Adopt – A – Beach:
Long-Term Monitoring of Camping Beaches in Grand Canyon
Summary of Monitoring Observations for Year 2013

By Paul Lauck[1]

Abstract

For the past eighteen years, the Adopt-A-Beach repeat photography program has been monitoring beaches along the Colorado River through Grand Canyon. Through comparative examination of photo series and on-the-spot observations contributed by the volunteer photographers, campsite conditions are evaluated. Factors considered which contribute to changes, both positive and negative, include: fluctuating river flows, aeolian action, vegetation increase/decrease, human introduced change, rain associated erosion or other actions, natural or anthropomorphic, that may have an effect on the camp. The 250 miles of river in the study are divided into four separate geomorphic reaches, and the resulting evaluations are also segregated and examined by reach. The conclusions are presented as observational, monitoring data only.

For the time spanning the 2013 summer boating season, early April to early November, 37 of the 44 study beaches in the program had photographs and photographer comment sheets covering a sufficient period of time to be evaluated. Of these 37 beaches, 30% were classified as Unchanged for the time period, 0% had Improved through the summer and 70% were considered as Degraded by the end of the season. Of the Unchanged beaches, 36% are located in the Marble Canyon reach, 36% in the Upper Granite Gorge reach, another 28% are contained in the Muav Gorge reach and none are in the Lower Granite Gorge reach. Twenty three percent of the Degraded beaches are located in the Marble Canyon reach, another 31% in the Upper Granite Gorge reach, 38% are found in the Muav Gorge reach and 8% were from the Lower Granite Gorge reach. The primary factor cited in those camps classified as Degraded is the fluctuating flow releases from Glen Canyon Dam, followed closely by rain events. As in 2012, rain erosion or debris flow deposition removed or covered approximately 75% of some beaches. This occurred primarily during the late summer monsoon season when tributary flooding is most likely to become a problem for parties camping on the beaches, and was found throughout the reaches. In at least five instances, rain events caused catastrophic damage to beaches.

A comparison of the beaches from late season 2012, from photos obtained prior to the November High Flow Experiment (HFE), and early 2013 was conducted on a total of 27 beaches. With three exceptions, all of the beaches appeared Improved in 2013, this being attributed to the Fall 2012 HFE. Of the 3 unimproved camps, 2 were basically Unchanged compared to the previous fall and 1, Soap Creek Camp at River Mile 11.3 was classified as Degraded. A considerable amount of beach front had been scoured from the beach since 2012, presumably during the HFE.

More significantly, 19 of the beaches were photographed immediately following the HFE, allowing an evaluation of the winter flow regime and immediate effects on the beaches which responded well to the HFE. According to the streamflow gage for the Colorado River @ Lees Ferry, daily fluctuations of 7000 cubic feet/second (cfs) ramp up and then back down a full 7000 cfs began seven days after the HFE was concluded. These flows usually peaked in excess of 17000 cfs. They continued through January 2013, with similar; though slightly lower flows, continuing through February. The fluctuating flows, combined with the overall relatively high releases, are defined with a classification of Degraded for 9 of the beaches. The remaining 10 beaches were classified as Unchanged for the same time period. So, nearly 50% of the freshly deposited sand was affected adversely by the winter flow regime of 2012-2013. Twenty percent of the Unchanged and 22% of the Degraded beaches were located in the Marble Canyon reach and another 20% of the Unchanged and 56% of the Degraded beaches are located in the Upper Granite Gorge reach. The Muav Gorge reach contained the remaining 60% of the Unchanged beaches and the other 22% of the Degraded classified beaches.

While this represents just less than half of the 44 beaches normally reviewed by the study, the distribution of the results would indicate the possibility of similar effects throughout the canyon system.

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Introduction and Background

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) 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 camping area available for river parties and backpackers (Kearsley and Warren 1993, Kearsley and Quartaroli 1997).

The Grand Canyon Protection Act was passed by Congress in 1992 to ensure that ecological and cultural resources downstream of the dam would be monitored for changing conditions imposed by operation of the dam. The Act states that Glen Canyon 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).

In 1996, following completion of the "Operation of Glen Canyon Dam: Final Environmental Impact Statement" (EIS), a Record of Decision was signed and implemented which included provision for the use of "beach/habitat-building flows." Now referred to as High Flow Experiments (HFE), the EIS defined these events as "…scheduled high releases of a short duration designed to rebuild high elevation sandbars, deposit nutrients, restore backwater channels and provide some of the dynamics of a natural system" (U.S. Department of the Interior, 1995), with the added intent of restoring some of the dynamics that resulted from flooding in the ecosystem. Further, an HFE is defined as a flow release exceeding 31,500 ft^3/s. Sandbars 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). The first HFE was conducted in late March 1996, and consisted of a 7-day steady release of 45,000 ft^3/s that was preceded and followed by steady flows of 8000 ft^3/s for 4 days each (Melis, 2011).

Grand Canyon beaches form the substrate for communities of plants, invertebrates and vertebrates, including species such as riparian birds (Carothers and Brown, 1991). These beaches are also 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. Consequently, those who run the river are interested in observing the changes to camping beaches throughout the river corridor in the Grand Canyon. As a non-profit organization dedicated to protecting Grand Canyon and the Colorado River experience, Grand Canyon River Guides developed and implemented the Adopt-a-Beach (AAB) program prior to the initial flood event in 1996 in order to assess the evolving state of the recreational resource. The use of photographic duplication over time, and analysis of the differences between photo duplicates as a means of detecting change in the Grand Canyon landscape, has been demonstrated previously (Turner and Karpiscak 1980, Webb 1996). AAB is a long term monitoring program that relies on systematic photograph replication to document and analyze changes in sand deposition and other physical attributes of an initial dataset of 44 camping beaches along the Colorado River corridor in Grand Canyon. A cooperative agreement with Grand Canyon Monitoring and Research Center (GCMRC), ensures that the extensive AAB photo archive and legacy data are incorporated into the GIS Campsite Atlas project to build a more complete and robust understanding of the status, trends and conditions of camping beaches in the river corridor affected by the operations of Glen Canyon Dam.

Since its inception in 1996, the Adopt-A-Beach program has utilized volunteer photographers to conduct repeat photography of these camps. 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 field season and between years. Volunteer photographers 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 study beach. With the end of the 2013 season, river runners have produced nearly 8300 replicate photographs on more than 3500 dates with associated field sheets recording the sequential condition of beaches.

Standardized comment forms completed by the volunteers at the time the photographs are acquired, assisting in the effort to document the beach conditions. The program assesses the visible photographs and first-hand, objective comments pertaining to changes to beaches, and reports on the conditions as influenced by regulated flow regimes, rainfall, wind, vegetation, human impacts or any other factors that may be present. 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 (Lauck, 2009).

Recently, the presence and impacts of the tamarisk beetle, *Diohabda spp*. have been included in these comments and documented photographically. This component of the analysis has been added not only for ecological monitoring reasons, but also because of related questions pertaining to the recreational experience: will the beetle remove valuable shade from camping areas, how will other vegetation respond to the impacts on the tamarisk and how does this affect the camp. Also, in what ways may defoliation of tamarisk affect aeolian or streamflow related erosion. These are examples of recreational concerns.

The purpose of this report is to present the results of the monitoring effort for the period between late 2012 and early November 2013. Also, after each of the HFE events, beaches were shown to have eroded at differing rates (Thompson, Burke and Potochnik, 1997, Lauck 2009). Hence, researchers are concerned with the longevity of bars and camping areas augmented by the HFEs, and a comparison of the 2013 beach conditions with those photographed both before and after the HFE conducted in November 2012 are included.

Research results include reporting positive “Improved” conditions, negative “Degraded” conditions or “Unchanged” conditions, when no changes were found in beaches. Longevity of these camps and attributes of the primary and secondary processes that cause change in camping beach area and quality are also included. Specific research questions that are addressed by this report are:

- What changes, if any, are found at the beaches through the boating season of 2013?
- How do the beach conditions of late summer 2013 compare to those of late fall 2012, both before and after the High Flow Experiment?
- What changes occurred in beach conditions during the winter between the November 2012 High Flow Experiment and April 2013?
- How are changes in the beaches, if any, distributed throughout the river corridor?
- Which processes resulting in a change of condition at a beach are most prevalent?

Methods

Study locations and beaches

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 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, 1996-2011. The reaches 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.

Two additional critical reaches were added during the 2003 monitoring season. The purpose was 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 has been collected for the Glen Canyon reach for a few years, but the Lower Gorge reach, which was been extended to include the 250 Mile Camp in 2009, is still being monitored.

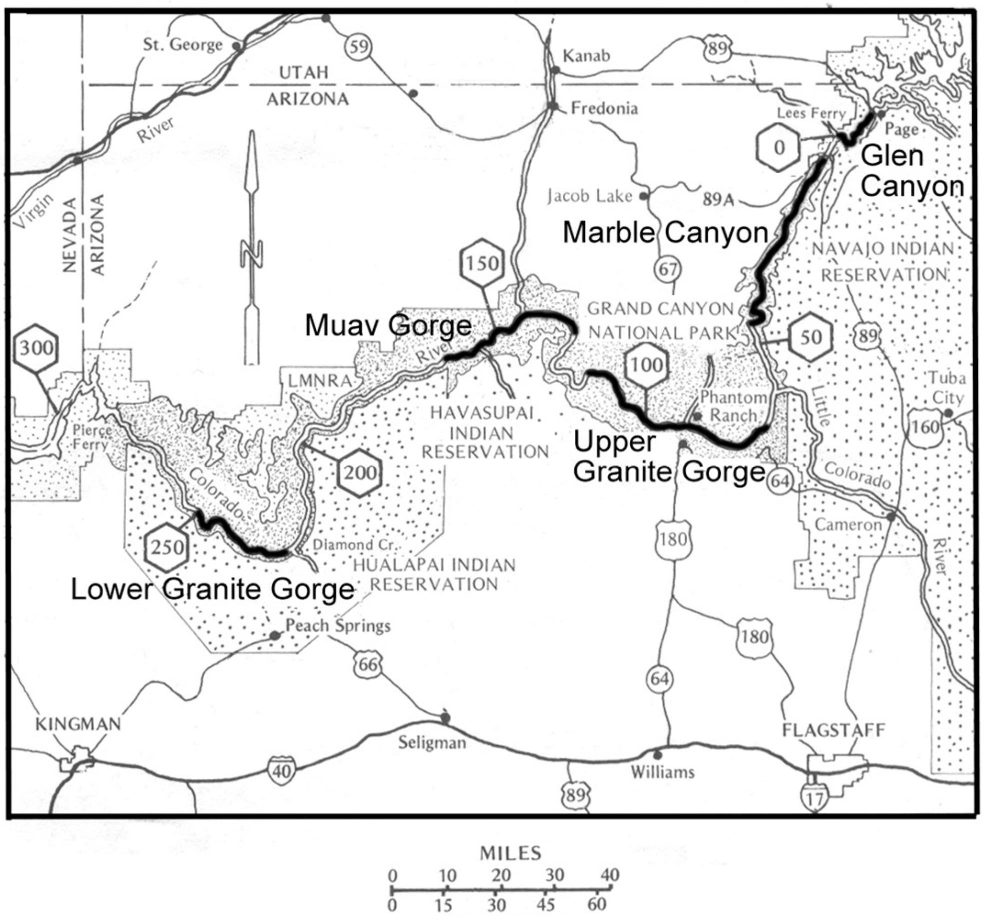


Figure 1. Locations of five critical reaches along the Colorado River in Grand Canyon National Park

Table 1 shows popular campsites (n = 44), 34 of which were originally inventoried in 1996, and includes beaches added in 2000, 2001 and 2009.

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 Canyon
		16.6	Hot Na Na	81.7	Grapevine	133.7	Talking Heads	250.0	250 Mile
		19.4	19.4 Mile	84.6	Clear Creek	134.2	Race Track		
		20.7	North Cyn	85.0	Zoroaster	134.5	Lower Tapeats		
		22.7	23 Mile	92.1	Trinity Creek	135.2	Owl Eyes		
		29.5	Shinumo Wash (Silver Grotto)	96.6	Schist	137.8	Back Eddy		
		35.0	Nautiloid (Middle&Lower)	97.3	Boucher	144.0	Kanab Creek		
		37.9	Tatahatso	98.7	Crystal	146.1	Olo		
		38.6	Martha's (Bishop's)	100.2	Lwr Tuna	148.9	Matkat Hotel		
		41.2	Buck Farm	108.3	Ross Wheeler	150.9	Upset Hotel		
				109.0	Lwr Bass	156.3	Last Chance		
				110.0	110 Mile	165.2	Tuckup		
				114.9	Upper Garnet	167.0	Upper National		
				115.1	Lower Garnet	167.2	Lower National		

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

Unlike other established re-photography studies, both within and outside of the Grand Canyon, the AAB program does not adhere to a regime which includes matching photos per a specific time of day or date (Webb1996, Webb, Boyer and Turner, 2010). The photographs obtained here are much more opportunistic and acquired whenever a volunteer happens to pass their chosen camp. However, guidelines for the volunteer are provided to help regulate the consistency required to make adequate comparisons between the images. 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. However, the portion of the camp photographed at each beach, the relative photographic locations between beaches and the number of images acquired per beach are not all the same. This means that one beach may be evaluated through slightly differing information than another one, in that not every beach photo set contains the same 'clues.' The resulting evaluations can only be compared with results for camps using the same views. 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. Photos taken from specifically designated locations on shore, looking across the front of the beach, usually from an elevated, oblique angle, are often acquired as well. 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. Also, almost half of the beaches 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.

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.

Figure 2 & 3. Shinumo Wash Camp, RM 29.5 L, 4/2/13 (top) and 9/21/13 (bottom)
Documents erosion across beach front after summer fluctuating flows.

The time-series photos taken within study locations allow assessment of relative change over the course of each season and between monitoring years. The number of adopted beaches with useable season long data in 2013 totaled 37. Each record in the data base represents an individual visit to a beach where each beach usually has 1-5 photos associated with it. Adopters often take extra snapshots of various impacts such as flash flooding in Schist Camp (August 2002) and North Canyon (October 2010) and debris flows at National Canyon (July 2012). These documented events and data are available to any interested researchers through Grand Canyon River Guides or Grand Canyon Monitoring and Research Center, http://www.gcmrc.gov/ and the images are currently available as part of the Adopt-A-Beach photo gallery, http://www.geanious.com/gallery/main.php. Part of the Adopt-A-Beach program is to provide photos of unusual natural events in Grand Canyon to interested parties.

Analysis

When a volunteer requests a camera and a beach assignment, they are asked to photograph a completed datasheet, identifying the beach name and mile, plus the photo date and time, immediately prior to photographing the camp. This information is included in the captioning of the image, and helps to correctly place the photo chronologically during analysis. While this practice occurs most of the time, occasionally the datasheet is photographed later or, rarely, not at all. Photos without a distinct date/time attribute in the photography sequence are examined by water color, shadowing on the surrounding walls, or other common elements such as guest attire when available, to help correctly identify the proper sequential placement of the image(s). It is possible that the date/time attributes are incorrectly applied to a very few images.

When comparing the photos for evaluation, numerous criteria are used to gather the empirical data. After the images are sorted by camp and have been given a date and time caption, a consistent pattern of examination was conducted for every analysis. This began with the water level determination for the first image examined in any set. This was accomplished by consulting the flow graph of one or all of the following USGS gauges: Colorado River @ Lees Ferry, AZ (09380000), Colorado River Near Grand Canyon, AZ (09402500), Little Colorado River Above Mouth Near Desert View, AZ (09402300), Kanab Creek Above the Mouth Near Supai, AZ (09403850), Havasu Creek Above the Mouth Near Supai, AZ (09404115) or the Paria River @ Lees Ferry, AZ (09382000). See Figures 6 – 11. These graphs also helped determine when additional sediment may be entering the mainstem for possible deposition along beaches downstream. During comparison to each subsequent image, identification of a near-shore landmark or two and its proximity to the current shoreline was employed to help determine relative water levels. The flow graphs were also revisited if required, particularly when it appeared that the river volume and possible sediment load changed due to additional input from the Paria or Little Colorado tributaries.

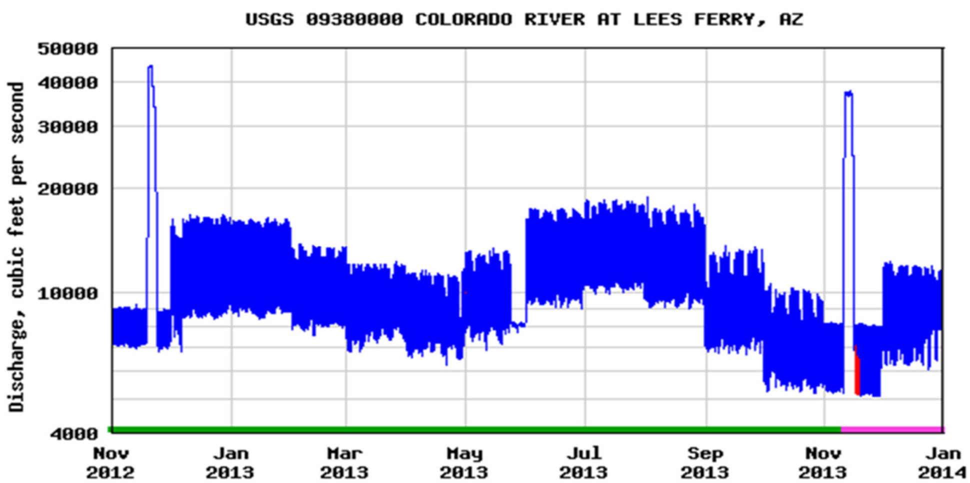
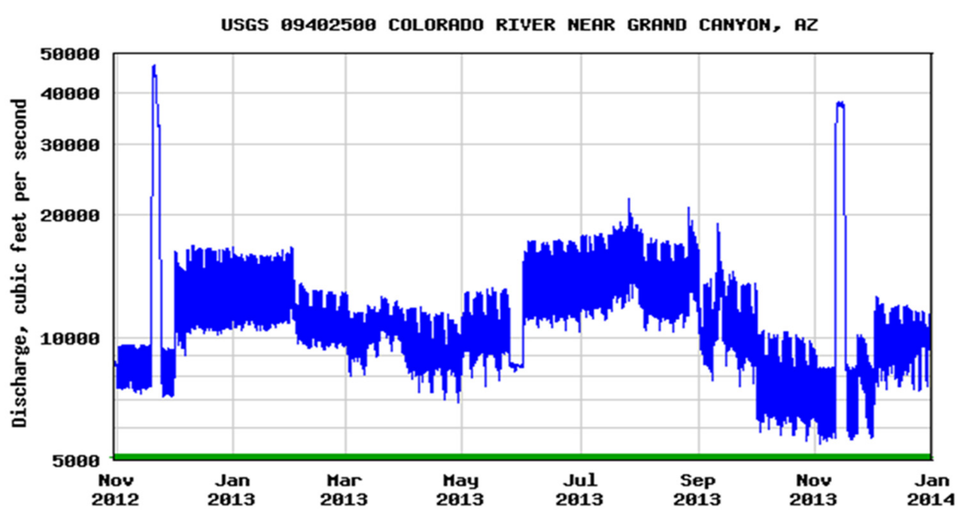


Figure 4. Flow graph for Colorado River at Lees Ferry, AZ., late 2011 through 2013



F igure 5. Flow graph for Colorado River near Grand Canyon, AZ., late 2011 through 2013.

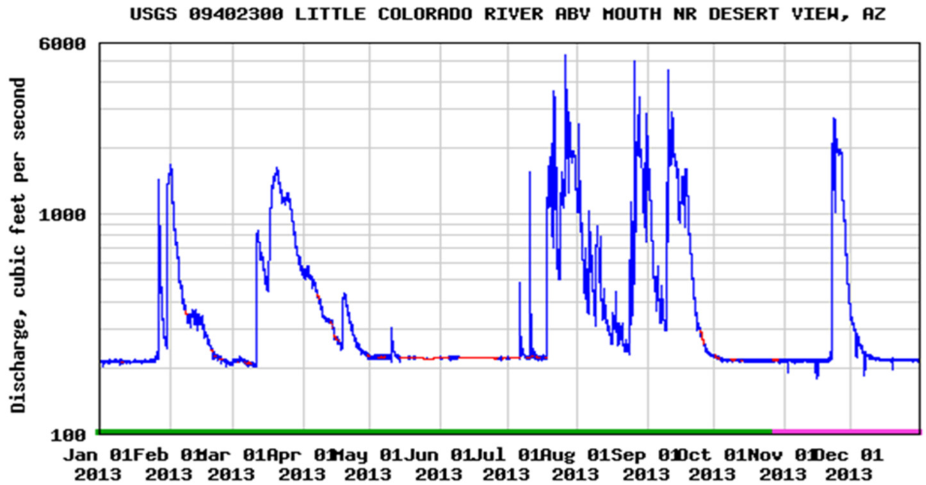


Figure 6. Flow graph for Little Colorado River above mouth near Desert View, AZ., 2013

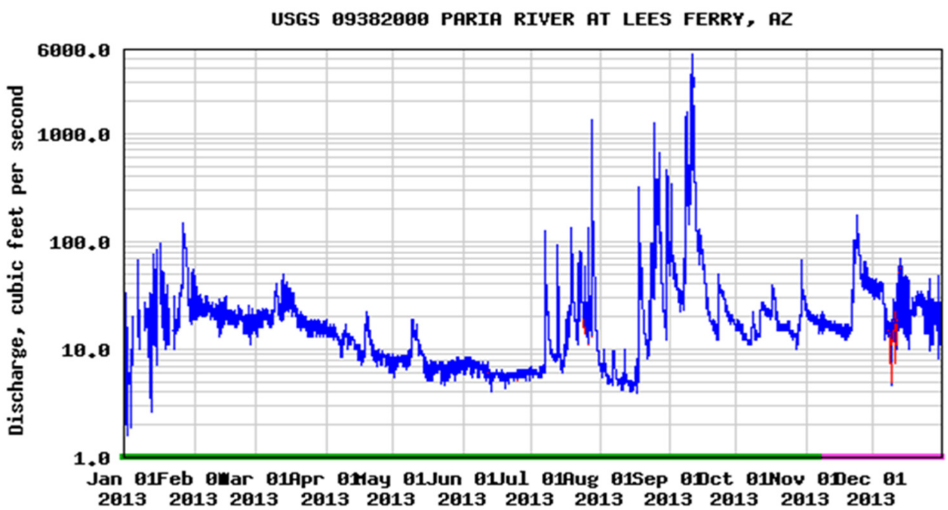


Figure 7. Flow graph for Paria River at Lees Ferry, AZ., 2013

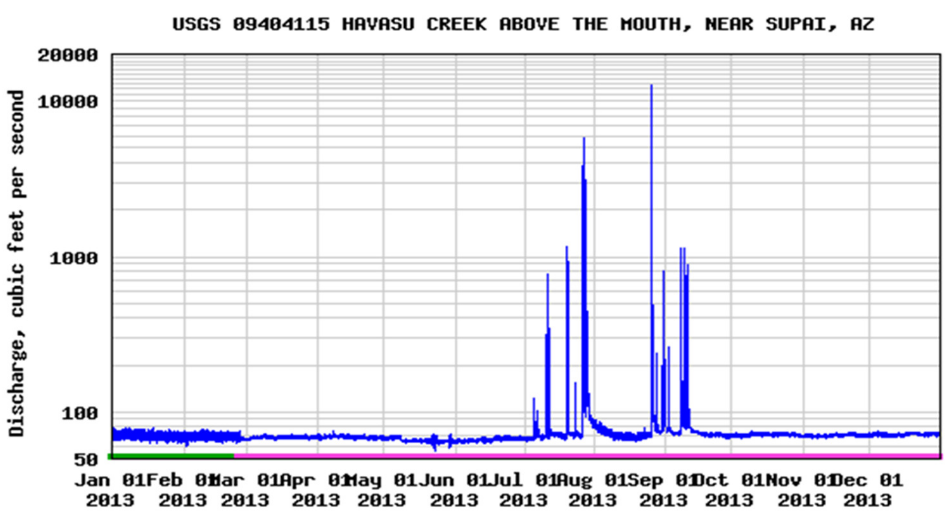


Figure 8. Flow graph for Havasu Creek above the mouth near Supai, AZ., 2013

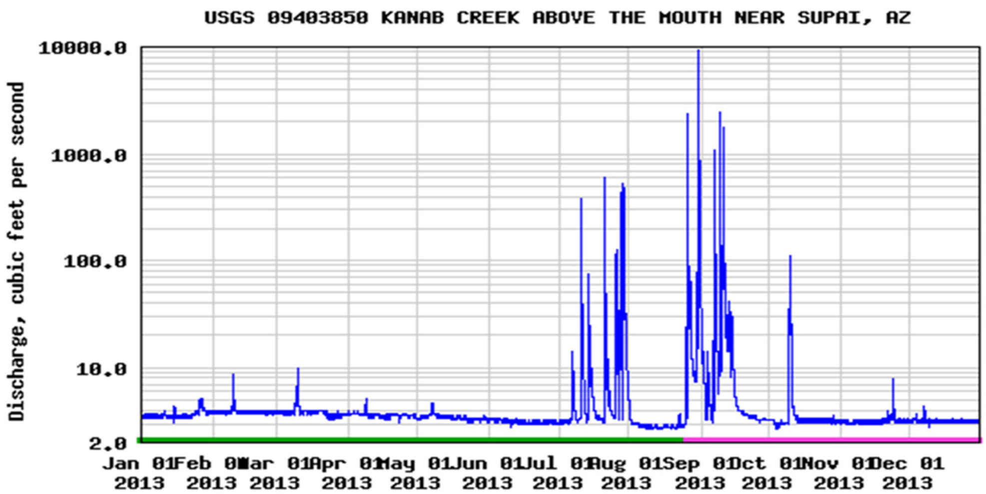


Figure 9. Flow graph for Kanab Creek above the mouth near Supai, AZ., 2013

The images were viewed for evaluation using Adobe Photoshop v7.0 on two Sony 19' monitors, side-by-side, with one image on each. Beginning at the front, or shoreline of the beach, the images were examined and compared. The presence/absence of rocks or debris, either hindering or enhancing boat parking, were noted. Due to the variety of river flow levels between the comparison photos, change in the 'parking' at a particular beach is often difficult to evaluate, and, when covered at higher flows, is considered only when recorded by the AAB observer. Any beach front cutbanks which would affect unloading/loading of boats at similar flow levels, or which indicated erosion of the beach by the river flow were also noted. Conversely, the absence of a cutbank or smoothing of an access slope helped determine the possible addition of sand by sediment augmentation or other river action that benefited the camping desirability of the beach.

The images being compared were then examined progressively from front to back to note the absence or addition of rocks or other debris which would impact the total area being used as a camp. The location and visual extent of emerging rocks can usually indicate the physical action which occurred to reveal the rocks. As an example, rocks which were covered in image "A" by sand, covered by river flow in image "B" and subsequently revealed as the water level receded, are noted as indicators of river flow erosion. Conversely, the reverse action would be noted as an indicator of sediment deposition.

Figures 10 & 11. Tatahatso Camp, RM 37.9 L. Photo on top taken April 2,2013 and bottom taken July 11, 2013. Documented defoliation of tamarisk tree.

The same kind of visual clues can also be used to determine aeolian action, particularly when the exposed and/or covered rocks and shelves are higher than any possible river flow level during the time period being examined. During the November 2012 HFE, some camp areas increased as a result of boulders and bedrock being covered by sand carried onto the beach at the higher flow. Since then, some of these rocks have re-emerged as a result of wind scour, resulting in a decrease in camp area. The upper portion of Lower Tuna Camp is an excellent example of this action.

Determining whether a beach was uncomfortably steep for access was easily assessed if one of the photos was taken across the front, either looking up or downstream. But beaches with only head-on photos are more difficult to discern. Well-trodden paths, leading to and from obvious access points, creating easily eroded channels, are the primary clues. Human caused erosion is usually noted by the volunteer photographer and can be correlated with the images.

Beach images acquired from various viewpoints were the easiest to determine changes in vegetation. When this was not possible, such as head-on only shots, a systematic comparison from one end of the beach to the other was used. Baccharis species, arrow-weed (*Pluchea sericea*), Russian thistle (*Salsola tragus*), coyote willow (*Salix* species) and camelthorn (*Alhagi* species) were usually identifiable when noted moving into a previously open sand area, or were missing from subsequent images.

Because of varying photo locations from one beach to the next, some agents of change are more readily apparent than others. Deposition/erosion across a beach front at waterline is always more prominent in the images than perhaps vegetation incursion or loss. Aeolian activity on a beach is more apparent when the photograph is acquired from an angle slightly higher than the beach itself, and vegetation changes are more readily denoted when there are images of the beach in addition to the beach front itself. Not all beach photos include areas where human impacts would most likely be found.

While every effort is made to ensure an even, consistent analysis of the beaches, the patterns of photo acquisition on any particular beach may bias the evidence of an agent of change. Conversely, some bias towards a No Change determination may be present in other photo acquisition sets. The final determination is sometimes dependent on the patterns of photo acquisition established for a particular beach and, to a lesser extent, the effort exerted by the volunteer photographer.

For those beaches where one or more tamarisk trees, or partial trees, are clearly visible in a photo, the percent of green, leafy branches were noted early in the season. If the same plant appears to have leaf loss in subsequently dated photos, and particularly if the same plant produces more foliage later in the summer, then the presence of *Diohabda spp.* is assumed and recorded. This method of analysis may need to be adjusted as the effects of the beetle on the trees changes. In a few instances, such as Kanab Creek Camp, where beetle damage to trees has already killed or partially killed trees, it is simply noted as evidence of beetles is present.

Knowledge of the study sites by this investigator was also considered, though this did not determine the final classification used for any particular beach. Using these analysis criteria, the beaches are given classifications indicating desirability as camping beaches, stated as Improved, Degraded or Unchanged. While the designations of Unchanged, Improved and Degraded are inherently subjective, the results are reflective of the stated evaluation purpose of determining the beach as a useable camp for river trips. No photogrammetry techniques were employed and this should not be interpreted in any way that results were obtained using anything other than objective evaluation.

The data are compared and analyzed according to the research questions that are most applicable for the time period being studied. For the season of 2013, evidence of change between April 1 and the latest photo acquired for the year, but before the November HFE, was evaluated. The majority of the ending date photos were taken from mid-September into November. Seven of the beaches which had early season information were not included in this portion of the study because the last photo of the beach was taken on or before August 1. Other analysis conducted with this data set compared the early April 2013 photographs to both the pre-HFE 2012 and the post-HFE 2012 images.

Figures 12 & 13. Upper North Canyon Camp, RM 20.7 R   April 2, 2013 (top} and October 30, 2013 (bottom). Exposure of bedrock and large boulders above the high water line indicates wind erosion of beach.

Results

Through 2013 boating season

For the time spanning the 2013 summer boating season, photos were used which spanned from early April to early November, with the average fall season ending date being October 12. Thirty seven of the 44 study beaches in the program had photographs and photographer comment sheets spanning a sufficient period of time to be evaluated. The highest release flows during the season started July 1 and continued through August, and with few exceptions, the earliest season ending date considered was September 1. Only three of the beaches were orphaned after the initial April photo set, but 4 others were not photographed late enough in the year to be considered for a complete season. Of the 37 beaches included in this portion of the analysis, 30% did not show significant changes, and were classified as Unchanged through the season. Twenty six of the beaches, just over 70%, were Degraded through the summer. None of the beaches evaluated were considered Improved in the Fall of 2013. Those beaches classified as Unchanged were distributed fairly evenly through the upper three reaches, with 4 in the Marble Canyon reach, 4 also in the Upper Granite Gorge reach and 3 residing in the Muav Gorge reach. Of the three beaches found in the Lower Granite Gorge reach, none was considered as Unchanged. The

26 Degraded beaches were located in each of the four reaches, with 23% in Marble Canyon, 31% in the Upper Granite Gorge, another 38% distributed through the Muav Gorge and 8%, or two the three beaches, in the Lower Granite Gorge.

The most often cited cause of beach degradation this season was the erosion by fluctuating flows, particularly the higher flows during the second half of the season, but rain events had a greater impact overall. Incision of camps by rain runoff was found throughout the Grand Canyon but tributary flows were catastrophic in both the Muav Gorge and the Lower Granite Gorge for the second year in a row. Wind deflation of camps was also a frequent cause of erosion and was a severe enough agent to warrant a classification of Degraded in a couple of instances.

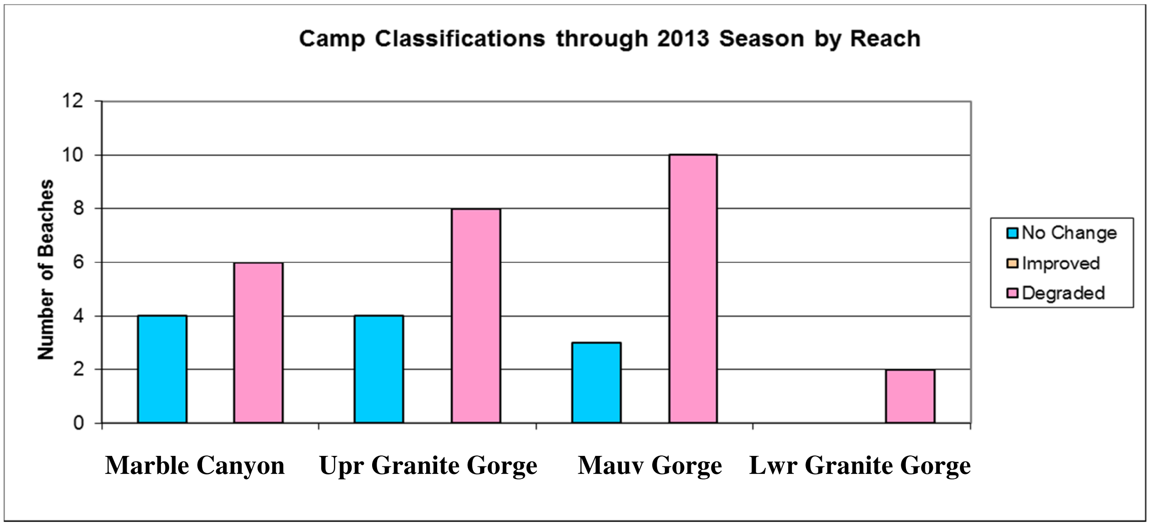


Figure 14. Graphic illustration for 2013 seasonal evaluations

Winter of 2012 - 2013

A High Flow Experiment was conducted in the Grand Canyon in November of 2012 (see Fig. 4). This event complicated the normal analysis of how the winter flow regime and weather factors affected the beaches between October 2012 and April 2013. Briefly, all but three beaches demonstrated Improvement from the HFE. Soap Creek Camp at river mile 11.3 was reduced in size across the beach front, apparently by scouring from the HFE and was classified as Degraded. Below Bedrock Camp displayed a slight recession across the front with a small cutbank and 110 Mile Camp, while gathering a considerable quantity of driftwood was relatively unaffected, so both were classified as Unchanged.

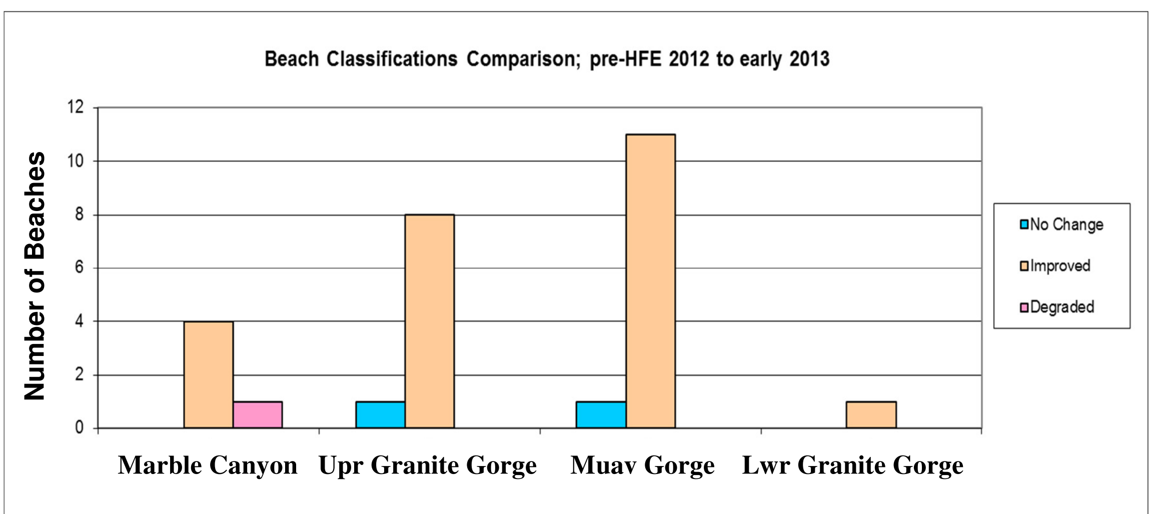


Figure 15. Graphic illustration for pre_HFE 2012 to Spring 2013 evaluations

Changes between High Flow Events

Fortunately, the Park Service had a trip on the river immediately following this flow and volunteers from that trip acquired photos of 19 beaches after the river receded. These photos were used to conduct an analysis of winter changes in the beaches between HFEs.

The November 2012 HFE resulted in increased camping areas and improved boat parking at almost all of the beaches. Unfortunately, the erosion created by the continuous fluctuating flows in December 2012 and January 2013, which often topped 16,000 cubic feet per second (cfs) release, was quite evident by the following April. All of the beaches classified as having Degraded between November and April, or 47% of the 19, exhibited steep, shear cutbanks across the front of the sand and exposure of rocks at the 12 – 16,000 cfs level, typical of erosion resulting from fluctuating flows. No other agent of change was significantly present.

The distribution of these results was dispersed through the first three reaches, and the reader is reminded that the volunteers only photographed on opportunistic occasions, and the data here is very incomplete. In the Marble Canyon reach, 20% of the total beaches considered were designated as Same and 22% as Degraded. In the Upper Granite Gorge reach, 20% of the total were again classified as Same and 56% as Degraded. The Muav Gorge contained the remaining beaches, with 60% considered Same and 22% as Degraded.

While this is less than half of the 44 beaches normally reviewed by the study, the distribution of the results would indicate the possibility of similar effects throughout the canyon system.

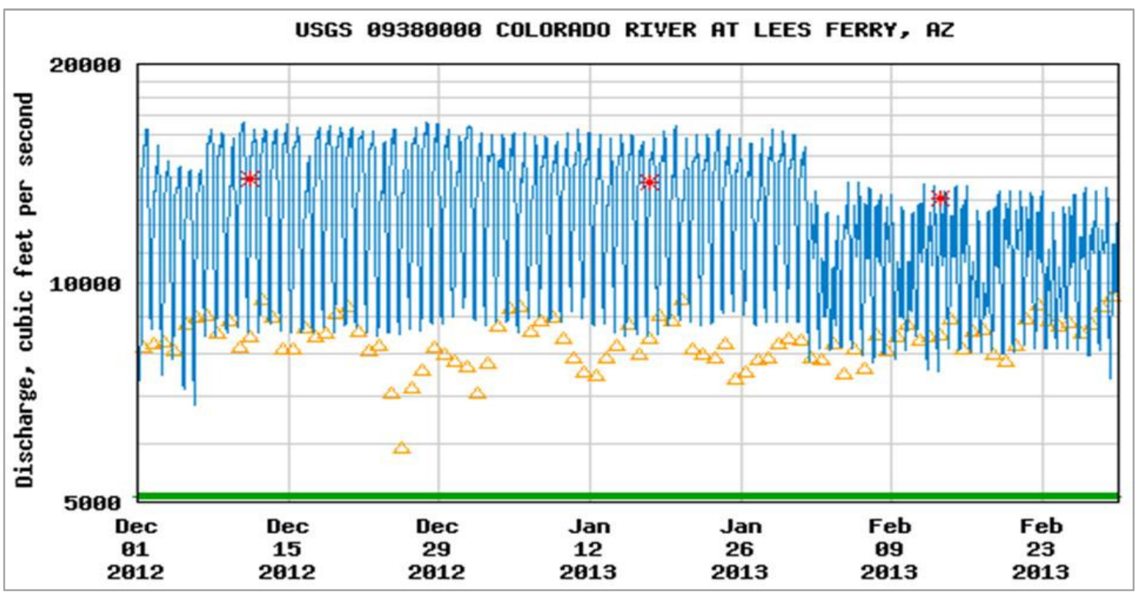


Figure 16. Fluctuating release flows from Glen Canyon Dam late 2012 and early 2013

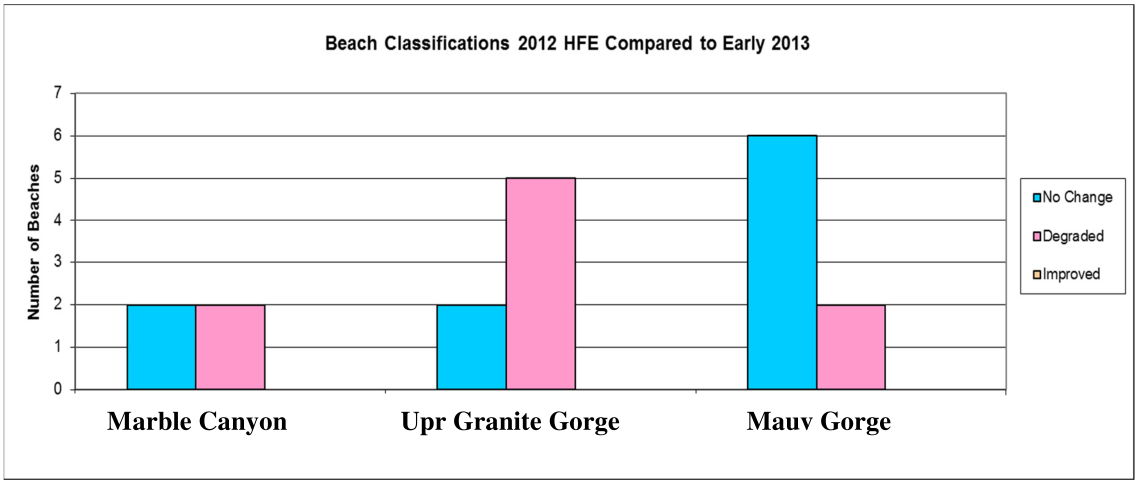


Figure 17. Graphic illustration for winter 2012-2013 seasonal evaluations

Tamarisk beetle tracking

This is the third season that the AAB program has been noting and recording the presence of *Diohabda spp.*. As observed in the images, the effects of the beetle appear as trees that go from green foliage and full form early in the season, then appear leafless and/or burnt orange in early July, and finally return to partial green again later in the summer.

Of the 44 beaches photographed in early April 2013, 26 had enough photographic evidence through the season to evaluate the presence or absence of the beetles. Of these, 10 beaches were considered as having beetle infestation and 16 are confidently classified as being beetle free. The remaining 18 beaches were fairly evenly divided into categories of 1.) Not sufficient evidence to assume presence, 2.) No tamarisk was found in the photos, and 3.) Photo sequences for the beach were deficient of temporal information to make an evaluation. An effort to locate and photograph trees closely associated with all beaches is being implemented in 2014 to help broaden this database.

Beetles were considered present at all 6 of the classified beaches in the Marble Canyon reach, but only one of the 8 classified beaches in the Upper Granite Gorge exhibited beetle evidence, and this was at the camp furthest upstream. The Muav Gorge reach contained 10 beaches where analysis could be determine Presence/Absence. Of these, 2 had strong evidence of beetle presence and 8 were decidedly beetle free. The Lower Granite Gorge reach split, with the upper-most beach, Travertine Falls Camp, free of beetles and significant defoliation found at 250 Mile Camp, the farthest downstream beach in the Adopt-A-Beach study.

Conclusions

While this analysis is limited to reporting monitoring observations and presumptive factors affecting change, it does provide evidence of changes in the beaches and the effects on associated recreational camping. Both natural and manmade actions contribute to the acceptability of a beach as a desired recreational camp area. As reported in earlier studies by various investigations, fluctuating releases from Glen Canyon Dam are usually the agent of change most often associated with beach degradation, but it is certainly not the only factor.

Subsequent analysis using the results accumulated during the past eighteen years of observations could perhaps consider the hierarchical role of these factors of change. Another direction for evaluation could be the way in which individual beaches responded to the multiple HFE events, or how these results are distributed through the different reaches in the system.

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Geanious, Chris. Website gallery for Adopt-A-Beach images

Appendix A

Results of Analysis in Tabular Form

Page 1 Results of evaluations, through 2013 season

Camp name	Rvr mile	2013	thru	season	reason
		Unchngd	Improved	Degraded	
Soap Creek	11.3 R	X			Minimal change
12.4 Mile	12.4 L			X	Erosion gully from rain, veg increase
Hot Na Na	16.6 L				No late season photos
19.4 Mile	19.4 L			X	Receding shore from flucuating flows
Upper North Canyon	20.7 R			X	Wind activity very evident
23 Mile	22.7 L			X	Rain erosion, some recession from fluc flow
Shinumo Wash	29.5 L			X	Huge cutbank and recession from fluc flow
Nautaloid	35 L	X			Sand recession and deposition equalized
Tatahatso	37.9 L	X			Identical except slight veg increase
Martha's	38.6 L	X			Minimal change
Buck Farm	41.2 R			X	Shoreline recession from fluc flow and wind loss
Total above	11	4	0	6	
Nevills	76 L			X	Shoreline recession from fluc flow and wind loss
Hance	77.1 L				No late season photos
Grapevine	81.7 L	X			Wind loss noted, but no degradation
Clear Creek	84.6 R			X	Shoreline recession from fluc flow and veg increase
Zoroaster	85 L			X	Huge beach recession from fluc flow, rain and wind
Trinity Creek	92.1 R			X	Lots of wind loss, rain erosion/debris deposit
Schist	96.6 R			X	Rain gully erosion
Boucher	97.3 L	X			Slight loss across front and wind action
Crystal	98.7 R			X	Shoreline recession from fluc flow
Lower Tuna	100.2 L	X			Already cutbank from spring fluc flow
Ross Wheeler	108.3 L	X			Wind erosion evident, but camp basically same
Bass	109 R				No late season photos
110 mile	110 R				No late season photos
Upper Garnet	114.9 R			X	Rain erosion and some fluc flow recession
Lower Garnet	115.1 R			X	Rain erosion and substantial fluc flow recession
Total above	15	4	0	8	
Below Bedrock	131.7 R			X	Shoreline recession from fluc flow
Stone Creek	132.5 R			X	Huge cutbank and recession from fluc flow, wind
Talking Heads	133.7 L			X	Already cutbank from spring fluc flow, increased
Racetrack	134.2 R	X			Some shoreline slump, but beach same
Lower Tapeats	134.5 R			X	Steady shore loss through season from fluc flows
Owl Eyes	135.2 L	X			Wind duning, but beach held up well
Backeddy	137.8 L				No late season photos
Kanab	144 R			X	Creek flood wiped out the HFE deposit
Olo	146.1 L			X	Cutbank from spring fluc flows, creek flood removed all
Matkat Hotel	148.9 L			X	Rain erosion and some cutbank
Upset Hotel	150.9 L			X	Sand eroded by humans then removed by fluc flow
Last Chance	156.3 R			X	Rain erosion, debris covers sand, cutbank upper end
Tuckup	165.2 R			X	Already cutbank from spring fluc flow, rain gullies
Upper National	167 L	X			Veg increase, but not in primary camp areas
Lower National	167.2 L				No late season photos
Total above	15	3	0	10	
Travertine Falls	230.6 L				No late season photos
Gneiss	236.1 R			X	Shoreline recession from fluc flow and wind loss
250 Mile	250.0 R			X	Flash flood during first visit removes beach
Total above	3	0	0	2	
Totals	44	11	0	26	
% of reporting beaches		30	0	70	

Page 2   Results of evaluations, winter season, late 2012 to April 2013, pre-HFE

Camp name	Rvr mile	late 2012	pre-HFE to	early 2013	reason
		Unchngd	Improved	Degraded	
Soap Creek	11.3 R			X	front scoured - HFE?
12.4 Mile	12.4 L				no late season photos
Hot Na Na	16.6 L				no late season photos
19.4 Mile	19.4 L				more rocks, less parking
Upper North Canyon	20.7 R		X		parking, access improved
23 Mile	22.7 L		X		larger camp area
Shinumo Wash	29.5 L		X		larger camp area
Nautaloid	35 L		X		rocks at parking area covered, big camp
Tatahatso	37.9 L				no late season photos
Martha's	38.6 L				no late season photos
Buck Farm	41.2 R				smaller camp, rockier - HFE scoured?
Total above	11	0	4	1	
Nevills	76 L				no late season photos
Hance	77.1 L				no late season photos
Grapevine	81.7 L		X		sand eroded in 2012 replaced by HFE
Clear Creek	84.6 R		X		veg removed or covered by HFE
Zoroaster	85 L				no late season photos
Trinity Creek	92.1 R		X		much larger camp
Schist	96.6 R		X		more sand at parking area
Boucher	97.3 L				no late season photos
Crystal	98.7 R		X		slight improvement over 2012
Lower Tuna	100.2 L				no late season photos
Ross Wheeler	108.3 L				no late season photos
Bass	109 R		X		less cutbank across front
110 mile	110 R	X			no change in camp, lots of driftwood!
Upper Garnet	114.9 R		X		fewer rocks in parking area
Lower Garnet	115.1 R		X		steep, but more camp area
Total above	15	1	8	0	
Below Bedrock	131.7 R	X			slight recession
Stone Creek	132.5 R		X		huge improvement throughout beach
Talking Heads	133.7 L		X		huge improvement throughout beach
Racetrack	134.2 R		X		filled gullies, covered some veg
Lower Tapeats	134.5 R				no late season photos
Owl Eyes	135.2 L		X		beach expanded, veg/rocks covered
Backeddy	137.8 L		X		slight improvement
Kanab	144 R		X		campable again!!
Olo	146.1 L				no late season photos
Matkat Hotel	148.9 L		X		filled gullies expanding camp
Upset Hotel	150.9 L		X		better parking, but noticable traffic wear
Last Chance	156.3 R				no late season photos
Tuckup	165.2 R		X		filled gullies
Upper National	167 L		X		slight improvement, but still sparse camp
Lower National	167.2 L		X		much larger camp area
Total above	15	1	11	0	
Travertine Falls	230.6 L				no late season photos
Gneiss	236.1 R		X		larger, less veg (annuals?)
250 Mile	250.0 R				no late season photos
Total above	3	0	1	0	
Totals	44	2	24	1	
% of reporting beaches		7	89	4	

Page 3 Results of evaluations, post-HFE 2012 to April 2013

Camp name	Rvr mile	2012 po	st HFE to	early 2013	reason
		Unchngd	Improved	Degraded	
Soap Creek	11.3 R				no post HFE 2012 photos
12.4 Mile	12.4 L				no post HFE 2012 photos
Hot Na Na	16.6 L				no post HFE 2012 photos
19.4 Mile	19.4 L				no post HFE 2012 photos
Upper North Canyon	20.7 R	X			slight loss across front
23 Mile	22.7 L				no post HFE 2012 photos
Shinumo Wash	29.5 L			X	sand recession through winter
Nautaloid	35 L			X	scour loss of sand across front
Tatahatso	37.9 L	X			steep at parking, but no change from 2012
Martha's	38.6 L				no post HFE 2012 photos
Buck Farm	41.2 R				no post HFE 2012 photos
Total above	11	2	0	2	
Nevills	76 L			X	scour across front
Hance	77.1 L				no post HFE 2012 photos
Grapevine	81.7 L			X	sand loss across front at both ends
Clear Creek	84.6 R			X	sand loss across front at both ends
Zoroaster	85 L			X	huge recession through winter from fluc flows
Trinity Creek	92.1 R	X			no noticable change
Schist	96.6 R				no post HFE 2012 photos
Boucher	97.3 L				no post HFE 2012 photos
Crystal	98.7 R	X			no noticable change
Lower Tuna	100.2 L			X	huge recession through winter from fluc flows
Ross Wheeler	108.3 L				no post HFE 2012 photos
Bass	109 R				no post HFE 2012 photos
110 mile	110 R				no post HFE 2012 photos
Upper Garnet	114.9 R				no post HFE 2012 photos
Lower Garnet	115.1 R				no post HFE 2012 photos
Total above	15	2	0	5	
Below Bedrock	131.7 R	X			slight degrading but still good
Stone Creek	132.5 R	X			slight degrading but still good
Talking Heads	133.7 L			X	much recession from fluc flows
Racetrack	134.2 R				no post HFE 2012 photos
Lower Tapeats	134.5 R			X	significant loss of sand through winter across front
Owl Eyes	135.2 L	X			no noticable change
Backeddy	137.8 L				no post HFE 2012 photos
Kanab	144 R				no post HFE 2012 photos
Olo	146.1 L				no post HFE 2012 photos
Matkat Hotel	148.9 L				no post HFE 2012 photos
Upset Hotel	150.9 L	X			very little change
Last Chance	156.3 R				no post HFE 2012 photos
Tuckup	165.2 R				no post HFE 2012 photos
Upper National	167 L	X			very little change
Lower National	167.2 L	X			no noticable change
Total above	15	6	0	2	
Travertine Falls	230.6 L				no post HFE 2012 photos
Gneiss	236.1 R				no post HFE 2012 photos
250 Mile	250.0 R				no post HFE 2012 photos
Total above	3	0	0	0	
Totals	44	10	0	9	
% of reporting beaches		53	0	47	

 Results of tamarisk beetle observations, end of 2013 season

Camp name	Rvr mile	Beetle	Present	evidence of Diorhabda ssp
		YES	NO	
Soap Creek	11.3 R	X		Yes, trees defoliated
12.4 Mile	12.4 L			??
Hot Na Na	16.6 L			??
19.4 Mile	19.4 L	X		Yes, cycle evident
Upper North Canyon	20.7 R			??
23 Mile	22.7 L	X		Yes, defoliation
Shinumo Wash	29.5 L			??
Nautaloid	35 L	X		Yes, cycle evident
Tatahatso	37.9 L	X		Yes, defoliation
Martha's	38.6 L			??
Buck Farm	41.2 R	X		Yes, cycle evident
Total above	11	6	0	
Nevills	76 L	X		Yes, defoliation
Hance	77.1 L			??
Grapevine	81.7 L			No tammarisk nearby
Clear Creek	84.6 R		X	No evidence found
Zoroaster	85 L		X	No evidence found
Trinity Creek	92.1 R		X	No evidence found
Schist	96.6 R		X	No evidence found
Boucher	97.3 L		X	No, tammies blooming!
Crystal	98.7 R			??
Lower Tuna	100.2 L		X	No evidence found
Ross Wheeler	108.3 L			??
Bass	109 R			??
110 mile	110 R			??
Upper Garnet	114.9 R		X	No evidence found
Lower Garnet	115.1 R			??
Total above	15	1	7	
Below Bedrock	131.7 R	X		Yes, defoliation
Stone Creek	132.5 R		X	No evidence found
Talking Heads	133.7 L		X	No evidence found
Racetrack	134.2 R		X	No evidence found
Lower Tapeats	134.5 R			??
Owl Eyes	135.2 L		X	No evidence found
Backeddy	137.8 L			??
Kanab	144 R	X		Yes, defoliation
Olo	146.1 L			??
Matkat Hotel	148.9 L		X	No evidence found
Upset Hotel	150.9 L			No tammarisk nearby
Last Chance	156.3 R		X	No evidence found
Tuckup	165.2 R		X	No evidence found
Upper National	167 L		X	No evidence found
Lower National	167.2 L			??
Total above	15	2	8	
Travertine Falls	230.6 L		X	No evidence found in Nov
Gneiss	236.1 R			No tammarisk nearby
250 Mile	250.0 R	X		Yes, defoliation
Total above	3	1	1	
Totals	44	10	16	
% of reporting beaches		38	62	

Appendix B

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 cutback
- ☐ 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)