Long Term Monitoring of Camping Beaches In Grand Canyon

Summary of Results for the Year 2009 with Comparisons to Pre 2008 High Flow Experiment

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

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Adopt – A – Beach:
Long-Term Monitoring of Camping Beaches in Grand Canyon

Summary of Results for Year 2009

Introduction and Methods

The Adopt-A-Beach (AAB) program has now completed its fourteenth year as a long-term photo-matching study that monitors camping beaches along the Colorado River in Grand Canyon. This program, sponsored by Grand Canyon River Guides, Inc., is implemented by a 100% volunteer group of river guides, private river runners, scientists and NPS personnel. Results are submitted to various agencies such as the Socio-Cultural Program of the Grand Canyon Monitoring and Research Center (GCMRC) and Grand Canyon National Park. Results are also presented to the stakeholders of the Glen Canyon Dam Adaptive Management Program in order to effectively integrate observational data on the evolving recreational resource into management recommendations forwarded to the Secretary of the Interior.

The methods implemented are repeat photography and real time observational comments that document a selected set of camping beaches in Grand Canyon. Data collection is typically conducted from April through October of the year, though data has been gathered as early as January and as late as December in some years. The beaches monitored were not selected randomly, but rather are categorized as belonging within one of four different critical reaches within the river corridor (Marble Canyon, the Upper Granite Gorge, the Muav Gorge and the Lower Granite Gorge). A critical reach is defined as an extended area in which camping beaches are sparse, small, and/or in high demand.

The program assesses visible photographs and first-hand observations pertaining to changes of beaches, as influenced by regulated flow regimes, rainfall, wind, vegetation and human impacts. Research results include beach criteria categorizations of positive, negative or no change; an analysis of the longevity of the Beach Habitat/Building Flows (BHBF) and High Flow Experiment (HFE) deposits; and an examination of the primary and secondary processes that cause change in camping beach area and quality.

Volunteers for this program are unique in that many run the Colorado River more than once in one season, and are able to provide sets of repeat photographs and on-the-spot comments for each beach in the dataset. To date, river runners have produced more than 2500 repeat photographs and associated field sheets recording the sequential condition of beaches. These images categorized by beach and year (1996 – 2009) are now part of the extensive *Adopt-A-Beach Photo Gallery*, accessible to researchers and the general public through a link on the AAB page of Grand Canyon River Guides' website: http://www.gcrg.org/advocacy_aab.php.

Additionally, Cooperative Agreement #08WRAG0048, Mod #002 from the United States Geological Survey, integrates the Adopt-a-Beach program data and repeat photographs into the comprehensive GIS Campsite Atlas that is currently being developed by Grand Canyon Monitoring and Research Center in cooperation with Grand Canyon National Park. The integration of events, images and data from other sources such as Adopt-a-Beach contributes to the greater understanding of the recreational resource as a whole while maximizing efficiency through information sharing.

We extend our appreciation to our funders for their support: the above referenced cooperative agreement with Grand Canyon Monitoring & Research Center as well as support from the Grand Canyon Conservation Fund, a non-profit grant-making program established and managed by the Grand Canyon river outfitters.

Results and General Conclusions

For the year 2009, 36 beaches had an adequate span of photos to assess the beginning to ending of the season. Twenty-three of the beaches (64 %) reviewed were classified as being relatively unchanged through the year. While 2 of the beaches (6 %) are reported as having improved, 11, or 31 %, are considered as having degraded in camping desirability by late 2009.

The factor sited as being the primary contributor of degradation is erosion created by fluctuating flows that contain low sediment concentrations. This was particularly evident following the early July jump in dam release and subsequent increase in the mean of the daily fluctuation. Increased vegetation and aeolian effects were noted as secondary factors, and were minor in comparison. Vegetation encroachment is often a less dramatic and a less frequent factor in beach change, though reduced camp area and camp desirability due to vegetation, particularly arrowweed and camelthorn, are commented on by adopters. Most wind action involved sand buildup in the back and upslope of the camping areas.

One of the predominant factors in beach degradation for the past few years has been the creation of gullies or significant sand removal in the camp area due to rainfall (Thompson and Pollock, 2006, Lauck, 2008). This was not observed, nor reported in the comments this year.

Of the 2 beaches that appeared improved, one was due to a softening of the slope at the parking area, possibly from human induced 'creep' of the sand when moving up and down to the boats. The second was classified as BETTER because of an increase in sand covering rocks in the parking area, as reported on one of the comment sheets.

Some wind reworking of sand and vegetation growth were noted on almost all of the remaining beaches, but not in an amount considered to warrant a classification other than SAME.

Early comparison of the beaches in 2009 to late season photos acquired in 2008 was possible for 27 of the study sites. Over-winter changes were found at 6 of the beaches, with 2 having improved and 4 classified as WORSE.

The 2 BETTER beaches (7 %) had a marked softening in the front slope of the beach, while the 4 WORSE camps (15 %) exhibited increases in cutbank formation. One of these camps also had an increase in rock exposure in camp. As this was found above the maximum flow line, it is assumed to be the result of wind scour. Twenty-one beaches (78 %) displayed little or no change.

To help ascertain the long term effects of the March 2008 HFE, a comparison of the photos acquired in late season 2009 with the same beaches as photographed in late season 2007 was also conducted. A total of 38 sites qualified for this comparison, with almost all time spans between photos being 23 or 24 months. The typical photo dates were mid-to-late September of each year.

Of these 38, a total of 9, or (24 %), were considered as less desirable than the same camp in late 2007. Of these, 3 were previously evaluated as having been degraded from the effects of the March 2008 HFE, and vegetation increase and beach erosion from river fluctuations were equal in importance as factors. Thirteen of the beaches (34 %) were classified as being fairly similar to the same camp two years earlier, and 16 (42 %) were rated as having improved when compared to their pre-HFE photos. Most improvements noted were increased camp area and fewer rocks exposed at the boat landing spots.

The data accumulated for 2008 - 2009 emphasize the need for continued BHBF and HFE events whenever the sediment load available in the system allows, followed by low fluctuating flows. The flows that exceed power plant capacity are vital in replacing beach areas above the normal dam release flow line where sand has been removed by flash floods and wind, for restoring beach fronts eroded by river and wave action, and to help mitigate the effects of vegetation encroachment and human impacts.

For questions or comments please contact Paul Lauck or Lynn Hamilton at Grand Canyon River Guides, Inc., Flagstaff, Arizona (928) 773-1075.

INTRODUCTION

In 1981, the Glen Canyon Environmental Studies (GCES), under the administration of the Bureau of Reclamation, began to study the effects of controlled flow releases from the dam on the downstream river ecosystem (U.S. Department of Interior, 1987). Included in this study were effects on sediment supply and recreational resources. Studies of sediment dynamics showed that fluctuating flow releases from the dam have had a degrading effect on sand bar deposits (Hazel and others 1993, Schmidt and Graf 1990, Grand Canyon Monitoring and Research Center, 2009) 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 science based recommendations would be forwarded to the Secretary of the Interior in order to satisfy the primary mandate for Glen Canyon Dam (Section 1804):

"…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 referred to as "controlled floods" and have been described both as Beach/Habitat Building Flows (BHBF) or High Flow Experiment (HFE) releases (Hazel, J.E.,Jr. et al, 2010). 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. For this report, any reference to the controlled flood implemented in March 2008 will be termed a High Flow Experiment.

The Adopt-A-Beach Program (AAB) was begun in the Spring of 1996 as a means to monitor the evolving 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, 1996-2009, as river runners have observed changes to the beaches and have recorded this information through repeat photography and written comments associated with each photograph.

Each record in the data base represents an individual visit to a beach where each beach has 1-5 photos associated with it. Part of the Adopt-A-Beach program is to provide photos of unusual natural events in Grand Canyon to interested parties. 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 Olo (August 2008) and debris flows at Hot Na Na (July 2000).

Inception of Adopt-A-Beach was a result of the first HFE of 45,000 cfs in the Spring of 1996. Specifically, the AAB program was launched by GCRG immediately prior to the HFE 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 HFE was highly effective in depositing new high-elevation sand, but that the post-HFE 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 (GCDAMP), the Grand Canyon Monitoring and Research Center (GCMRC), and Grand Canyon National Park. The results and conclusions are synthesized through a representative that serves on the Technical Work Group (TWG) of the GCDAMP. 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 2009. Specific research questions posed for the year in the current study target:

- How do the beaches compare between the beginning of 2009 and late 2008?
- How do the beaches compare between early and late in the year 2009?
- How do the beaches compare between the end of 2009 and immediately preceding the 2008 High Experimental Flow?
- Which processes resulting in change were most prevalent?
- Were there differences in these results per each critical river reach?
- 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.

The flow release during the period examined included high fluctuating flows (~9500 to ~ 17500 cubic feet/second) for the months December and January 2009 and again for July and August 2009. The months of November 2008, February through June 2009 and again in November 2009 had average releases fluctuating between approximately 7500 and 12500 cfs daily. As with 2008, the months of September and October saw flows held steady, this year at just over 10000 cfs. Increased flow volume by supplementation from tributaries within the Grand Canyon is not included in these figures.

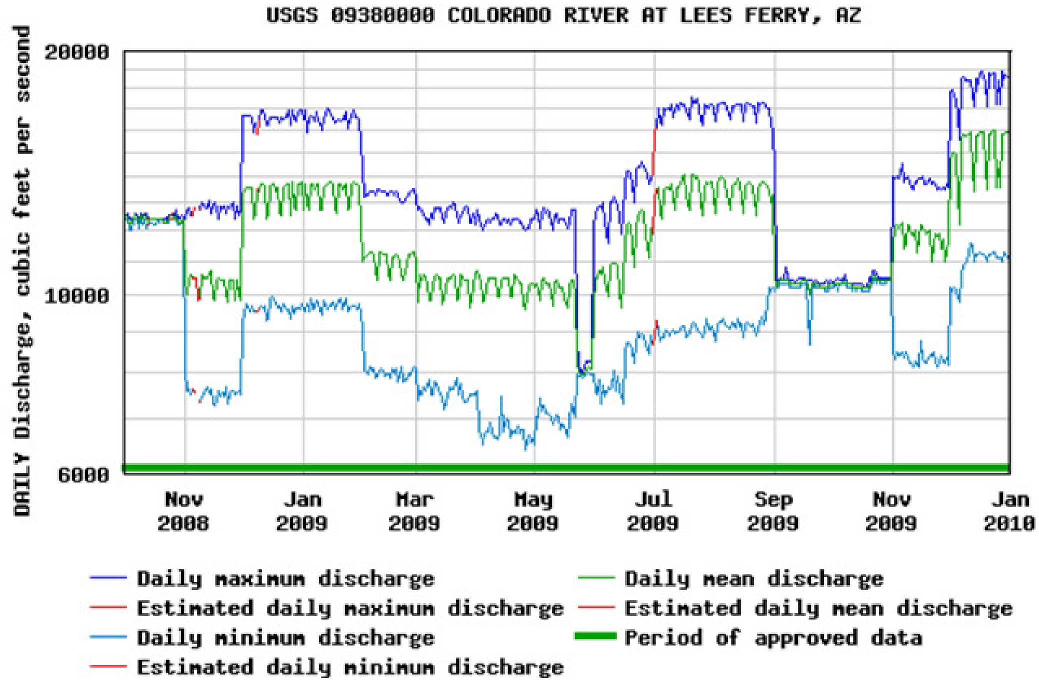

Figure 1. Streamflow graph for Lees Ferry, AZ, October 2008 to January 1, 2009 From USGS Real-time streamflow website

Study Locations

Since 1996 the AAB program has studied an average of 38 beaches per year from within three of the five *critical reaches* of the river corridor (Figure 2). 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, 1996-2009. They are as follows: 1) Marble Canyon, river miles 9-41; 2) Upper Granite Gorge, river miles 71-114; 3) Muav Gorge, river miles 131-165. See Figure 2.

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, which has been extended to include the 250 Mile Camp, is included.

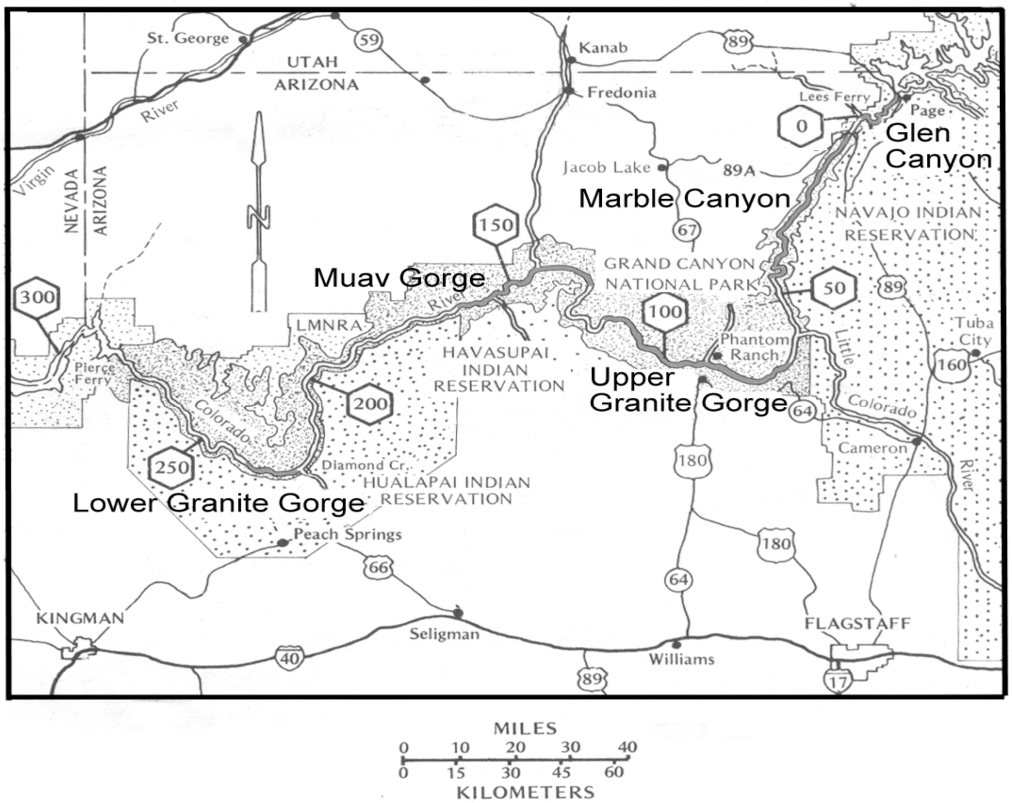

Figure 2. Locations of five critical reaches in Grand Canyon National Park.

Table 1 shows popular campsites (n = 44), many of which were originally inventoried in 1996, and include beaches added between 2000 and 2009. Every beach in the inventory has one or more established photographic locations that show 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 = 28) 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 full, season long data in 2009 totaled 38.

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.

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	11.3	Soap Creek	76.0	Nevill's	131.7	Below Bedrock	230.6	Travertine
-8.0	Lunch Beach	12.4	12.4 Mile (Salt Water Wash)	77.1	Hance	132.5	Stone Creek	236.1	Gneiss
				81.7	Grapevine	133.7	Talking Heads	250.0	250 Mile
		16.6	Hot Na Na	84.6	Clear Creek	134.2	Race Track		
		19.4	19.4 Mile	85.0	Zoroaster	134.5	Lower Tapeats		
		20.7	North Cyn	92.1	Trinity Creek	135.2	Owl Eyes		
		22.7	23 Mile (Indian Dick)	96.6	Schist	137.8	Back Eddy		
				97.3	Boucher	144.0	Kanab		
		29.5	Shinumo Wash (Silver Grotto)	98.7	Crystal	146.1	Olo		
				100.2	Lwr Tuna	148.9	Matkat Hotel		
		35.0	Nautiloid (Middle&Lower)	108.3	Ross Wheeler	150.9	Upset Hotel		
				109.0	Lwr Bass	156.3	Last Chance		
		37.9	Tatahatso	110.0	110 Mile	165.2	Tuckup		
		38.6	Martha's	114.9	Upper Garnet	167.0	Upper National		
		41.2	Buck Farm	115.1	Lower Garnet	167.2	Lower National		

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

Methods and Analysis

The photographers' viewing locations at the individual study beaches varies from site to site. However, the locations are consistent for each beach throughout the season, and, as much as possible, from year to year. Most commonly, the photos are shot from the boat on the river, taken as a single image or series, to provide a full, upstream to downstream look at the beach. There is also another photo or photos taken from specifically designated locations on shore, looking across the front of the beach, usually from an elevated, oblique angle. Combined, these views provide a considerable amount of information for analysis.

A few beaches are photographed from the river only. Unfortunately, this often limits the visibility of the upper or rear part of the camp. Efforts are being made to expand these visits to include a shore based view, but this is completely up to the volunteer and their time available.

Almost half of the beaches also have photo locations toward the back of the camp, looking across the upper part of the beach or toward the river. While not always practical, these views are invaluable additions to the beach dataset.

The year 2009 also begins a transition for the program to obtain digital images exclusively. While a few images have been submitted taken with the volunteers' own digital cameras, previous photos have been acquired using waterproof 35 mm disposable cameras, processed straight to disc. Two compact digital cameras where distributed for use this year, with full transition to digital planned within a year or two. The resulting images are almost always superior in quality to those taken with the disposable cameras.

When comparing the photos for evaluation, 8 criteria were used to gather the empirical data used. 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 17,000 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 photo dates, vegetation cover, rocks covered/uncovered by the flow changes or wind action 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 during various flows was usually difficult to evaluate, and often was considered only when recorded by the AAB observer. Knowledge of the study sites by the investigator were also considered, though this did not determine the final classification used for any particular beach.

Using these criteria, the beaches were given classifications indicating either "Better camping", or "Worse camping". Otherwise, a classification of "Same" was used for that beach. While the designations of Same, Better and Worse are inherently subjective, the results are reflective of the stated evaluation purpose of determining the beach as a useable camp for river trips. This should not be interpreted in any way that results were obtained using anything other than Objective evaluation.

Data are analyzed according to the particular research questions asked for that year. For this study, the data are grouped into three temporal time frames. One is focused to evaluate the long term effects of the March 2008 HFE, begins in late 2007 and ends in late 2009. A second evaluation considered the beach response during the winter of 2008-2009 and spans the period from late October 2008 to the earliest photos acquired for 2009, usually the beginning of April. The third period of analysis compared the earliest photo date to the final date in 2009, to analyze the overall yearly response this year.

Results of this classification process are presented in tabular format. See Tables 2, 3 and 4 in Appendix B

RESULTS

Analysis of beach stability through the 2009 Season

Of the 44 beaches currently photographed regularly in the AAB Project, 36 have been photographed in 2009 a minimum of twice during the year, once in April or May and again in late August or September. All of the beaches considered had been photographed in early April during a reassessment visit as part of the Guides Training trip, and almost all were photographed frequently through the summer into September and early October. The reassessment visit is done every year or two to evaluate the appropriateness of the photo location points and to ensure an early season view of the beaches for analysis.

For the year 2009, 2 beaches ((6 %) were classified as having improved through the summer. Both Martha's, RM 38.6 and Upper National, RM 167.0, were reported by the photographer volunteers as being BETTER due to improved boat parking areas. This was due to more sand being deposited in the eddies, covering some of the rocks which had been exposed earlier. In addition, Upper National had a visible cutbank reduced to a softer slope, making loading and unloading easier.

There were 11 of the camps (31 %) receiving a designation as being degraded during the summer. The factor cited as being the primary contributor of degradation is erosion from fluctuating river flow. This was markedly noticeable following the ramp-up of releases in early July and the subsequent increase in the mean of the daily flows. Increased vegetation and aeolian effects were noted as secondary factors, and were minor in comparison.

Although some vegetation increase, sand loss from river and wind erosion and human impacts were often found or reported, 23 of the beaches (64%) remained basically unchanged, as these factors were not of magnitude to warrant a different designation. The vegetation was often considered to be an annual variety, and would likely be absent from the initial photos acquired next season. Much of the sand loss from river erosion was beach front sand that was carried to the level of maximum release flow by human traffic through the summer and then was lost by the change in flow after the beginning of July. If no cutbank was associated with this loss, it was generally considered to be of negligible impact.

One of the predominant factors in beach degradation for the past few years has been the creation of gullies or significant sand removal in camps due to rainfall and hill/slope runoff (Thompson and Pollock, 2006, Lauck, 2008). This was not observed in 2009.


Figures 3 & 4. Recession of beach front following July increase in fluctuating releases, camp at Shinumo Wash, RM 29.5 L. Left photo 6-21-09, right photo 8-31-09

Figures 5 & 6. Zoroaster camp, RM 85.0 L, is one of the beaches that frequently shows degradation by both river and wind erosion. Left photo 4-07-09, right photo 9-28-09.

These results are distributed through Reaches 2, 3 and 4. There were only one photo date for the camps located in Reach 5, and no photos were taken in Reach 1. Reach 2 had 5 beaches classified as BETTER, 2 degraded and were classified as WORSE, and 5 beaches remained similar throughout the season.

In Reach 3, 10 beaches remained the SAME, none were found to be improved, and 4 received a WORSE rating. And in Reach 4, 1 beach has improved, 5 degraded considerably, and 8 showed no change.

Analysis for the period between late 2008 and early 2009

After steady flow releases in October 2008 and low-medium flow fluctuations in November, the months of December and January both saw daily release rises to ~17000cfs, with a mean of the daily release at approximately 13500cfs. The daily high flow was then gradually reduced until June.

Early season 2009 photo comparison to late 2008 photos was possible for 27 of the study sites. For 21 (78 %) of the beaches, no over-winter change was found, and they were classified as SAME in the analysis. Change was discovered at 6 of the beaches, with 2 (7 %) improving and 4 (15 %) being classified as WORSE than the previous fall. Both of the beaches that looked BETTER, Upper North Canyon camp, RM 20.7 and Tatahatso, 37.9, had ended the 2008 season with distinctive cutbanks on the beach front which collapsed or were otherwise graded to lower angles, making it easier to load and unload gear from the boats. All 4 of the degraded beaches suffered from introduction of new cutbanks near the high winter release flow-lines. One camp, Lower Tuna at RM 100.2, also showed sign of wind scour resulting in exposed rocks well above the high flow mark.

The 2 camps that improved are both located in Reach 2. One camp that lost ground and was classified as WORSE is in Reach 3 and 3 other degraded camps are found in Reach 4. The beaches that remained relatively unchanged are not evenly distributed, with 2 being located in Reach 2, and 9 and 10 found in Reaches 3 and 4, respectively.

Analysis of the end of 2009 season beaches relative to the pre-2008 HFE Flow

One of the continually debated questions regarding the results of the HFE flows revolves around the possible duration of any beneficial effects the HFE may have on the camps. Melis and others (Melis et al, 2010) found that most newly created or enlarged sandbars had been severely eroded within 6 months after the experiment. This is largely dependant on the flow regime immediately after the HFE.

In an effort to monitor the 'life-span' of the beaches in the AAB program study, a comparison was made between the photos taken in late 2009 and those acquired in late 2007, prior to the March 2008 HFE. There were 38 qualifying beaches in this analysis, with an almost universal time span between photos of 24 months.

There were a total of 9, or 24 %, of these beaches considered as being less desirable at the end of 2009 than they had been viewed in 2007. An important note to this that 3 of these beaches had already been rated as degraded by the action of the HFE in 2008. Erosion from river flows and increased vegetation were equal in importance as factors in these changes. Arrowweed and other profusely propagating plants quickly sprouted in the newly deposited sand and grew extremely well in the open, river side terrain.

Thirteen of the beaches (34 %) did not have significant differences between the two years photos, indicating that any beneficial effects from the HFE had been negated within 18-20 months. It may also indicate that these beaches have achieved a balance point of stability, at least at the maximum flows seen since March 2008. This remains to be seen. Just as importantly, 16 camps (42 %) are classified as being more desirable than they had been in 2007. The most often cited reasons for this rating are increased camp area and better parking due to fewer exposed rocks at the beach fronts.

The most frequent observation, which occasionally resulted in a down grading of the beach, is the huge increase in dune formation on or near the camp areas. This often reduced the campable area at a beach and, in a couple of instances, inhibited the ability of larger groups with many boats to park together.

Figure 7. Dune creation (left) and expansion (right) at the upper end of Boucher camp, RM 97.2 L, 7-19-09 .

Figures 8 & 9. Stone Creek Camp, RM 132.5, is a camp that suffered serious erosion in late 2009, yet remains improved compared to Pre-2008 HFE. The photo on left is from 9-28-07, the right was taken 9-13-09.

The results were evenly distributed through Reaches 2, 3 and 4. Four of the camps that still show improvement as the result of the HFE are located in Reach 2, 6 are in Reach 3 and another 6 are found in Reach 4.

Two camps classified as WORSE when compared to the same beach prior to the HFE are located in Reach 2, there are 3 found in Reach 3 and the Reach 4 stretch contains 4.

Receiving a SAME rating, there are 4 located in Reach 2, another 3 downstream in Reach 3 and the final 4 are located in Reach 4.

CONCLUSIONS

The results of this study since 1996 are generally consistent with those presented by other authors and agencies in the past. Following HFE events, beaches have continued to decrease in size and acceptability as time passes. The physical factors such as river width, local geology and gradient play an important role in the beach longevity, but the flow regime from dam release is a far greater factor. Degradation of beaches occurs throughout the year, with the greatest impacts closely following the HFE event (O'Brien, 2000; Lauck, 2007). The annual magnitude of beach loss and degradation of camps appears to apply primarily to erosion associated with fluctuating flow patterns (Hazel and others, 2007). As flows are reduced, or more importantly, held to a steady release pattern, less erosion is seen to occur.

As demonstrated throughout the 15 years of this project, most beach fronts, regardless of reach, become static and beach front erosion becomes almost mute. Once the sand has achieved an angle of repose at the landing areas, the effects of dam release flows appear to be minimal. However, as demonstrated at Lower Tapeats camp, and to a lesser extent at other beaches, erosion from fluctuating flows can severely impact beaches in a very short time period, and can conceivably remove the usefulness of the camp entirely.

Vegetation encroachment into camp areas, aeolian action and human impacts are usually slower to produce noticeable changes. However, for 2009, both vegetation encroachment and wind erosion were more pronounced than in recent years. Both of these factors may have been accentuated by the HFE. Observations indicate that sand movement did increase as a result of the resent deposit, though what effect the HFE may have had would be purely speculative. More information is needed to assess how the controlled flood may have affected vegetation propagation.

The results of this years AAB study concur with this statement by Dennis Kubly of the Bureau of Reclamation, "Sediment – triggered floods (in Grand Canyon) temporarily improve beach building and improve sediment retention, long term sustainability may require additional flow modification or augmentation" (Kubly, 2009). This investigator would change that statement slightly to " ….WILL require additional flow modification and augmentation."

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 river runners 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 opportunity to educate the river running public fostered by the volunteers' actions. By taking time to include guests as active participants and by answering their questions, volunteers can further educate about the Glen Canyon Dam Adaptive Management Program and elucidate how our recreational 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, to Andre Potochnik for his foresight and his efforts to get the AAB program up and running, and to former Adopt-a-Beach primary investigators who have analyzed the photos and data over the years. We would like to thank the Grand Canyon Conservation Fund, a non-profit grant-making program established and managed by the Grand Canyon river outfitters, for being our staunch supporter since the program's inception. The project described in this publication was also supported by Cooperative Agreement #08WRAG0048, Mod #002 from the United States Geological Survey.

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APPENDIX 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

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

Did you camp here this visit? Yes No How many people in your group?

If you camped here, does it feel crowded or comfortable given this water level and group size?

Considering the campsite quality factors above, and the restriction against camping in the Old High Water Zone, what would a good group size be for this camp at the current water level? ______________________

APPENDIX B

Results of Analysis in Tabular Form

Table 2.

2009 Season Camp name	GCMRC River mile	Compare early 2009	to	2008	reason
		same	better	worse	
Soap Creek	11.3 R	X			
12.4 Mile	12.4 L				No late season 2008
Hot Na Na	16.6 L				No late season 2008
19.4 Mile	19.4 L				No late season 2008
Upper North Canyon	20.7 R		X		Cutbank has softened, rocks covered
23 Mile	22.7 L				No late season 2008
Shinumo Wash	29.5 L	X			Slight beach recession
Nautaloid	35 L				No late season 2008
Tatahatso	37.9 L		X		Cutbank has softened. From people?
Martha's	38.6 L				No late season 2008
Buck Farm	41.2 R				No late season 2008
Total above	11	2	2	0	
Nevills	76 L	X			Some veg growth - spread
Hance	77.1 L				No late season 2008
Grapevine	81.7 L	X			Beaver removed veg! Some wind duning
Clear Creek	84.6 R	X			
Zoroaster	85 L				No late season 2008
Trinity Creek	92.1 R	X			Obvious wind reworking
Schist	96.6 R	X			Identical
Boucher	97.3 L	X			Slight aeolian action
Crystal	98.7 R				No late season 2008
Lower Tuna	100.2 L			X	Receding bank, lots of wind reworking
Ross Wheeler	108.3 L	X			
Bass	109 R	X			
110 mile	110 R	X			Identical
Upper Garnet	114.9 R				No late season 2008
Lower Garnet	115 R				No late season 2008
Total above	15	9	0	1	
Below Bedrock	131.7 R	X			
Stone Creek	132.5 R	X			Almost identical
Talking Heads	133.7 L				No late season 2008
Racetrack	134.2 R			X	Cutbank increase, sand loss in camp
Lower Tapeats	134.5 R			X	More sand recession and loss in camp
Owl Eyes	135.2 L	X			Identical

Backeddy	137.8 L	X			Identical
Kanab	144 R	X			
Olo	146.1 L	X			Some sand slump from high bank
Matkat Hotel	148.9 L	X			
Upset Hotel	150.9 L			X	Sand loss at beach front
Last Chance	156.3 R	X			Sand is moving downhill toward front
Tuckup	165.2 R	X			Well defined sand line at max release
Upper National	167 L				No late season 2008
Lower National	167.2 L	X			Some veg increase on dune
Total above	15	10	0	3	
Travertine Falls	230.6 L				No late season 2008
Gneiss	236.1 R				No late season 2008
250 Mile	250.0 R				No late season 2008
Total above	3	0	0	0	
Totals	**44**	**21**	**2**	**4**	of 27 beaches evaluated

Table 3.

2009 Season	GCMRC	Compare			
Camp name	River mile	2009	thru	year	reason
		same	better	worse	
Soap Creek	11.3 R	X			Stable at parking
12.4 Mile	12.4 L	X			Slight veg increase on front slope
Hot Na Na	16.6 L	X			
19.4 Mile	19.4 L			X	Rockier parking late in season
Upper North Canyon	20.7 R	X			
23 Mile	22.7 L				No photos taken
Shinumo Wash	29.5 L			X	Serious beach erosion late summer
Nautaloid	35 L				No late season photos
Tatahatso	37.9 L				No late season photos
Martha's	38.6 L		X		New sand in eddy improved parking
Buck Farm	41.2 R	X			
Total above	11	5	1	2	
Nevills	76 L	X			Arrowweed filling in front slope
Hance	77.1 L	X			Stable

Grapevine	81.7 L			X	Beach front erosion
Clear Creek	84.6 R	X			Very active, but ends same
Zoroaster	85 L			X	Lots of river & wind erosion
Trinity Creek	92.1 R			X	Big cutbank late in season
Schist	96.6 R	X			
Boucher	97.3 L	X			Dunes building in back of camp
Crystal	98.7 R	X			Slight cutbank
Lower Tuna	100.2 L	X			Wind action but camp same
Ross Wheeler	108.3 L	X			Very slight veg increase
Bass	109 R				No late season photos
110 mile	110 R			X	Veg increase and wind scour
Upper Garnet	114.9 R	X			No change found or reported
Lower Garnet	115 R	X			Slight sand loss from river
Total above	15	10	0	4	
Below Bedrock	131.7 R			X	Cutbank, rockier in front
Stone Creek	132.5 R			X	Beach recession thru summer
Talking Heads	133.7 L	X			
Racetrack	134.2 R	X			Very slight cutbank late in season
Lower Tapeats	134.5 R			X	River and wind erosion
Owl Eyes	135.2 L			X	Big cutbank, steeper late in season
Backeddy	137.8 L	X			Almost identical
Kanab	144 R	X			Some veg increase near creek
Olo	146.1 L				No late season photos
Matkat Hotel	148.9 L	X			Some growth in veg areas
Upset Hotel	150.9 L	X			
Last Chance	156.3 R	X			
Tuckup	165.2 R			X	Parking getting worse
Upper National	167 L		X		Slope in front has softened
Lower National	167.2 L	X			
Total above	15	8	1	5	
Travertine Falls	230.6 L				Only one photo date
Gneiss	236.1 R				No photos taken
250 Mile	250.0 R				Only one photo date
Total above	3	0	0	0	
Totals	**44**	**23**	**2**	**11**	of 36 beaches evaluated

Table 4.

2009 Season Camp name	GCMRC River mile	Compare 2009	to	pre 08 HFE	reason
		same	better	worse	
Soap Creek	11.3 R			X	Main beach is much smaller in 09
12.4 Mile	12.4 L			X	Beachfront has recessed, steeper camp
Hot Na Na	16.6 L	X			
19.4 Mile	19.4 L		X		Bigger camp
Upper North Canyon	20.7 R		X		More sand in back of beach
23 Mile	22.7 L	X			
Shinumo Wash	29.5 L		X		Huge difference - bigger camp!
Nautaloid	35 L	X			
Tatahatso	37.9 L				No late season 09 photos
Martha's	38.6 L		X		Better parking eddy
Buck Farm	41.2 R	X			Identical
Total above	11	4	4	2	
Nevills	76 L	X			More sand but more veg
Hance	77.1 L	X			
Grapevine	81.7 L		X		Huge difference - bigger camp!
Clear Creek	84.6 R	X			Slight changes
Zoroaster	85 L		X		Huge difference - bigger camp!
Trinity Creek	92.1 R		X		Huge difference - bigger camp!
Schist	96.6 R		X		Slightly bigger camp area
Boucher	97.3 L	X			Slightly bigger in 09 ??
Crystal	98.7 R		X		Bigger camp in 09 - but steeper
Lower Tuna	100.2 L		X		Much bigger camp in 2009
Ross Wheeler	108.3 L	X			
Bass	109 R				No late season 09 photos - better in May
110 mile	110 R			X	Veg increase mainly
Upper Garnet	114.9 R			X	More camp, better parking in 07
Lower Garnet	115 R			X	More sand, better parking, less veg 07
Total above	15	5	6	3	
Below Bedrock	131.7 R		X		Bigger camp - better parking
Stone Creek	132.5 R		X		More camp space at upper end
Talking Heads	133.7 L		X		More sand in back of camp
Racetrack	134.2 R		X		Slightly larger camp area
Lower Tapeats	134.5 R			X	Veg increase, sand loss
Owl Eyes	135.2 L		X		Bigger camp, but steeper lower end

Backeddy	137.8 L	X			
Kanab	144 R			X	Veg increase
Olo	146.1 L				No late season 09 photos
Matkat Hotel	148.9 L	X			
Upset Hotel	150.9 L	X			Slightly more sand in back 09
Last Chance	156.3 R		X		More sand in sleeping area
Tuckup	165.2 R	X			Slight veg increase in 09
Upper National	167 L			X	Less camp area, worse parking 07
Lower National	167.2 L			X	Less veg and flatter in 07
Total above	15	4	6	4	
Travertine Falls	230.6 L				No late season 09 photos
Gneiss	236.1 R				No 2009 photos
250 Mile	250.0 R				No late 2007 photos
Total above	3	0	0	0	
Totals	**44**	**13**	**16**	**9**	of 38 beaches evaluated