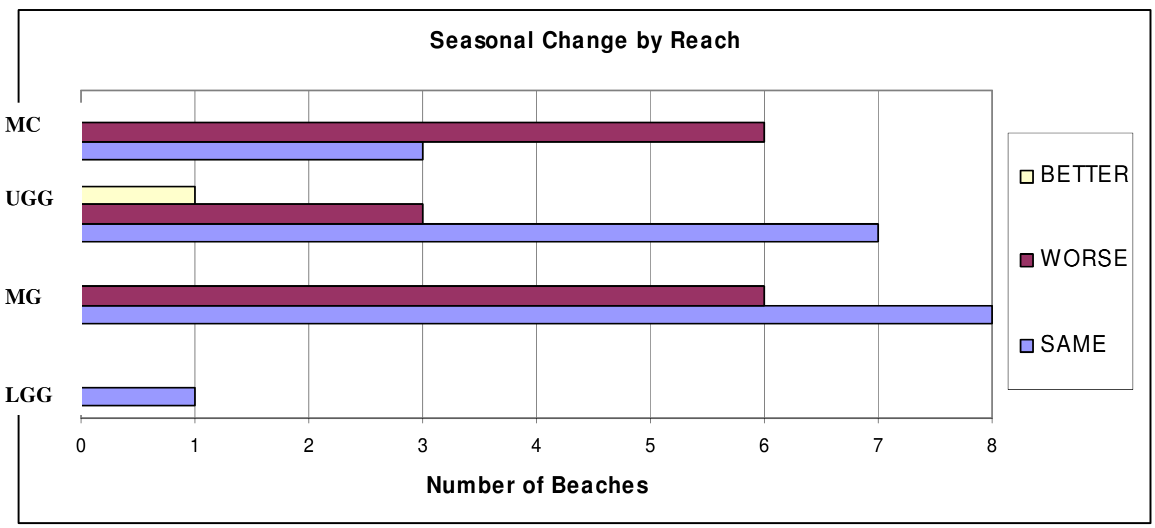


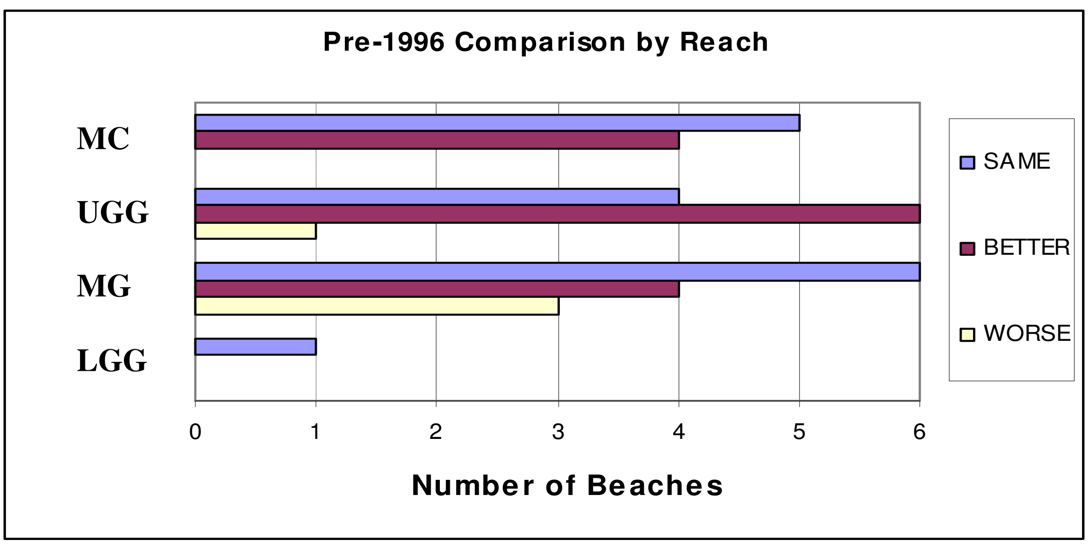
Figure 5. 2005 Seasonal Change by Reach.

COMPARISON OF BEACHES TO PRE-1996 BEACH/HABITAT BUILDING FLOW

The success of the Beach/Habitat Building Flow of 1996 demonstrated the need for periodic beach building for maintaining campsites beaches in Grand Canyon. With the advent of the High Experimental Flow in November 2004, the chronological 'clock' ticking away the degradation of the beaches was somewhat reset. Multiple sediment studies have determined that an HEF could be extremely beneficial if the Colorado River has received sediment inputs from the major tributaries (Rubin and others 2002, Lucchitta and Leopold 1999, Topping 1997). As this report has discussed, many beaches and their campability were improved through the use of this tool for beach morphological manipulation.

Specifically, at the end of the 2005 season, 35 beaches were compared to photos of those same beaches taken in March 1996, before the 1996 BHBF. Of those beaches, 16 (46%) have been classified by this study as being relatively the Same as they were in 1996. 14 (40%) beaches were classified as having improved to Better than they were in the 1996 photos, and 5 (14%) are regarded as having degraded to Worse than when evaluated in 1996.

By reach, these same beaches break down in the following fashion. In the Marble Canyon reach, 5 (14%) are reported as being Same as in 1996 and 4 (11%) are classified as Better. Four of the beaches located in the Upper Granite Gorge are reported as the Same as 1996, 6 (17%) are considered to have improved to Better and 1 beach (3%) is reported as having become Worse compared to the 1996 information. In the Muav Gorge, 6 (17%) are unchanged and classified as Same, 4 (11%) receive a Better classification and 4 (11%) are now perceived as Worse than they were pre-BHBF. Finally, the lone beach (3%) for which data is available in the Lower Granite Gorge remained the Same.



CONCLUSIONS

As was demonstrated with the BHBF of 1996, the HEF of November 2004 proved to be of benefit to the overall condition of the beaches in Grand Canyon. A healthy 54% of the beaches included in this study displayed an increase in sand deposition, and 75% of those beaches with an increase were considered to have improved for camping by recreational boaters. Through the 2005 primary boating season, 54% of the beaches remained unchanged, of which 47% had been classified as having been improved by the HEF. A total of 43% of the beaches degraded over the summer, and 1 beach (3%) received a Better rating. This last beach was severely impacted by the HEF and required considerable time and reworking by various factors to be reclassified to a Better status.

Additionally, at the end of the 2005 season, 40% of the beaches are considered to have improved when compared to the Pre-BHBF 1996 photos. Only 14% are considered as Worse than these same photos, and 50% of these were downgraded due to recent flash flood erosion. The implementation of future BHBF's, as specified by Rubin (2002) and other authors, cannot be over-emphasized. The ability to take recent sedimentation inflows from tributaries and distribute it to the beaches should be given highest priority.

The primary cause of beach degradation, as reported by the volunteers and through photo interpretation, is the result of fluctuating flows. A large percentage of the beaches that improved were classified as such because of beachfront sand addition and the covering of rocks in the boat parking areas. As has been reported by AAB in the past, the sediment free fluctuating flows throughout the summer often removed this sand and exposed hazardous boat parking. The rate of slope increase at beachfronts rose conversely.

The second most frequently cited cause for beach degradation is gully creation as a result of tributary flooding. While the HEF did fill and otherwise rework previous gullies, resulting in improved camping areas, subsequent storms again eroded beach sand deposits and in one instance rendered a camp unusable.

Beachfront erosion from camper activity was evident, but was interpreted as minor, and did not play a significant role in changing any classification. While camper action may have helped gravity bring sand to the beachfront waterline, cutbank creation from the fluctuating flow regime had more impact.

Also, wind deflation was noted, as evidenced by freshly exposed rocks in the 25-40,000 cfs zone. Again, this did not result in a classification change for the 2005 summer season, but is noted as a parameter to be carefully observed in future analysis.

Although only mentioned briefly in this report, perhaps the most difficult variable to evaluate could be highly significant. Vegetation encroachment is definitely evident in all of the 2005 photos. Because most of the repeat photo locations are near the river, they provide only low angle oblique photo observations. Through the years, vegetation has grown to obscure parts of the beaches from these photo points. Even with the re-establishment of photo location points, large areas of the study beaches will be hidden from the camera by both dense brushy plants and low to medium size trees, hindering the ability to analyze the photos correctly.

The previously well established vegetation restricts the possible beach 'growth' by sand deposition experienced from future BHBF events. Once a plant such as arrowweed or tamarisk grows to a height exceeding the BHBF waterline, simple replenishment of sand will not create a better camping opportunity. With further information it could possibly be argued that a good watering from a high flow event would increase the growth and spread activity of established plants in the camp.

ACKNOWLEDGEMENTS

Grand Canyon River Guides, Inc. would like to thank all of the adopters for volunteering the time to pull over and photograph their beaches and for their valuable observations and written comments. It takes time and effort to do this, and the dedication shown by guides has literally kept this program alive for ten plus years. The result is the most comprehensive collection of repeat photographs of critical camping beaches in the Grand Canyon. An added benefit is the public outreach fostered by the volunteers actions. By taking time to include guests as active participants and by answering their questions, volunteers can further explain how our resource in Grand Canyon is enhanced, degraded or maintained by the influence of man and technology.

Special thanks to Lynn Hamilton for exhaustive work in support of this project; Andre Potochnik for his continued hard work as GCRG's (and therefore, this project's) representative of recreational interests in the Adaptive Management process.

Thanks also to our contributors, the Grand Canyon Conservation Fund, established and maintained by the commercial outfitters in Grand Canyon, to the Public Outreach Ad Hoc Committee of the Adaptive Management Program and, finally, to those individual contributions from individual GCRG members who believe that the Adopt-A-Beach project worthy of their support.

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Appendex A

Adopt-A-Beach Data Sheet
Used by Volunteers to Record Comments

Adopt a Beach Data Entry Form

Guide's Name ______________________

Camp Name ______________________

Camp Mile ____________________

Date ____________________

River Flow (circle one) Low (5-12K) Med (12-18K) High (18-25K)

Photo Numbers: ______________ (remaining)

Any Comments about Beach Change? (describe in this space)

Change in Beach Size from Previous Visit (circle one): Increase Decrease Same

Dominant Cause of Change (circle one):

Spike Daily/Monthly Flow Rain Wind People Don't Know

Supporting Observations for Dominant Cause (check any that are appropriate):

- New cutbank
- Change of slope
- Bench in eddy
- Gully
- Trib/Debris flow
- Scour from wind or people
- Mounded sand

Secondary Cause of Change (circle one):

Spike Daily/Monthly Flow Rain Wind People Don't Know

Supporting Observations for Secondary Cause (check any that are appropriate):

- New cutbank
- Change of slope
- Bench in eddy
- Gully
- Trib/Debris flow
- Scour from wind or people
- Mounded sand

Campsite Quality Compared to Last Visit (circle one): Same Better Worse

Supporting Observations for Campsite Quality (check any that are appropriate):

- Boat parking
- Rockiness
- Vegetation encroachment
- Steepness
- Trail erosion
- Open sand area
- Human impacts- ants, pee spots, litter (circle those that apply)

Any Comments about Campsite Condition? (describe in this space)

Appendex B

Chart of Beach Comparisons
Resulting from November 2004
High Experimental Flow

Camp name	River mile	Sand +	Sand -	Sand ~	Better	Worse	Same
Soap	11.0	Y			Y		
Salt Water Wash	12.2			Y			Y
Hot Na Na	16.3	Y			Y		
19 Mile	19.1	Y					Y
North Canyon	20.4	Y			Y		
23 mile	23.0	Y					Y
Silver Grotto	29.3	Y			Y		
Middle Nautaloid	34.5	Y			Y		
Lower Nautaloid	34.7	Y			Y		
Bishop/Martha's	38.3	Y					Y
Buck Farm	41.0		Y			Y	
Nevill's	75.2			Y			Y
Grapevine	81.3	Y					Y
Schist	96.0			Y			Y
Boucher	96.7	Y			Y		
Crystal	98.0			Y			Y
Tuna	99.7	Y			Y		
Ross Wheeler	107.8			Y			Y
Bass	108.3	Y				Y	
110 mile	109.4			Y		Y	
Upper Garnet	114.3	Y			Y		
Lower Garnet	114.5	Y			Y		
Below Bedrock	131.1			Y			Y
Stone	132.0			Y			Y
Talking Heads	133.0	Y			Y		
Racetrack	133.5			Y			Y
Lower Tapeats	133.7			Y			Y
Owl Eyes	134.6	Y			Y		
Backeddy	137.0	Y			Y		
Kanab	143.2			Y			Y
Matkat	148.5	Y			Y		
Last Chance	155.7			Y			Y
Tuckup	164.5	Y			Y		
Upper National	166.4			Y			Y
Lower National	166.6			Y			Y
Travertine Falls	230.0			Y			Y
Gneiss	236.0			Y			Y

Chart A. Beaches and Classification Results for Post November 2004 HEF.