

2012 Report of the Hopi Long-Term Monitoring Program for Öngtupqa (the Grand Canyon)

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Hopi 2012 monitoring crew.

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INTRODUCTION

This report reflects the fourth year of implementation of the Hopi Long-term Monitoring Program protocols (Yeatts and Huisinga, 2007) for the Glen Canyon Dam Adaptive Management Program (AMP). Since 1993, the Hopi Tribe has been documenting the resources of cultural value in *Öngtupqa* (the Grand Canyon). Beginning in 2003, protocols for explicitly monitoring the health of these resources from the unique cultural perspective of the Hopi people was undertaken, with formal adoption of these protocols by the AMP occurring in 2007. During development of the monitoring program protocols, culturally appropriate approaches were explored and tested, interview questions were refined, and ongoing resources monitoring was conducted using interim procedures during the annual Hopi river trips. With the continued implementation of the now standardized procedures, the Hopi Long-term Monitoring Program is evolving into a mature project with the focus on maintaining a consistent evaluation of Hopi values for the health on *Öngtupqa* through time.

Guiding Philosophy

Öngtupqa is an extremely important place in Hopi culture because of the integral role it plays in Hopi history, the many Hopi deities that reside in and are associated with it, and its function in the Afterlife of Hopi people and spirits. Plants, birds, and animals in the Grand Canyon are imbued with the sacred character of *Öngtupqa*, and are linked with all aspects of Hopi life through the philosophical concept of *Soosoy Himu Naanamiwiwyungwa*, wherein all things in the cosmos are connected. Hopi people have a spiritual obligation to serve as stewards of *Hopitutskwa* (Hopi land) and this responsibility extends to caring for the native plants, birds, and animals found in the Grand Canyon. The Hopi Tribe's desire to be a fully engaged partner in the adaptive management and long-term monitoring of the Grand Canyon stems from this spiritual and historical commitment of Hopi religious people to *Öngtupqa* (Yeatts and Huisinga 2007:1).

Given this overarching philosophical guidance, the Hopi Long-term Monitoring Program seeks to address this stewardship role in a culturally appropriate manner, recognizing both the cultural and logistical constraints associated with working in *Öngtupqa*. This means that:

- Integration of Hopi traditional values and knowledge into a Western science program would need to occur primarily at the level of data analysis, not at the data collection stage;
- Data collection and data analysis do not necessarily need to be conducted by the same entity once appropriate procedures are developed;
- Duplication of the field efforts of other researchers should be avoided where possible;
- Some data can only be collected by knowledgeable Hopi people;
- Components of the ecosystem are interconnected and cannot be viewed in isolation;
- Hopi cultural mandates greatly restrict who can or should enter *Öngtupqa*;
- Hopi traditional knowledge is not uniformly distributed among the Hopi people;
- Methodologies that can evaluate the resources of *Öngtupqa* without actually having to take large numbers of Hopi people into *Öngtupqa* would be the only approach that could adequately sample and provide representative data on the health of the resources from a broad Hopi perspective;
- Traditional scientific presentations of data are generally not the best mechanism for conveying information, particularly to a different culture.

A key concept of the Hopi Long-term Monitoring Program is that the “state” of a resource and its “health” are two separate concepts, and it is towards this second measurement that this program directed. The “state” of the resource can easily (sometimes) be measured through the western scientific

approach; how many fish there are, their size, the temperature of the water, its clarity, how many millions of tons of sand are in the system, the amount of vegetation coverage, etc. Whether a given resource “state” is healthy, however, is a cultural evaluation, drawing on the cultural understanding of the system and the roles the resource plays within the system and society, in this case the Hopi society. The long-term goal of the program is to measure resource health through time in a way that reflects Hopi cultural values and their understanding of the ecosystem, is scientifically defensible, and in the future, can be statistically evaluated.

Protocols

The philosophy, design, and protocols to implement the Hopi Long-term Monitoring Program are presented in detail in Yeatts and Huisinga (2007); the following summarizes some of the key methodologies. The foundation of the Hopi Long-term Monitoring Program is a survey-based approach to record Hopi impressions of resource health. Standardized survey instruments are used to record the opinions of Hopi informants about the health of culturally important resources in *Öngtupqa*. These surveys are conducted following a standardized presentation that relays the current knowledge about the states of the culturally important resources (primarily as documented through western scientific studies), the perceptions of Hopis involved in previous monitoring episodes, and any management actions that are being undertaken or proposed. These general surveys can be given to any Hopis at any time or place. In addition, more detailed surveys are completed following direct examination of the resources in *Öngtupqa* by a subset of Hopi people who can participate in the annual resource monitoring river trips. To the greatest extent possible, the Hopi Long-term Monitoring Program relies on information about the resource states obtained through the Grand Canyon Monitoring and Research Center scientific studies, Grand Canyon National Park Service monitoring, and any other relevant research. This approach seeks to minimize the impacts to the resources from multiple, overlapping field studies of the same resources and to recognize the spiritual danger of entering *Öngtupqa* for the Hopi people. In the development of this monitoring approach, the Hopi Tribe worked with other researchers conducting monitoring in order to maximize the relevance of their data to the Hopi analysis (Huisinga and Yeatts 2003).

Specifically, data about the status and trends of culturally important resources is annually summarized into a standardized presentation that is presented to various constituencies of the Hopi Tribe (the full presentation format is provided in Yeatts and Huisinga 2007; see also Appendix 1). Following the presentations, written surveys are completed which assess resource health based on the information provided during the presentation. The surveys include categories for narrative, yes/no, and demographic response data. This information provides the basis for the resource health assessment. In addition, supplemental interviews and discussions provided further detail to better understand the responses and to expand on cultural values underlying the responses. These can also provide management recommendations that don't necessarily get coded in the surveys.

A vital aspect of the Hopi Long-term Monitoring Program is the annual resource monitoring trip undertaken by a small number of Hopi consultants who travel into *Öngtupqa*. The same surveys that are given to the larger Hopi public are conducted pre-trip and then an additional post-trip survey is administered to ascertain changes in responses that direct interaction with the resources may produce (referred to as “**general**” and “**post-trip**” surveys hereafter). During the development of the survey instrument, it became apparent that for a number of the resources, Hopi people did not feel confident in making a health assessment without actually seeing the resource. Therefore, the general survey contains a subset of the questions that are asked on the post-trip survey. Finally, the Hopi monitoring trip provides for monitoring of resource attributes that cannot be accomplished by western scientists (eg. spiritual/cultural values).

All of the data that is collected is entered into a database utilizing Nvivo8® software (Qualitative research software from QSR International) for summarization and analysis. Data can also be exported from this software in order to be analyzed by other statistical methods not contained within the software suite.

2011-2012 ACTIVITIES

A number is different task were completed during the 2011-2012 monitoring efforts.

Consolidation of Knowledge About Resource States

Consolidation of information about the resource states for resources of cultural value to the Hopi people is the first step in developing the standardized resource presentations. The various formal and informal “knowledge assessments” conducted by GCMRC and others in the AMP are invaluable in understanding the current state of the resources and it is recommended that these types of activities continue in the future. Additionally, numerous reports, scientific presentations, and discussions with scientists were utilized in order to create the information for the standardized presentation. As with the last several years, little new information has been collected by the AMP program for many resources of cultural value to the Hopis, particularly those in the terrestrial portion of the Colorado River corridor. Therefore, for a number of resources, “unknown” or “no new information” was all that could be reported in the standardized presentations.

Data Entry

During 2008-2009, all of the information from the surveys that had been used during the development of the monitoring program was entered into the database and coded to be comparable with the current protocols. In 2009-2010, the work continued to integrate non-survey sources of information, including field notes and interview data, into the database; this work is still ongoing through 2012. All of the new surveys that were completed during the 2012 were also incorporated including those from the annual monitoring trip.

2012 Annual River Monitoring Trip

From May 8th through May 16th, 2012, seven cultural consultants, two researchers, a boatman, and the tribal liaison for the Office of the Assistant Secretary for Water and Science participated in the annual Hopi monitoring river trip. This motorized trip ran from Lees Ferry to Diamond Creek, on the Hualapai Indian Reservation. During the trip, numerous resources including archaeological sites, cultural sites, vegetation, animals, springs, minerals, sediment, and the general environment were examined. Discussions about the scientific research, management activities and issues, and the AMP in general were held. Formal surveys were conducted prior to and at the end of the trip; other interview data was collected during the trip.

Participants on the trip were:

Tommy Canyon	Ma’saw Clan	Moencopi village
Thomas Hoyungowa	Corn Clan	Hotevilla village
Christopher Talayumtewa, Sr.	Sun Forehead Clan	Sipaulovi village
Brendan Kayquaptewa	Rabbit/Tobacco Clan	Hotevilla village
Fredrick Koruh	Spider Clan	Mishongnovi village
Edison Tu’tsi	Tobacco Clan	Kyktosmovi village

John Halliday DOI Tribal Liaison (Racoon clan)
 Lynn Roeder Boatman
 Kristin Harned Co-PI
 Michael Yeatts Co-PI

DATA ANALYSIS

Data collected in the form of surveys or interviews is entered into the Nvivo8® database for further processing, consolidation, trend analysis, pattern searching, and ultimately statistic analysis. Since the beginning of the monitoring, a total of 195 surveys have been entered into the database and form the basis for this analysis. This includes information from 111 different Hopi individuals, and 11 non-Hopis (only the information collected from Hopi participants is included in the subsequent analyses). Table 1 summarizes this information.

Table 1. Summary of all Survey Data.

	Number of people	Total # of surveys
GC River Trip 2003	8	16
GC River Trip 2004	6	9
GC River Trip 2006	8	16
GC River Trip 2007	9	18
GC River Trip 2008	9	16
GC River Trip 2009	8	14
GC River Trip 2010	9	17
GC River Trip 2011	11	22
GC River Trip 2012	7	14
SJ River Trip Women 2009	9	13
CRATT	12	12
Hopi Natural Resources	3	3
Hopi Tribal Council	9	9
Misc Hopi participants	3	3
Non-Hopi participants	11	13
Total Hopi	111	182
Total people including non-Hopi	122	195

Table 2 presents a summation of all the responses to the questions asked on the survey. This information provides snapshot of the overall distribution of responses and provides an introduction to the response categories that are used in this document. In general, a “Yes” response indicates that a resource is considered healthy, a “No” response that it isn’t, and the remaining responses indicate that the respondent was uncertain about the resource health or had a more nuanced assessment. It should be noted that in the analyses of the individual resource questions in later portions of the report, responses including “Don’t Know,” “Yes and No” to a single question, and where there was no response to a question (**Blank**) are grouped together into a single “Other” category for graphical presentation. This was done because all of these types of responses indicate a hesitancy to evaluate the resource as good or bad, and so was reflecting a similar category of response.

Table 2. Summary of Responses

	Yes	No	Yes and No	Don't Know	Blank	Total responses
Q01 Overall health	105	11	6	46	5	173
Q02 Hopi involvement	161	1	1	6	4	173
Q03 Importance of information	169	1	0	2	1	173
Q04 Relation to cultural teachings	149	1	1	2	2	155
Q05 Recent changes positive	83	0	0	37	1	121
Q06 Marshes	88	24	2	19	6	139
Q07 Birds	108	7	1	20	3	139
Q08 Recreation	70	44	28	19	12	173
Q09 Trout removal	57	47	6	9	10	129
Q10 Non-native species	80	45	3	7	4	139
Q11 Archaeological sites	78	41	3	13	4	139
Q14 Öönga, Hopi Salt Mines	64	8	2	8	1	83
Q15 Willow	59	6	3	12	3	83
Q16 Animals	64	2	0	14	3	83
Q17 Native fish	31	16	0	29	7	83
Q18 Snakes	51	3	0	23	6	83
Q19 Insects	63	2	0	15	3	83
Q20 Springs and seeps	57	8	5	10	3	83
Total Cumulative Percentages (inclusive of 2012)	68.80%	11.95%	2.73%	13.03%	3.49%	Total 2234
Results of 2012	77.83%	11.82%	1.48%	2.46%	6.40%	

Table 2 also highlights some of the legacy issues that occurred during the development of the monitoring program. When looking at the total number of responses to any given question, it is apparent that there are always fewer than the total number of surveys completed by Hopi participants (see Table 1). This is due to changes in questions as the protocols were developed; some questions were added or dropped during the development of the survey program and others had wording changes to make them more understandable to the Hopi respondents. If the questions through time solicited the same fundamental resource information, the responses were retained; otherwise they were not included in the analysis. The questions asked have remained the same since 2008. Additionally, during the development of the survey instrument, some questions were focused on the survey instrument itself (as feedback in order to improve it) but are no longer included on the survey. Questions Q02, Q03, and Q04 are somewhat in this category, but are retained on the questionnaire as an ongoing assessment of the relevance of the Hopi-Long-term Monitoring Program to the tribe (they are addressed in the “management” section of the report).

As can be seen, over the life of the monitoring program, Hopis have responded that resource conditions have been largely positive (a “Yes” response) and that the Hopi monitoring effort is a positive activity that provides value and should be continued. The responses in 2012 continue this trend of a positive response to questions by more than a 2:1 ratio.

Resource Trends

While a summary of all of the data provides a good broad-brush snapshot of what the data tells us to date, it is the trends that are important in assessing whether ongoing management of *Öngtupqa* is being implemented successfully. A resource that is healthy when all data is lumped together may

in fact be trending towards decreasing health and this is important to know in order to effect a management change before the situation becomes irreversible. Therefore, the next two sections of the report look specifically at the resource trends in the monitoring data. The first section looks at the results for each individual resource or resource class that has been identified as culturally important to the Hopi people. The second section addresses the Hopi perception of activities that could be classified as “management” in nature. These include things such as recreation, data recovery at archaeological sites and non-native removal activities.

All figures displaying trend information for the remainder of the report portray two temporal spans. The thin lines represent the best-fit line over the entire period for which data has been collected and the thick lines are the trend over the last four monitoring episodes. This display format was done to explore any differences in short and long term perspectives. As the temporal span of the data collection gets long enough, it is anticipated that the slopes of the long-term trend lines will tend to center around zero and their relative positions (y-intercept) will stabilize. These will then represent something of a “baseline” condition. On the other hand, the trend line over the previous four monitoring episodes will reflect a more timely assessment of the system and highlight deviations from the long-term trend. The selection of four years for the duration of the short-term trend is somewhat arbitrary, but is felt to be short enough to capture the recent views as to system health, but at the same time to be long enough to even out stochastic variability. A consistent deviation in the direction of the short-term trend from the long-term trend may indicate that an issue is arising that may need to be addressed and changes in the relative positions of the lines with respect to each other could indicate a fundamental change in how the health of the resource is viewed.

The y-axis in all the following trend figures portray the normalized response rates for each question ([number of responses in category]/[total responses to question]). This was done to make inter-annual comparisons equivalent given that different numbers of people responded to the survey in differing years.

Overall Health

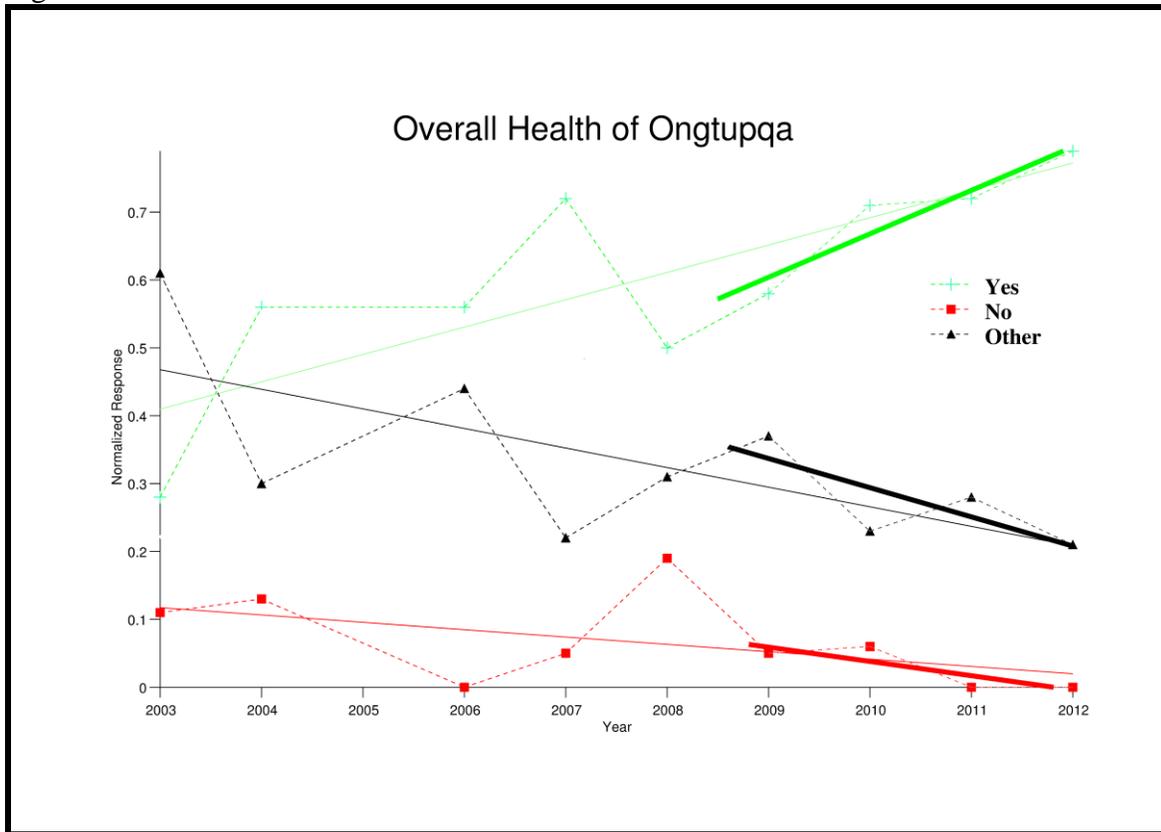
Survey Question:

-Do you think *Öngtupqa* (Grand Canyon) is better cared for now than in the past?
Yes No Don't Know

Table 3. Is *Öngtupqa* Better Cared for Now than in the Past

	Yes	No	Yes and No	Don't know	Blank
2003 surveys	5	2	1	8	2
2004 surveys	13	3	1	5	1
2006 surveys	9	0	0	7	0
2007 surveys	13	1	1	3	0
2008 surveys	8	3	2	2	1
2009 surveys	11	1	0	6	1
2010 surveys	12	1	0	4	0
2011 surveys	23	0	0	9	0
2012 surveys	11	0	1	2	0
Total	105	11	6	46	5
Percent	60.69%	6.36%	3.47%	26.59%	2.89%

Figure 1. Trends for Overall Health



The response to this specific question mirrors the assessment made above based on the overall distribution of responses (above): the majority of respondents view *Öngtupqa* as being healthy or at least better managed than in the past. While the percentages are not exactly the same as when all of the individual resource categories are combined, the distribution is very similar. Further, when looking at the results through time (Figure 1), there is a clear trend showing the percentage of Hopi people who believe that *Öngtupqa* is being well cared for has increased, both in the short and long terms. In the last two years, no respondents thought that *Öngtupqa* was being managed more poorly than in the past.

Interpreting why the Hopis feel that *Öngtupqa* is better cared for now than in the past is not straight forward solely from the results of this question. Because both perceived positive changes in resource health and increases in management activities both would result in a “YES” response, it is likely some combination of these factors is at play. Of particular note, the AMP provides a venue for the Hopi to once again play a more active role in the management of *Öngtupqa*, helping to maintain their traditional stewardship role and cultural connection to *Öngtupqa*. As one consultant noted, “...I think it is better cared for with the offerings we left.” The overwhelmingly affirmative replies to questions 2-4 (see Table 1), which assess the relevance and desire of the Hopi people to remain involved in the AMP and long-term monitoring of resources in *Öngtupqa*, likewise supports the assertion that active involvement by the Hopi Tribe is an important component to the health of *Öngtupqa*.

Recent changes

This question serves as a baseline indicator: if there are no perceived changes occurring in *Öngtupqa*, then any “changes” identified under the individual resources must be reflecting changing

values for what is considered healthy by the Hopis rather than being attributable to physical changes occurring in the resources.

Question:

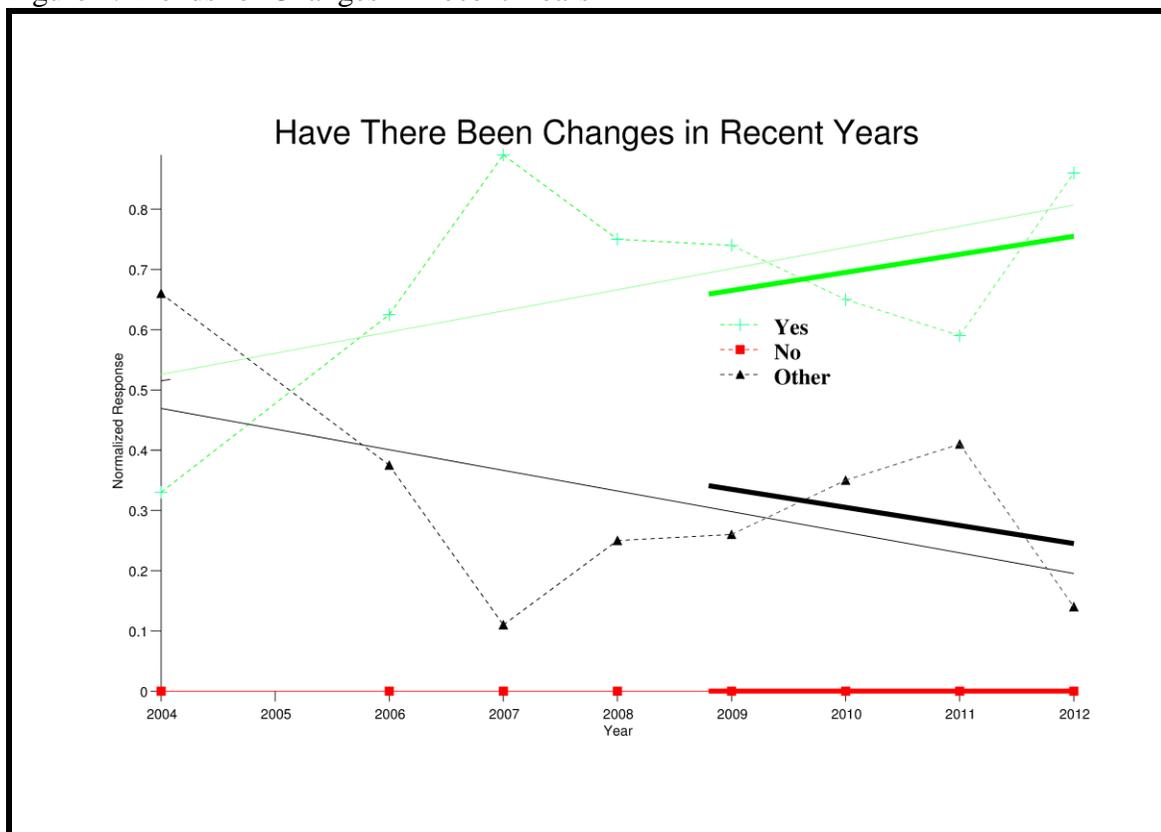
- Do you think there have been changes in *Öngtupqa* in recent years?

Yes or No or Don't Know

Table 4. Have There Been Changes in Recent Years

	Yes	No	Yes and No	Don't Know	Blank
2004	2	0	0	4	0
2006	5	0	0	3	0
2007	8	0	0	1	0
2008	12	0	0	4	0
2009	14	0	0	5	0
2010	11	0	0	6	0
2011	19	0	0	13	0
2012	12	0	0	1	1
Total	83	0	0	37	1

Figure 2. Trends for Changes in Recent Years



As in past years, none of the survey respondents felt that change did not occur in *Öngtupqa* (Table 4, Figure 2). The direction of the short-term trend line for “change is occurring” (**Yes**) has reversed direction from last year to once again mirror the long term trend, that is, increasing certainty that changes are in fact occurring in the system. Discussions with river trip participants and narrative responses on the surveys indicate that the **Other** category is selected by respondents not

because they didn't think that changes were happening, but because they did now explicitly know what those changes were, and therefore didn't feel comfortable in answering "Yes."

Archaeological Sites

Responses to this question reflect both the perceived physical state of the sites themselves as well as the appropriateness of management approaches that are being employed to try to preserve them. Because the state of archaeological resources has not been formally monitored by the AMP program in recent years, these results are based on the few sites that were visited during the Hopi monitoring trip and extrapolation of the trends that were reported during the last time that there was AMP archeological site monitoring.

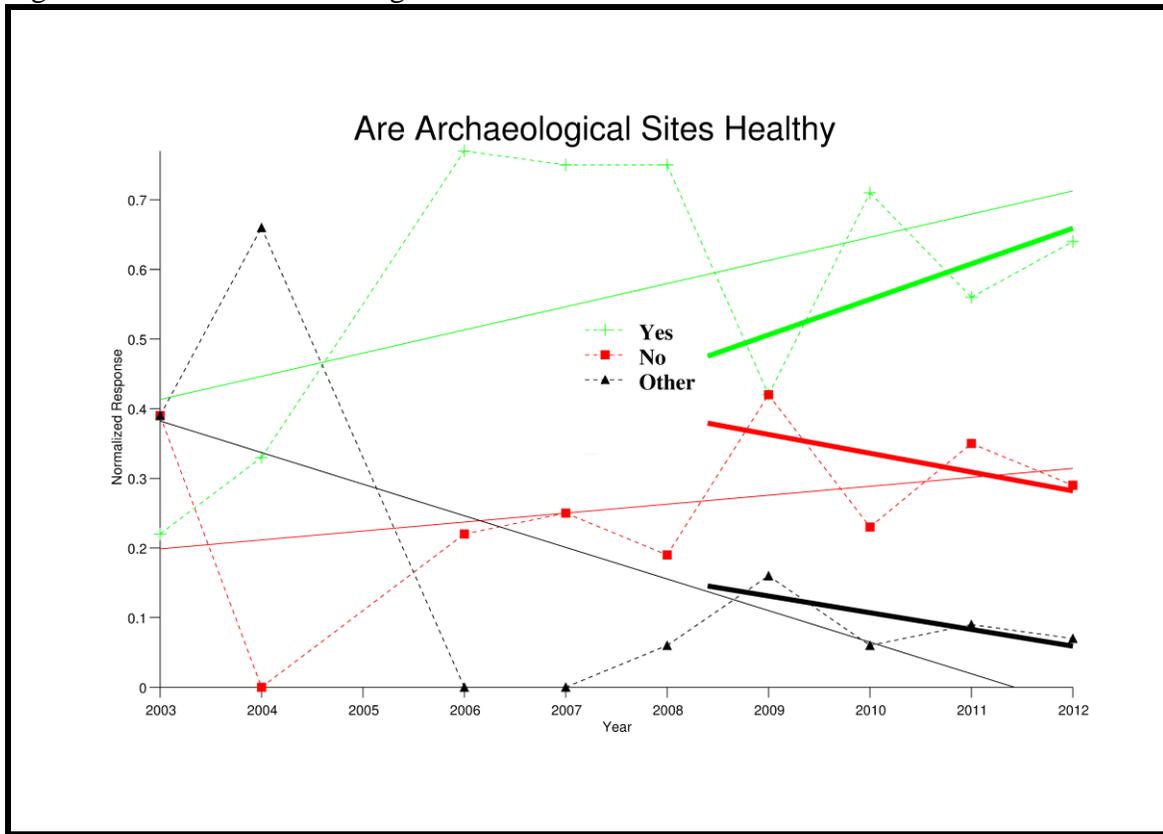
Question:

- Archaeological sites in Grand Canyon are healthy?
Yes or No or Don't Know

Table 5. Are Archaeological Sites Healthy

	Yes	No	Yes and No	Don't know	Blank
2003	4	7	0	7	0
2004	2	0	0	4	0
2006	6	2	0	0	0
2007	7	2	0	0	0
2008	12	3	1	0	0
2009	8	8	1	2	0
2010	12	4	1	0	0
2011	18	11	0	0	3
2012	9	4	0	0	1
Total	78	41	3	13	4

Figure 3. Trends in Archaeological Site Health



Both the short-term and long-term trends show that archaeological sites are still viewed as generally healthy (Table 5, Figure 3). Last year, the short-term trend data showed that there was decreasing confidence that sites were healthy; this trend has reversed in the current data. Given that no new information concerning the status of sites was available this year, some of this response may be due to the understanding that the protocol for High Flow Experiments (HFEs) has recently been developed and that as part of this experimentation, effects on archaeological sites will be studied. Since a general lack of sediment in the system is one of the factors postulates as contributing to site erosion, knowledge that HFEs will become part of the standard operations may be viewed as a positive management action. In addition, the plan to integrate traditional knowledge and tribal values into any treatment that occurs at sites in the future is similarly a positive development. One of the river trip participants noted that being able to pray at some of the sites was good.

Marshes

The health of two proxy species is used to gage the health of marsh habitats: cattails (*Typha* spp.) and reeds (*Phalaris* spp.). Because monitoring of this component of the ecosystem has not been undertaken recently by the AMP, assessment is being made primarily on the basis of field observation by the Hopis and an understanding of possible succession scenarios of marsh habitats under current flow regimes. The question asked is:

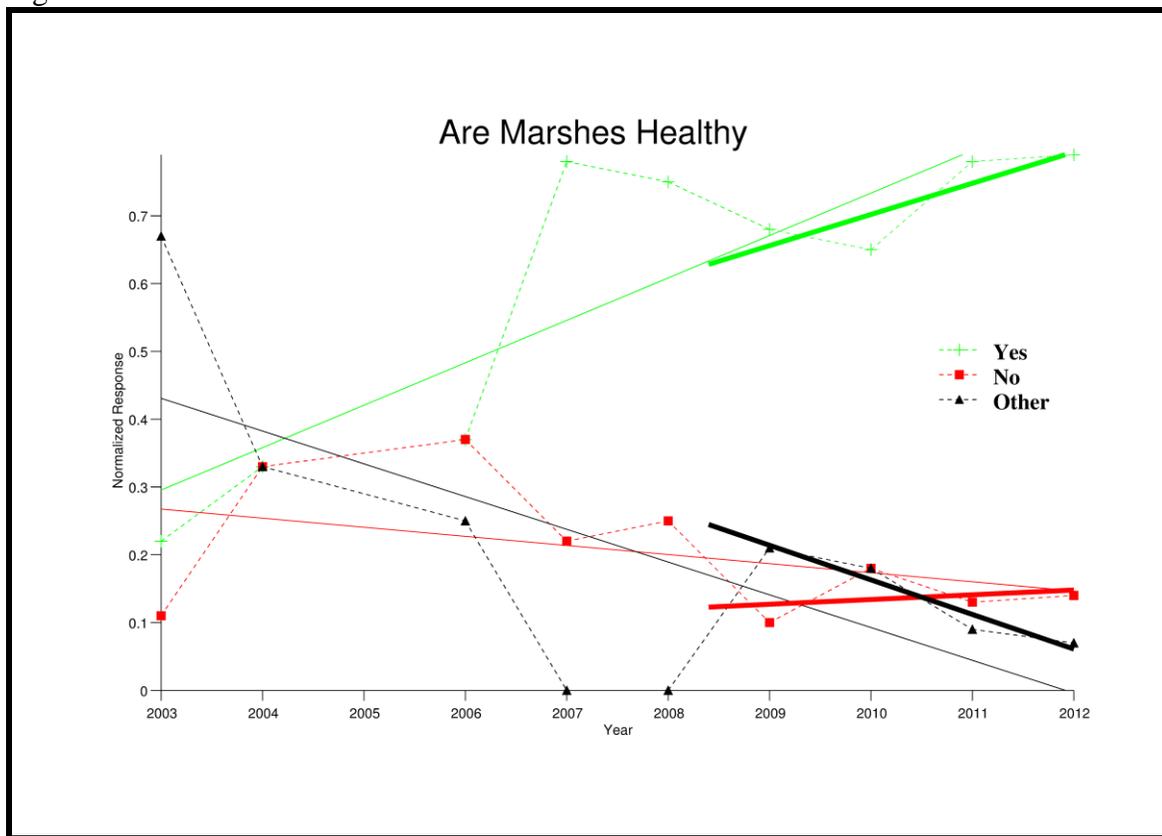
- From what you have heard, *Wipho'qölö* (patches of *wipho* or cattail) and *paaqap'qölö* (patches of *paaqavi* or reed) in Grand Canyon exist in a healthy state?

Yes or No or Don't Know

Table 6. Are Marshes Healthy

	Yes	No	Yes and No	Don't know	Blank
2003	4	2	0	11	1
2004	2	2	1	1	0
2006	3	3	1	1	0
2007	7	2	0	0	0
2008	12	4	0	0	0
2009	13	2	0	3	1
2010	11	3	0	2	1
2011	25	4	0	1	2
2012	11	2	0	0	1
Total	88	24	2	19	6

Figure 4. Trends in Marsh Health



The responses to this question clearly indicate that the Hopi respondents still view the health of marshes as good (Table 6, Figure 4) and that the measures are stabilizing at baseline levels. Several Hopis noted that the patches that they saw looked “...healthy and strong...” and that they saw a “...very healthy abundance.”

Birds

Bird species, particularly some the migrants figure prominently in Hopi culture. Unfortunately, in recent years the monitoring of birds by the AMP has been nonexistent. The Grand Canyon

National Park (GRCA) is apparently conducting some avian monitoring activities but the Hopi Tribe has not yet been able to incorporate this information into its monitoring program.

Question:

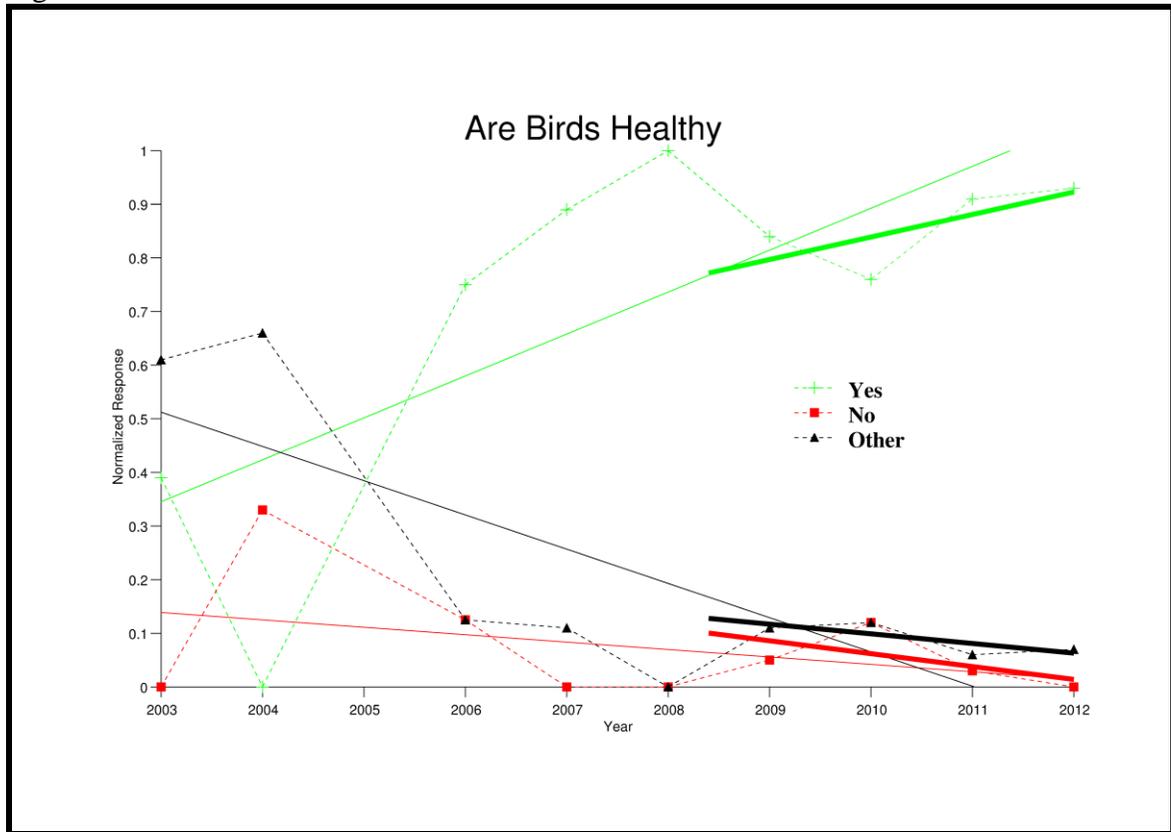
- *Tsirot* (birds) in Grand Canyon exist in a healthy state?

Yes or No or Don't Know

Table 7. Are Birds Healthy

	Yes	No	Yes and No	Don't know	Blank
2003	7	0	0	11	0
2004	0	2	1	3	0
2006	6	1	0	1	0
2007	8	0	0	1	0
2008	16	0	0	0	0
2009	16	1	0	1	1
2010	13	2	0	1	1
2011	29	1	0	2	0
2012	13	0	0	0	1
Total	108	7	1	20	3

Figure 5. Trends in Bird Health



Like the marsh health, the perspective of the Hopis is that the health of the birds is very good and the responses appear to be stabilizing at baseline levels compared to the first couple of monitoring cycles. (Table 7, Figure 5). Because of the lack of monitoring data from the AMP program, this result is driven primarily by what the Hopis are actually observing in *Öngtupqa* on the

monitoring trips. The information provided to the Hopis in the standardized presentation has remained unchanged and will remain so until there is new monitoring information available. A couple of the Hopis commented that they thought that the populations would remain healthy as long as the habitat is protected and maintained, something that is advanced by being inside of Grand Canyon National Park.

Öönga (Hopi Salt Mines)

The status of *Öönga* is one of the key indications to the overall health of *Öngtupqa*. Not only are there the physical processes that occur at the site, but also activities that occur at the Hopi Villages and by Hopis when in *Öngtupqa* affect the health of *Öönga*. Because it was determined during the development and earlier implementation of the Hopi Long-term Monitoring Program that Hopis were generally unwilling to answer this question unless they had actually visited the location, this question is only asked of people who have been to the site.

Question:

-*Öönga* (Hopi Salt Mines) is healthy?

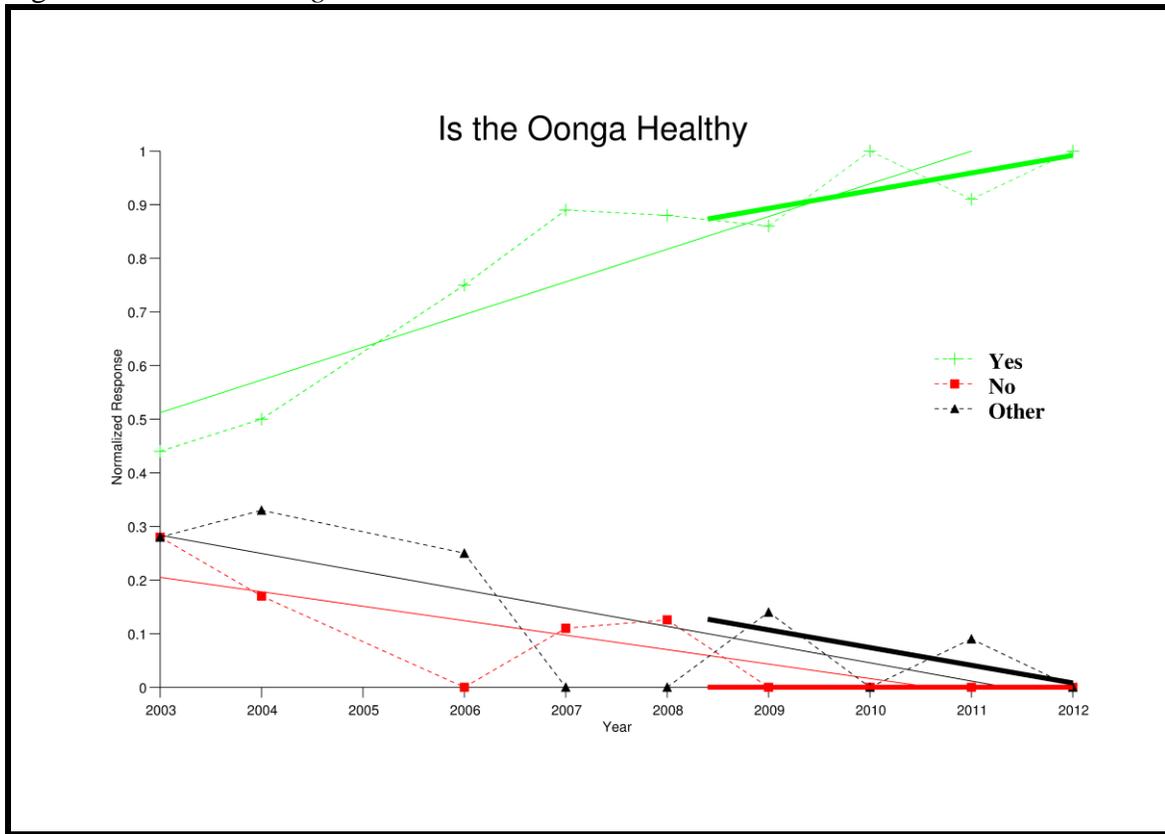
Yes or No or Don't Know

Table 8. Is *Öönga* Healthy

	Yes	No	Yes and No	Don't Know	Blank
2003	8	5	0	5	0
2004	3	1	0	2	0
2006	6	0	1	1	0
2007	8	1	0	0	0
2008	7	1	0	0	0
2009	6	0	1	0	0
2010	9	0	0	0	0
2011	10	0	0	0	1
2012	7	0	0	0	0
Total	64	8	2	8	1

Öönga is strongly identified as being healthy from the Hopi perspective (Table 8, Figure 6). The positive response has continually gone up and at the same time, negative and undecided have decreased. In fact, no one has reported *Öönga* as being unhealthy for the past four monitoring episodes. Because Hopis take an active role in maintaining the health of *Öönga* through visitation and offerings, they may feel that they have a direct and integral role in maintaining the health of this resource. The Hopis consistently commented that *Öönga* looked healthy and that it is replenishing itself. The biggest concern that is regularly expressed is that over collecting and visitation by inappropriate people could degrade the spiritual and physical health of this resource.

Figure 6. Trends in Öönga Health



Willows

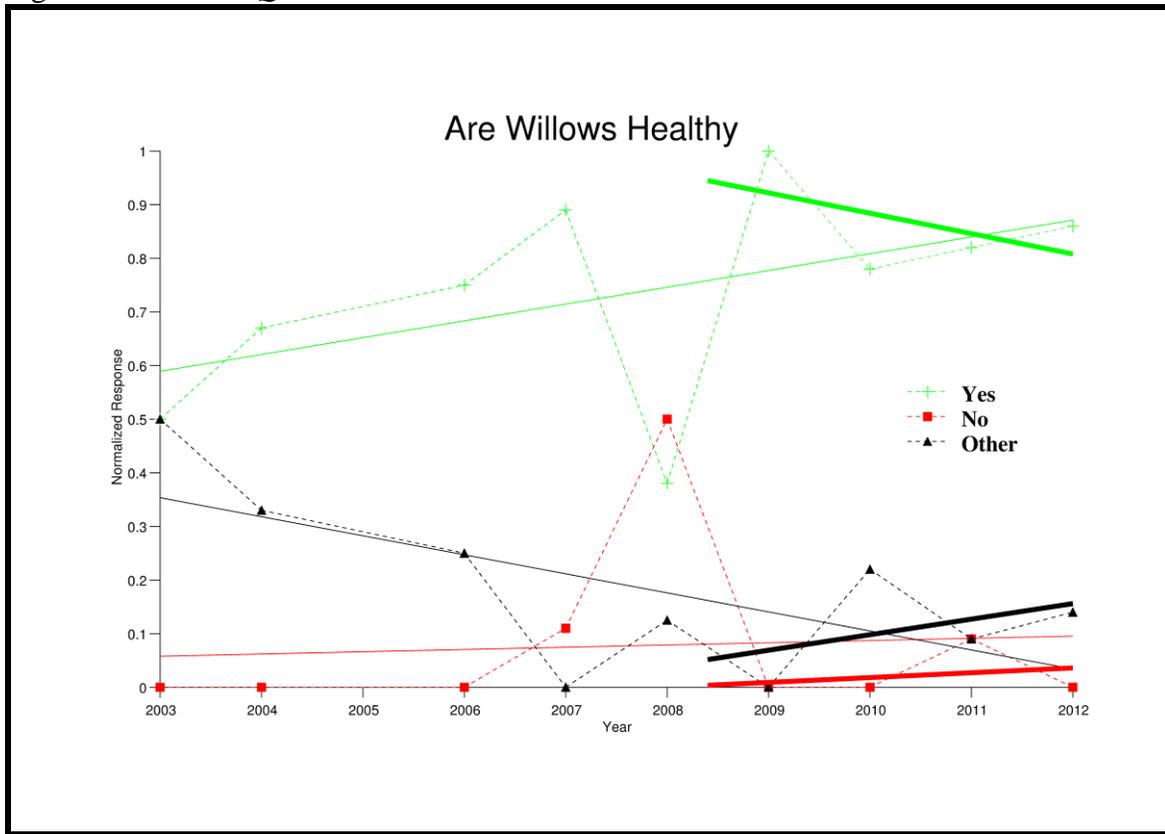
Willows are a culturally important species in their own right and they serve as an indicator species for the post-dam riparian zone. As noted above for the Marshes, monitoring of this component of the ecosystem has not been undertaken recently by the AMP. Therefore, assessment is being made primarily on the basis of field observation and an understanding of the general trend in riparian plant succession scenarios. The following question has been asked consistently:

-*Qahavi* (willow plants) in Grand Canyon exist in a healthy state?
Yes or No or Don't Know.

Table 9. Is *Qahavi* Healthy

	Yes	No	Yes and No	Don't know	Blank
2003	9	0	1	8	0
2004	4	0	1	1	0
2006	6	0	0	2	0
2007	8	1	0	0	0
2008	3	4	1	0	0
2009	7	0	0	0	0
2010	7	0	0	1	1
2012	6	0	0	0	1
Total	50	5	3	12	2

Figure 7. Trends in *Qahavi* Health



Overall the Hopi view the willows as being healthy, but as with a number of other resources, there is slightly more uncertainty about willow health in recent years (Table 9, Figure 7). As was predicted last year, the short-term trends are returning to slopes closer to the long-term trends now that 2008 is not included in the calculation. One commenter noted that there is some loss of *Qahavi* and other plants in the marsh areas due to riverbank erosion, but *Qahavi* was also noted as still being very abundant.

Animals

Because there is no systematic data collection for animals in the river corridor by the AMP, the results are purely based on field observations made by Hopi monitors while on the river trip (that is why the question has only been part of the post-trip surveys since 2004). This resource category includes primarily large and small mammals. Other animals such as fish, birds, and insects are addressed through separate questions.

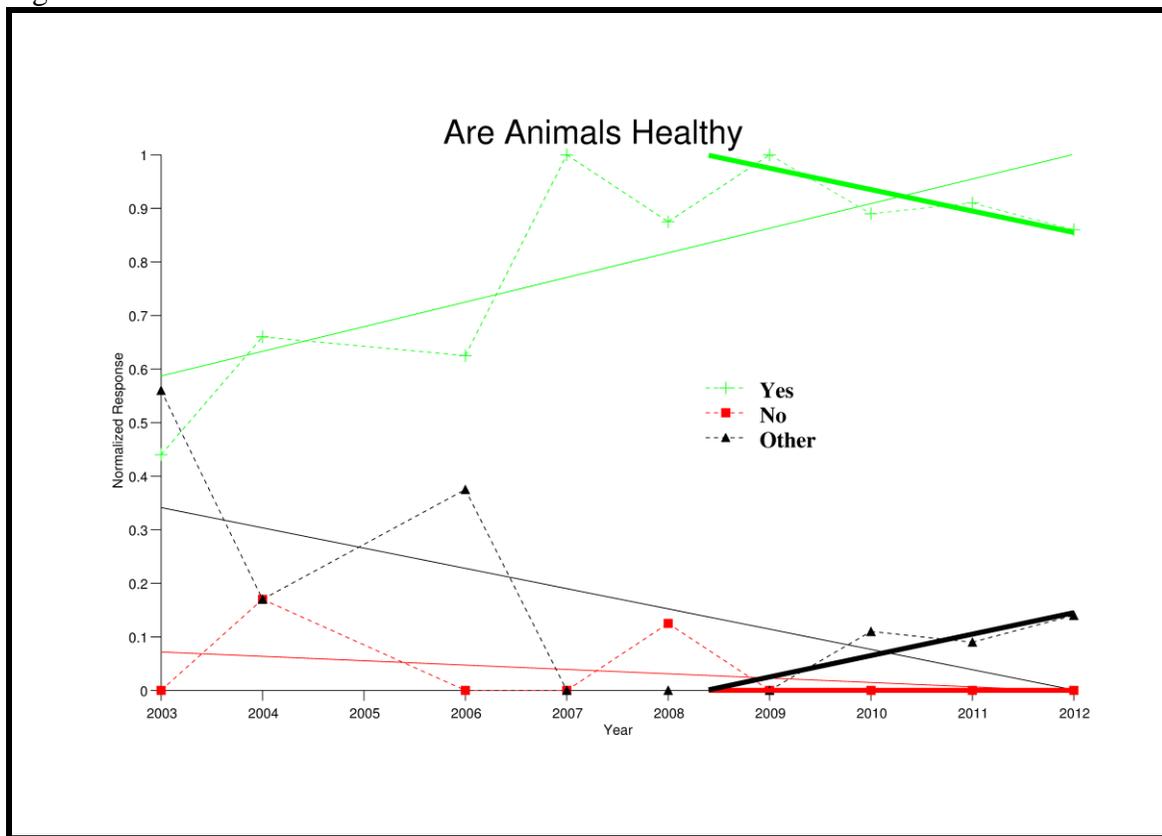
The questions asked is:

- Tuutuvost* (animals) in Grand Canyon exist in a healthy state?
Yes or No or Don't Know.

Table 10. Is *Tuutuvost* Healthy

	Yes	No	Yes and No	Don't know	Blank
2003	8	0	0	9	1
2004	4	1	0	1	0
2006	5	0	0	3	0
2007	9	0	0	0	0
2008	7	1	0	0	0
2009	7	0	0	0	0
2010	8	0	0	1	0
2011	10	0	0	0	1
2012	6	0	0	0	1
Total	64	2	0	14	3

Figure 8. Trends in *Tuutuvost* Health



From the responses, it appears the Hopi consider the animal population in *Öngtupqa* to be relatively healthy; for the past four years, no people thought that animals were unhealthy (Table 10, Figure 8). Because there is no population data being presented regarding animal populations during the standardized presentation, perceptions are largely driven by what is actually seen during monitoring trips, particularly for bighorn sheep and deer. Given that trips alternate between spring and fall in successive monitoring episodes, there may be a slightly alternating trend showing up in the data reflecting the seasonal variation of habitat usage. One Hopi noted that at this time of year (fall) the deer have migrated to the rims. As with the results for birds, it was noted that the protection afforded by being inside a Park was beneficial to the animals.

Native Fish

While the intent of this question is to get at the health of all native fish, it specifically keys in on the humpback chub, as this is the species has the most scientific data available. The humpback chub is also the fish that the general public, including those at Hopi, are most likely to have heard about.

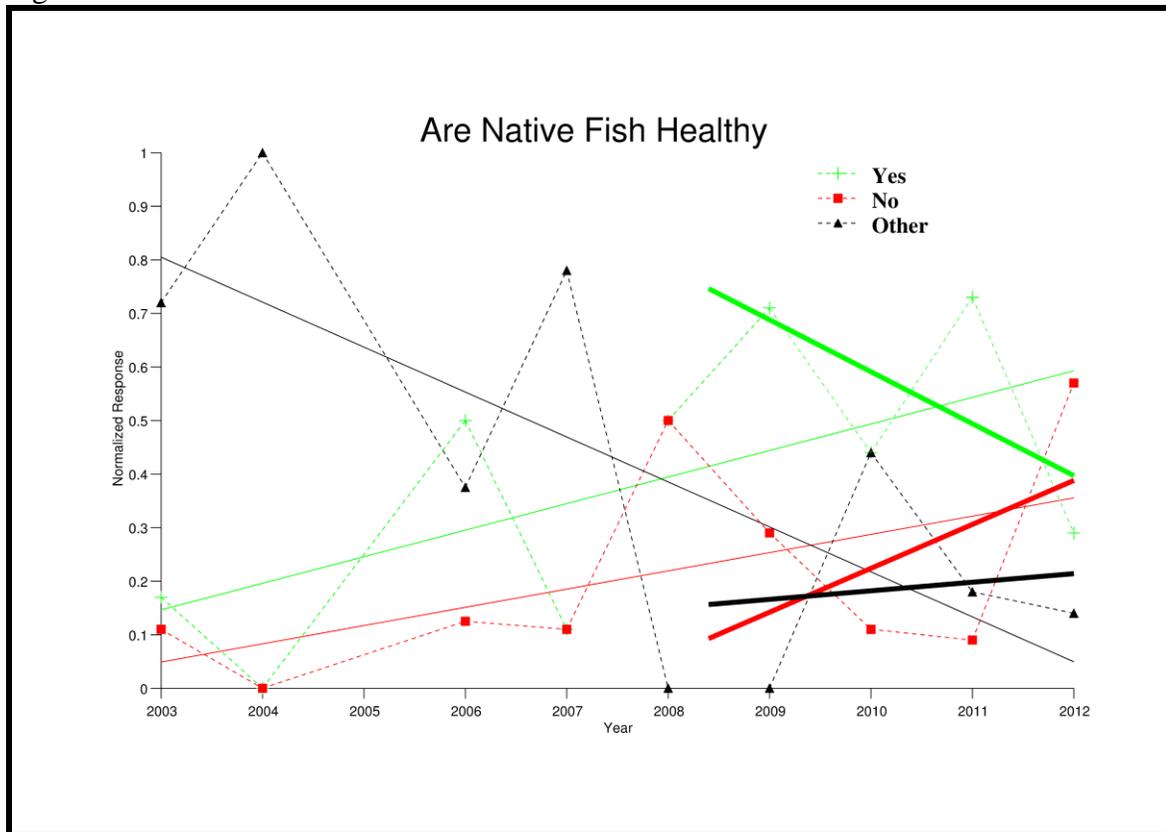
Question:

-Native fish called the Humpback chub exist in a healthy state in Grand Canyon?
Yes or No or Don't Know

Table 11. Are Native Fish Healthy

	Yes	No	Yes and No	Don't know	Blank
2003	3	2	0	12	1
2004	0	0	0	6	0
2006	4	1	0	3	0
2007	1	1	0	6	1
2008	4	4	0	0	0
2009	5	2	0	0	0
2010	4	1	0	2	2
2011	8	1	0	0	2
2012	2	4	0	0	1
Total	31	16	0	29	7

Figure 9. Trends in Native Fish Health



There seems to be more variability in responses about the health of the humpback chub than any of the other resources in the survey (Table 11, Figure 9). While there has been a consistent decline in the **Other** responses, meaning that people are making up their mind about whether the chub are healthy, there is a fairly even split about their health. Last year because the Hopis on the monitoring trip had the opportunity to conduct some backwater seining and got to see numerous native fish including humpback chubs, there was a strong feeling that they were doing well. Looking at the comments provided this year, the strong **No** response (“not healthy”) seems to be reflecting the fact that the fish are still endangered, even though their population has been increasing. Several comments expanded on this concept suggesting that “...with further management [the chub] could come to a healthier state.” Another noted that “...Game and Fish is on the right track by introducing these species upriver in smaller streams...” referring to the translocation efforts. This year is the first time since the initiation of the Hopi Long-term Monitoring Program that more people said the native fish were not in a healthy state than those saying that they were healthy. Given the fact that the long-term trend is still strongly positive (it doesn’t seem to be reaching a “baseline” equilibrium yet), the swing in the short-term trend line may just be reflecting the large variability in the data set. It will be interesting to see if there is a reversal again after the next monitoring episode.

Snakes

Snakes play an important, ongoing role in Hopi culture and society. As with a number of the other terrestrial resources, observations by Hopis during the monitoring trips and old monitoring data forms the sole data set for this resource as the AMP no longer monitors this culturally important group.

Question:

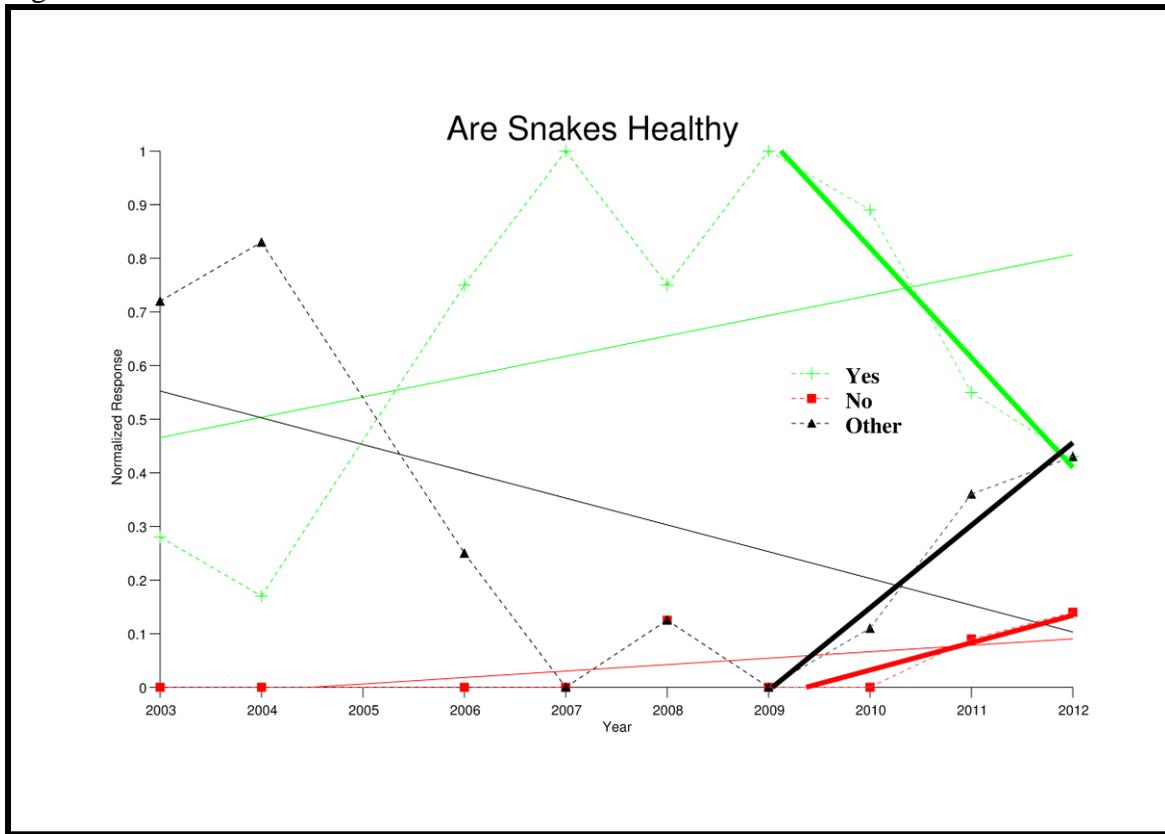
-Snakes in Grand Canyon exist in a healthy state?

Yes or No or Don’t Know

Table 12. Are Snakes Healthy

	Yes	No	Yes and No	Don't know	Blank
2003	5	0	0	12	1
2004	1	0	0	5	0
2006	6	0	0	2	0
2007	9	0	0	0	0
2008	6	1	0	1	0
2009	7	0	0	0	0
2010	8	0	0	1	0
2011	6	1	0	0	4
2012	3	1	0	2	1
Total	51	3	0	23	6

Figure 10. Trends in Snake Health



There has been a sharp decline in the number of people who feel that snakes are healthy in the past four years (Table 12, Figure 10). While there has been a slight increase in the number of people who feel that the snake populations are unhealthy, most of the decline has been driven by the sharp rise in “**Other**” responses. Clearly, the Hopi respondents just don’t have enough information to assess the health of snakes. Virtually all of the surveys noted that no snakes were seen during the monitoring trip.

Insects

Insects form an important component of the ecosystem, serving as food for other culturally important resource such as birds, reptiles, amphibians, and fish. Like numerous other components of the terrestrial zone, the AMP has only monitored them infrequently in the past and no longer does any type of invertebrate monitoring. Therefore, Hopi responses are based principally on field observations during the monitoring trips and older monitoring data.

Question:

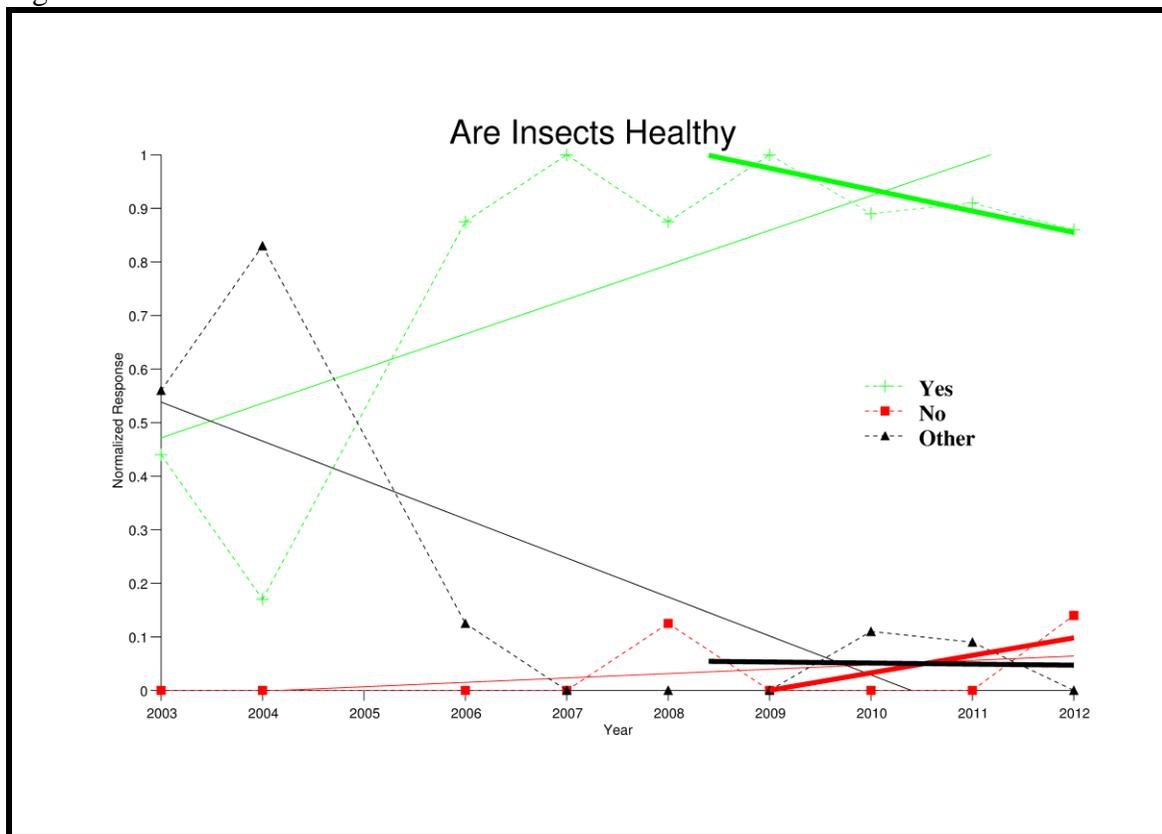
-Insects in Grand Canyon exist in a healthy state?

Yes or No or Don’t Know

Table 13. Are Insects Healthy

	Yes	No	Yes and No	Don't know	Blank
2003	8	0	0	9	1
2004	1	0	0	4	1
2006	7	0	0	1	0
2007	9	0	0	0	0
2008	7	1	0	0	0
2009	7	0	0	0	0
2010	8	0	0	1	0
2011	10	0	0	0	1
2012	6	1	0	0	0
Total	63	2	0	15	3

Figure 11. Trends in Insect Health



Insect health has consistently viewed as positive even though there has been a slight decline in the short-term trend (Table 13, Figure 11). Many respondents noted how many ants, bugs, and flying insects they saw, noting that there may be too many biting flies!

Springs and seeps

Springs and seeps are extremely important within the Hopi culture. Because they are essentially unaffected by most current operations of Glen Canyon Dam, they can somewhat serve as a control within the survey methodology.

Question:

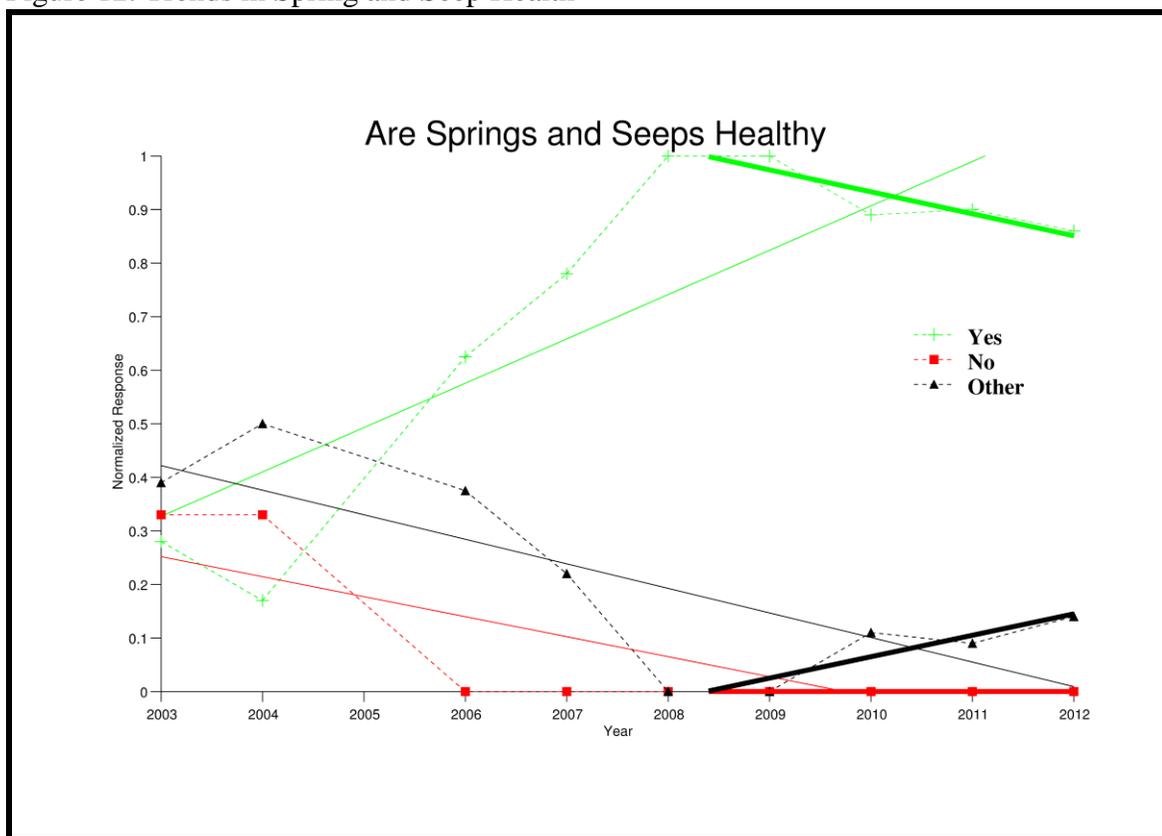
-Springs and seeps in Grand Canyon exist in a healthy state?

Yes or No or Don't Know

Table 14. Are Springs and Seeps Healthy

	Yes	No	Yes and No	Don't know	Blank
2003	5	6	0	6	1
2004	1	2	2	1	0
2006	5	0	0	3	0
2007	7	0	2	0	0
2008	8	0	0	0	0
2009	7	0	0	0	0
2010	8	0	1	0	0
2011	10	0	0	0	1
2012	6	0	0	0	1
Total	57	8	5	10	3

Figure 12. Trends in Spring and Seep Health



Hopis continue view springs and seeps as being healthy, although there has been a slight decrease in affirmative response in the recent years and increase in uncertainty (Table 14, Figure 12). No one has considered the springs to be unhealthy for the past seven monitoring cycles. Like with *Öönga*, the Hopi take an active role in directly maintaining the health of a number of seeps and springs through placement of offerings and ritual activities at Hopi. The positive view of seep and spring health may be a reflection of continued conduct of this stewardship role by the Hopis.

Trends for Management Activities

The next set of questions deal with activities associated with the management of resources in *Öngtupqa* rather than the resources themselves. These are used to track whether management activities that are occurring or are proposed are viewed as appropriate from the Hopi perspective.

Hopi Involvement in the AMP

Three questions are asked that assess the relevance of Hopi participation in the AMP and monitoring of resources in *Öngtupqa*. They are:

Question 1:

Should Hopi be involved in stewardship and Management of *Öngtupqa* (Grand Canyon)?

Yes or No or Don't Know

Question 2:

Is this information about *Öngtupqa* important to you?

Yes or No or Don't Know

Question 3:

Does this information about *Öngtupqa* relate to your cultural teachings?

Yes or No or Don't Know

These questions are used to track a couple of issues, foremost of which is whether the Hopi consider it appropriate that they remain involved in the AMP. Because there are very real cultural and political implications for working in *Öngtupqa* for the Hopi people, it is appropriate to identify whether participation is still considered important enough to outweigh the potential negative aspects of involvement. Additionally, responses are used to gauge whether the monitoring program is continuing to collect the “right” information. That is, is the Hopi Long-term Monitoring Program addressing the correct Hopi concerns or are there other resource issues that need to be examined? These questions are more for internal evaluation of the Hopi Long-term Monitoring program rather than to track the health of any given resource.

Since these questions have been asked, we have received a total of 501 responses, for these three questions combined (see Table 2). A total of 3 have been negative (1 for each questions) and another 19 total either did not know or simply did not respond; all respondents from 2012 responded “**Yes.**” This shows that there continues to be overwhelming support for Hopi participation in the AMP and that the work being conducted is culturally relevant and important to the Hopi people. One Hopi summed up the need for Hopi participation by noting: “Hopi have a long history with the Canyon, so who better to gather information from?”

Recreation

Recreational use of *Öngtupqa* is a contentious issue from the perspective of the Hopi Tribe. It has two principle impacts. First, there are the actual physical impacts that can occur to resources from trailing, vegetation damage, introduction of exotic species, damage to archaeological resources, littering, etc. Second, from the Hopi perspective, it is inappropriate and even dangerous for non-initiated people to venture into *Öngtupqa*. The correct spiritual preparations must be made before such a journey is undertaken and appropriate behavior must be followed. A consistent concern

voiced by Hopi consultants is that behavior that is not keeping with the sacred nature of the location may have negative effects on *Öngtupqa* and result in harm to those people who behave inappropriately. This concern extends to all users of *Öngtupqa*, including scientists and managers.

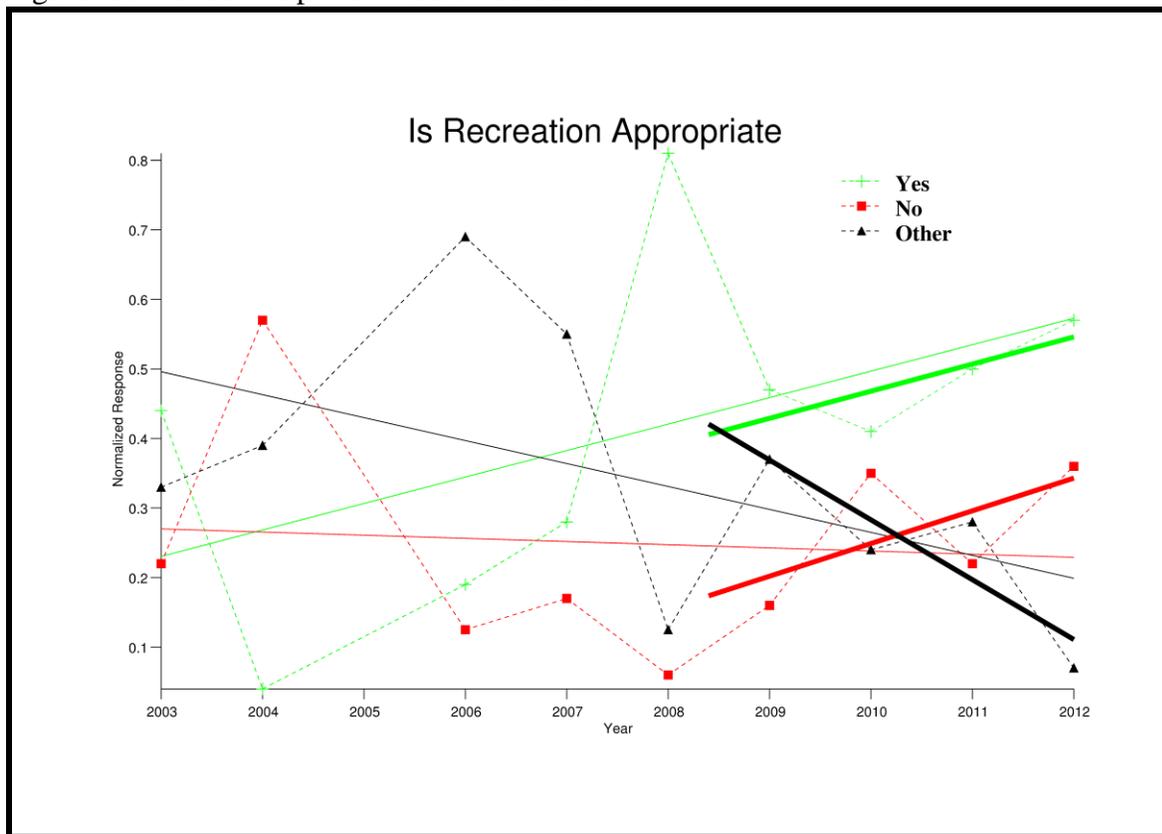
Whether recreation should be permitted is asked as follows:

-The National Park Service allows recreational visitation in *Öngtupqa* (Grand Canyon) on river trips. From your perspective, is this **right** or **wrong**.

Table 15. Should Recreation be Allowed in *Öngtupqa*

	Yes	No	Yes and No	Don't know	Blank
2003	8	4	1	5	0
2004	1	13	5	2	2
2006	3	2	6	5	0
2007	5	3	5	5	0
2008	13	1	2	0	0
2009	9	3	4	1	2
2010	7	6	0	1	3
2011	16	7	5	0	4
2012	8	5	0	0	1
Total	70	44	28	19	12

Figure 13. Trends in Opinion About Recreation



Support for recreation in *Öngtupqa* continues to be somewhat greater than opposition, but those who feel that it is not appropriate have been rising in recent years, diverging from the long-term trend direction. The number of respondents without a clear opinion has been consistently decreasing

at the same time. The mixed feeling about recreation is expressed in a number of the comments. Some who supported recreation clarified that it was appropriate “To an extent. I think that while it may be a hard decision to make, limits must be in place. We were never alone so it somewhat taints the experience.” And, “As long as they just look and not touch or take anything. Just leave everything as is and Respect the place.” The need to respect *Öngtupqa* was a common theme. Even those who felt that recreational use was wrong seemed resigned to the fact that it was going to happen.

Treatment of Eroding Archaeological Sites

Because archaeological sites are the “footprints” left by the Hopi ancestors, site preservation has been a concern of the Hopi Tribe ever since it became involved in the operations and management of Glen Canyon Dam. The overwhelming consensus is that archeological sites should be preserved in place, if possible. In situations where this is not possible, there is more divergence of opinion on what should be done. Because interview work identified that there is sometimes a distinction made between human caused impacts to archaeological sites and those that are due to “natural” processes, two separate questions are used provide feedback.

Question 1:

Should eroding archaeological sites be: a). **left to erode** b) **be reburied** c) **be excavated**

Question 2:

If an archaeological site is impacted because of human actions, it should be: a). **left to erode** b) **be reburied** c) **be excavated**

Table 16. Treatment of Archaeological Sites

	Excavate	Let erode	Rebury	Excavate & let erode	Excavate & rebury	Excavate, rebury & let erode	Preserve	Blank	Don't know
Q12 Eroding arch sites	30	37	29	7	5	4	2	4	3
Q13 Human caused erosion	32	19	44	0	9	3	2	8	3

It should be noted that respondents often selected more than one of the three responses to each question, suggesting a more nuanced, possibly stepwise approach to management of archaeological sites. Table 16 shows the various combinations of responses received for all of the monitoring that has occurred. As an example of a composite response, one commenter suggested that for a site being impacted by human actions: “Rebury it, if not in harms way, But have it excavated if there is no other options to save it.” Others commented that in essence, “humans should not impact burial spaces.”

In Table 17, the data from above is grouped into the three options from the original questions: **Excavate**, **Let erode**, or **Rebury**. For grouping, the assumption is made that a recommendation combining excavation with some subsequent action is still a recommendation for excavation. Similarly, “**Preserve**” was combined with “**Rebury**.” A forth, “**Other**” column was added for the “Blank” and “Don’t know” responses.

Table 17. Treatment of Archaeological Sites

	Excavate	Let erode	Rebury	Other
Q12 Eroding arch sites	46 (38.01%)	37 (30.58%)	31 (25.62%)	7 (5.79%)
Q13 Human caused erosion	44 (36.67%)	19 (15.83%)	46 (38.33%)	11 (9.17%)

Several trends are apparent in this data. First, whether erosion is attributed to human agency or not, only slightly over one-third of the Hopi respondents recommend that excavation be employed to recover information that would otherwise be lost. If the erosion is deemed to be human caused, there is a decrease in those who felt that the site should be left to erode and an increase in those calling for reburial. Interestingly, there is a slight decrease in the percentages recommending excavation. This may be the case of assuming that if humans are causing the erosion, then as a first step, they should stop the erosion. When sites are being impacted, whether by natural or human caused erosion, the overwhelming response is to conduct some type of intervention or treatment (ie. excavate or rebury): 63.63% in the case of “generic” erosion and 75.00% in the case of human caused erosion. In addition, when a χ^2 goodness-of-fit analysis is conducted on the distribution of responses between these two questions, it indicates that there is a statistically significant difference in the response patterns ($\chi^2=9.64$, $p=0.0470$). This provides some confidence that the root causes of erosion are being considered by the Hopis when making management recommendations and that the recommendations are different for different erosion scenarios.

Mechanical Removal

Mechanical removal of trout was tested as an approach for reducing trout populations beginning in 2002 and then later proposed as a management action, a question concerning whether this is appropriate in the context of benefiting the native species has been included on the questionnaire. Because mechanical removal is now an aspect of the decision coming out of the Non-Native Fish Control Environmental Assessment, this question is still very relevant, particularly in light of the affect its implementation has on *Öngtupqa* as a Hopi Traditional Cultural Property.

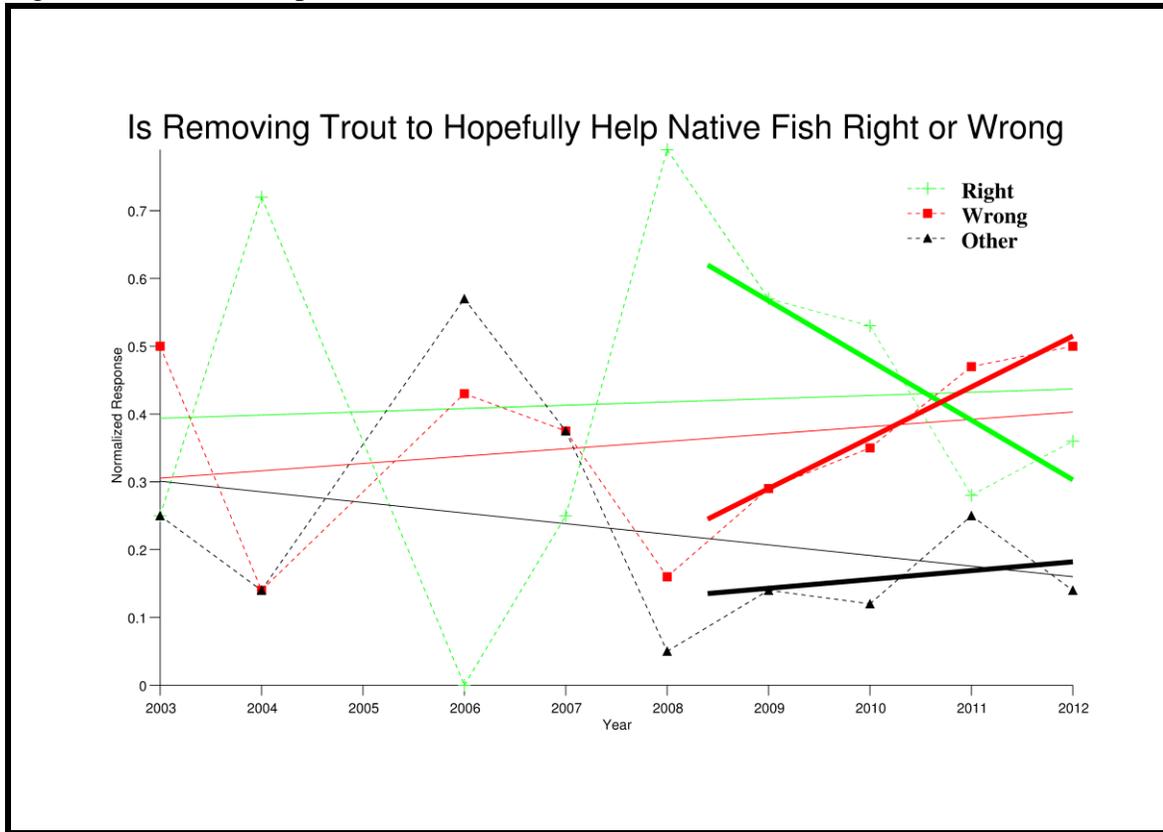
Question:

-Non-native trout and other fish are being killed to hopefully help native fish. From your perspective, is this **Right** or **Wrong**

Table 18. Mechanical Removal of Non-native Fish

	Right	Wrong	Right and Wrong	Don't know or Blank
2003	2	4	0	2
2004	5	1	1	1
2006	2	3	1	4
2007	0	3	0	3
2008	15	3	0	1
2009	12	6	0	3
2010	9	6	1	1
2011	9	15	1	7
2012	5	7	1	1
Total	59	48	5	23

Figure 14. Trends in Opinion for Mechanical Removal of Non-native Fish



This is the only question asked where the “No” responses currently outnumber the “Yes” responses (Table 18, Figure 14). The falloff of support for mechanical removal has been a consistent trend since about 2008. This is likely a response to the fact that the chub populations have been increasing in spite of increasing trout numbers and the uncertainty in the effectiveness in trout removal to benefit the chub. As one Hopi noted, trout removal is both “Right and wrong. ...I am a fisherman, but how do you keep all the trout at Lees Ferry? Being that water flows downstream the trout end up downstream. Still with the increase in natives, I think what is being done today is as good as we can do.” Support for trout removal was phrased by another Hopi as follows: “...they [chub] were here first and it is good to see something being done to keep them alive and well.” While most respondents who did not support mechanical removal simply said it was wrong, one elaborated by stating that the trout “...shouldn’t have been introduced to begin with and to resort to killing them is a ethical wrong thing to do. Two wrongs do not make a right, as white people would say.”

Non-native species

While the previous question targeted management primarily for an individual species, this question seeks to understand the broader perspective with respect to the values for native and non-native species in general.

Question:

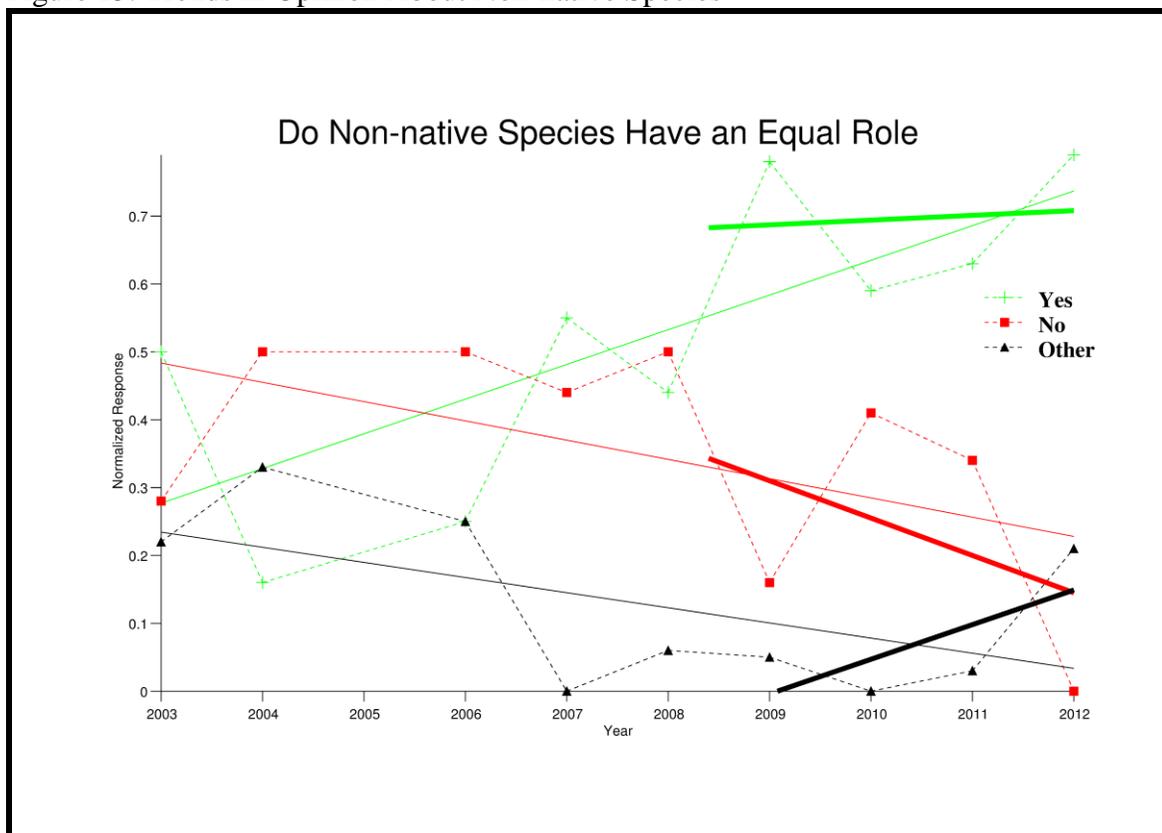
-Non-native species (such as tamarisk) and native species (such as cottonwood) have an equal role in the balance of the natural world?

Yes or No or Don’t Know

Table 19. Do Non-native Species Have A Role

	Yes	No	Yes and No	Don't know	Blank
2003	9	5	0	3	1
2004	1	3	1	1	0
2006	2	4	0	2	0
2007	5	4	0	0	0
2008	7	8	0	1	0
2009	15	3	1	0	0
2010	10	7	0	0	0
2011	20	11	0	0	1
2012	11	0	1	0	2
Total	80	45	3	7	4

Figure 15. Trends in Opinion About Non-native Species



As a counterpoint to the results of the previous question, there is clearly a belief by the Hopi that all species have a role to exist (Table 19, Figure 15). Through time, there has been increasing recognition that non-native species play a role in the current ecosystem. This may be due to a number of factors. It may simply be the recognition that the ecosystem below the dam is no longer purely “natural;” people have dramatically changed the equation and now the system is responding, which includes incorporation of non-natives (and natives that may not have been present or common pre-dam). Reflecting this assertion, one Hopi stated: “Everything natural has a role in the cycle of life. I’m sure sooner or later the non-native species would end up here, in time.” It also ties into the Hopi belief that life is important for its own sake, even if it is a non-native. This gets to the heart of the seeming contradiction between responses to this question and the previous one (should non-

natives be removed). There is a balance that needs to be struck between ensuring the survival of the native species and unnecessary taking of life. If coexistence is possible, then this is the appropriate course of action as it maximizes “life.”

Some of the support for coexistence is more pragmatic. One person noted the possible role that vegetation (both native and non-native) may play in beach stabilization. Another provided the example of both tamarisk (non-native) and cottonwood (native) being used in traditional crafts. In basketry, tamarisk and yucca are sometimes combined in the same item.

Demographic Analyses

Since the Hopi Long-term Monitoring program is drawing conclusions from a sample of Hopi individuals that are not necessarily randomized across the entire population, it is important to understand some of the biases that may be occurring in the data. Because the data set is still relatively small, the analytic focus is initially on a couple potential biases with the greatest implications for the overall monitoring methodology: 1.) whether responses are systematically different before and after taking a river trip; 2.) whether there is systematic change in response when multiple river trips are taken by an individual.

The first hypothesis is particularly important given the key assumption for implementing the Hopi survey methodology is that visitation is not required by Hopis to make a valid assessment of the health of *Öngtupqa*. Because river trip participants complete surveys following the standardized presentation (as is the protocol for surveys carried out at Hopi), but prior to the monitoring trip, an assessment can be made of changes in responses due to direct interaction with the resource versus only having heard about in the presentation. Finally, it is anticipated that as more surveys are completed, issues of age, clan, society, village, or other demographic variables will be analyzed. The use of Cultural Consensus Theory analysis may be applicable for addressing the data set and identifying underlying commonalities for better data interpretation (eg. see Romney et. al. 1986).

General versus Post-trip comparison

Because only a limited subset of Hopis are able to enter *Öngtupqa* and directly examine the resources, it is important to understand whether their view is fundamentally different from those who complete the questionnaire but have not been in *Öngtupqa*. Therefore, this sections looks at the responses supplied by people who completed the questionnaire both before and after a monitoring trip. As with previous sections, “blank and “don’t know” were grouped together under “other.” Differently however, in those cases where both “yes” and “no” were checked, the numbers were added to both the “yes” and “no” categories. While this doesn’t affect the yes-to-no ratio, it does incorporate the fact that the respondent did have an opinion (as opposed to stating “don’t know”) – they just did not make a value judgment. The raw data from all trips is presented in Table 20.

Table 20. Response Frequencies from Before and After a Monitoring Trip

	Yes (PRE)	No (PRE)	Other (PRE)	Yes (POST)	No (POST)	Other (POST)
Q01 Overall health	59	9	31	52	8	20
Q02 Hopi Involvement	94	0	4	68	2	6
Q03 Importance of Information	96	1	1	73	0	2
Q04 Relates to Cultural Teachings	86	2	1	64	0	3
Q05 Recent changes	32	0	22	51	0	16

Q06 Marshes	42	8	15	48	18	10
Q07 Birds	51	2	11	58	6	12
Q08 Recreation	44	41	25	54	31	6
Q09 Trout removal	28	20	9	35	33	10
Q10 Non-native species	42	21	3	41	27	80
Q11 Archaeological sites	36	23	9	45	21	8
Q14 Öönga, Hopi Salt Mines	2	4	4	64	6	5
Q15 Willow	4	0	6	58	9	9
Q16 Animals	5	0	5	59	2	12
Q17 Native fish	3	2	5	28	14	31
Q18 Snakes	2	0	8	49	3	21
Q19 Insects	4	0	6	59	2	12
Q20 Springs and seeps	2	2	6	60	11	7

As a visual representation of the data in Table 20, Figure 16 presents the results of a non-metric Multi- Dimensional Scaling of the normalized data using a Euclidean similarity measure. It should be noted that only Questions 01 through 11 were included in the analysis as they are the ones that are consistently asked both before and after trips. The statistical package “**Past**” was used to conduct the analysis. (Hammer et. al. 2001).

It is apparent that the “Yes”/“No”/“Other” response pattern to all questions is remaining relatively consistent between the Pre-trip and Post-trip surveys. The grouping of the Pre- versus Post- response pattern for the “Yes” and “Other” is slightly less-tight than in previous years, but still shows that people who have not been on the river are responding in a similar manner to those who have looked at the resources first hand and that the overall survey approach is recovering accurate information.

Single versus Multiple Trips

The second question posed above, whether responses change when a participant conducts multiple monitoring episodes, investigates the role of personal observation in influencing responses to the survey. When a consultant participates on only a single trip, the respondent cannot draw on personal memory to identify changes; they can only evaluate the resources based on what they are told in the standardized presentation about resource conditions through time. When participants complete multiple monitoring trips, they are able to rely on their own memory in addition to the information that is provided to them through the multiple standardized presentations. Therefore, if people who complete more than one trip respond significantly differently than those who only take a single trip, their feedback will need to be considered separately. Table 21 presents the raw numbers,

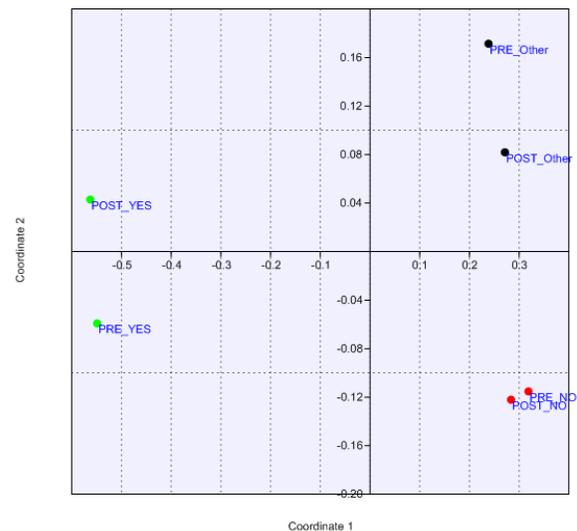


Figure 16. MDS Scoring of Responses from Before and After River Trips.

with the “Yes” and “No” and “Other” analyses being combined in the same manner as the previous analysis.

Table 21. Raw Data for Single and Multiple Trip Responses

	Yes (0-1 trips)	No (0-1 trips)	Other (0-1 trips)	Yes (2+ trips)	No (2+ trips)	Other (2+ trips)
Q01 Overall health	64	8	39	41	3	17
Q02 Hopi Involvement	106	0	5	54	1	6
Q03 Importance of Information	109	1	1	59	0	2
Q04 Relates to Cultural Teachings	97	1	1	51	0	4
Q05 Recent changes	53	0	25	30	0	12
Q06 Marshes	55	18	17	32	6	10
Q07 Birds	67	6	17	40	1	7
Q08 Recreation	46	32	33	24	11	26
Q09 Trout removal	42	29	12	15	17	13
Q10 Non-natives	55	26	9	25	18	5
Q11 Archaeological Sites	47	25	18	30	16	2
Q14 Öönga	39	5	7	25	3	4
Q15 Willow	34	3	14	25	3	4
Q16 Animals	38	2	11	26	0	6
Q17 Native fish	17	11	23	14	5	13
Q18 Snakes	30	2	19	21	1	10
Q19 Insects	35	2	14	28	0	4
Q20 Springs	34	6	11	23	2	7

Figure 17 shows the Non-metric MDS plot of the standardized data provided in Table 21 based on Euclidian similarity measures. In this case, responses to all of the questions were considered in the analysis as the data is pooled and whether a question was asked only after a trip, or both before and after is irrelevant. Further, data from people who never took a trip and those that took a single trip were also grouped as the analysis of responses from before and after a trip showed that there is no modified response pattern.

Once again, it is clear that people who never go on the river monitoring trip or who conduct only a single trip are responding in the same manner as those who have had multiple exposures to the resources along the river. Because respondents who have been on multiple trips have also heard multiple standardized presentations and have been involved in discussions that vary from one year to the next during the course of multiple river trips, the consistency in response lends confidence that responses are not being fundamentally altered by variations in how the data is being presented.

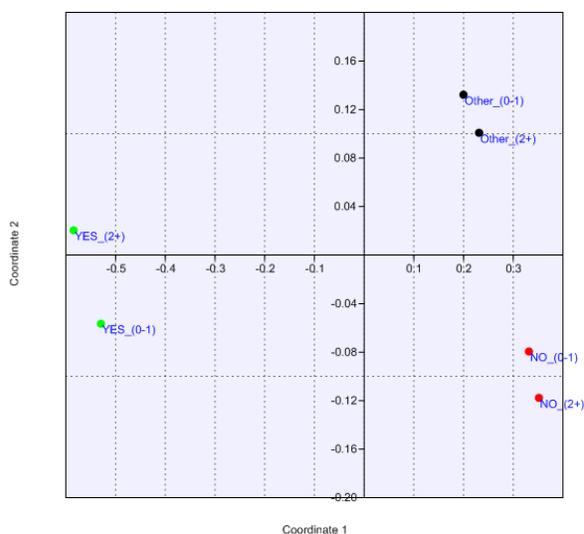


Figure 17. Single/Multiple Trip MDS Plot

DISCUSSION AND RECOMMENDATIONS

As in previous years, one of the impediments to the ongoing implementing the Hopi Long-term Monitoring protocols is the limited amount of new information coming out the AMP related to the state of terrestrial resources. During the development of the Hopi monitoring protocols, GCMRC was concurrently developing a monitoring approach for the terrestrial zone along the river. The Hopi Tribe coordinated with the development of GCMRC's approach to ensure that data being collected was relevant to Hopi monitoring needs (Huisinga and Yeatts 2003). Unfortunately, the scope of the terrestrial monitoring program has been so scaled back as to be essentially useless for input into the Hopi Long-term Monitoring Program. While the Hopi Tribe can continue to observationally monitor the culturally important resources in this zone, this work will only occasionally be informed by measured resource states as originally envisioned in the Terrestrial Ecosystem Monitoring Program. Therefore, most of the culturally important terrestrial resources will necessarily be discussed as having "not been monitored by the AMP" in the standardized presentations. Vegetation changes such as encroachment on camping areas and other easily observable traits can be conveyed, but structure and composition changes will not be updated. Likewise, new information regarding avifauna, small mammals, reptiles, amphibians, and insect populations can only be updated if new relevant information becomes available and can be obtained. The Hopi Tribe recommends that more emphasis be placed on monitoring of the terrestrial zone and developing an ecosystem approach that links the terrestrial and aquatic systems more fully.

Lack of progress related to the PA program for archaeological sites continues to be a concern to the Hopi Tribe. The overall lack of monitoring at archaeological sites by the AMP, the fact that there has been no mitigation of impacts at those sites which past monitoring has shown to have sustained adverse affects, and no apparent progress on updating or revising the PA to address current issues continue to plague the cultural resources program; from the Hopi perspective, the Bureau of Reclamation is still out of compliance with the current PA and section 106 of the National Historic Preservation Act. As recommended last year, there is still a need for comprehensive monitoring of archeological sites to track the rates of erosion and that any impacts that are occurring be mitigated. Where mitigation takes the form of data recovery, it should follow the outlines envisioned in the Research Design (Fairley nd.) and Treatment Plan (Damp et al. 2007) but with much greater emphasis on incorporating traditional tribal knowledge into the research questions, activities, and interpretation. There seems to be a movement in this direction coming out of the HFE MOA and, assuming that progress continues, this is a positive development.

What to do about trout and their effect on the humpback chub and other native fish has been a contentious topic over the past year. With the completion of the EA and MOA related to control of non-native fish, particularly rainbow trout, the potential for removing large numbers of non-native fish in proximity to the Little Colorado River mouth is again of concern. The monitoring shows that there is an increase in concern about the humpback chub but also a strong decrease in support for killing large numbers of trout. Similarly, the view that non-natives have a right to live is remaining strong. Therefore, the Hopi Tribe recommends that efforts to understand what are the limiting factors for the humpback chub (both habitat issues in mainstem and LCR, and the lifestage(s) where mortality rate is limiting) continue to be a focus of aquatic research. In addition, management actions such as the translocation should be continued as long as they are continuing to be successful.

Beyond the work with the humpback chub, better monitoring the dynamics of the remainder of the native fish population in the mainstem is important. Given that the populations of these species

seem to be increasing in tandem with the humpback chub and they are more directly associated with the mainstem Colorado River throughout its length, it makes sense that more emphasis should be focused on them by the AMP. Separating the management/conservation activities related to the humpback chub into a separately authorized and funded Recovery Program (that does not have the issues of whether a given action it is “in or out” of AMP purview) might make sense. This could free up funding for a broader ecosystem approach by the AMP.

Finally, as was recommended last year, the Hopi Tribe recommends that a much more formal, cooperative relationship be established between GCMRC and the two National Park units for sharing of monitoring data.

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APPENDICES

General and post-trip survey instruments from 2012

Hopi Long-Term Monitoring Program (May 2012 Trip)

_____ name

Based on research by scientists, this is the current state of things in *Öngtupqa*:

Paakiw, fish: Native fish have generally decreased in numbers since 1989, reaching a low in 2001, but numbers have greatly increased since 2002. Scientists believe the original decrease has been caused by many factors, including cold water and competition from non-native fish such as trout and catfish. In 2001, there were about 2000 adult Humpback Chub, an endangered native fish. Today there are more than 7000 adult Chub and the numbers are still increasing. The other native fish are also increasing in numbers. But so are the non-native rainbow trout, which spawn above Lees Ferry, but then move downstream. The affect that trout have on the Chub population is still not known.

Yamtaqa, Vasey's Paradise: *Yamtaqa* is a traditional cultural property (TCP) for Hopi. Photographs show us that flows from this spring vary from year to year. This spring is not affected by the operations of Glen Canyon Dam.

Suta, Hematite Mine, Sipapuni, and Öönga, Hopi Salt Mines: Non-tribal groups generally do not visit these sites and are forbidden to visit *Öönga*. Several tribal groups stop at these areas and collect salt and hematite. The salt slowly re-grows and is renewable; the *suta* is becoming much harder to collect and will never be replenished. Before tribes became involved in research in *Öngtupqa*, collection at these areas was likely very limited.

Tsuua, rattlesnakes and other snakes: Scientists are unsure if the snakes are affected by Glen Canyon Dam operations and do not study them any longer. There are 3 types of *tsuua* in Grand Canyon and 4 other types of snakes.

Sand and beaches: The river and nearby areas have much less sand and mud compared to before the dam was built. The water released from Glen Canyon Dam contains no sand or mud. Most new sand and mud into *Öngtupqa* is now from the Paria River and *Paayu*. Because of limited new sand, when areas along the river erode, they no longer rebuild like before the dam. Short duration, high flow experiments can put new sand on some areas along the river, but it is still under investigation whether it is enough sand to offset the erosion. High flow experiments have been conducted in 1996, 2004 and 2008 and will be tried again for the next 10 years. They can result in temporary increases in the sizes of beaches. These beaches are used by river runners for camping.

Archaeological sites: Archaeological sites continue to erode along the river and because of the limited amount of new sand available to rebury them. In the past, the Park Service has tried to slow erosion at some of the sites using traditional Zuni check dams. The high flow experiments may help protect some archaeological sites. Some archaeological excavation has been conducted at sites where erosion can't be stopped in order to recover information about the past before it is lost. To date, the tribal role in these excavations has been limited. For the past for years, there has been no monitoring of the sites in the Adaptive Management Program and no excavation of eroding sites.

Tuutuvost, animals: Scientists know very little about how Glen Canyon Dam operations affect the game animals that are seen along the river. The two most common types are *pangwu* (bighorn sheep) and *sowi'ngwa* (mule deer).

Kwaahu, eagles: *Nuva'kwaahu* (bald eagle) and *kwaahu* (golden eagle) are both occasionally seen along the river. Bald eagles are rarely seen now that trout (a favorite food) can't spawn in Nankoweap Creek because of flash floods.

Tsirot, birds: There are many types of birds that find food and shelter along the Colorado River. The increase in vegetation along the river shore since Glen Canyon Dam was built has caused bird numbers to increase. The birds use both the native and non-native vegetation and use *Öngtupqa* as a migration route. Birds are not monitored.

Plants: Withou natural floods, native and non-native plants have greatly increased along the shoreline. The most obvious plant, tamarisk, is a non-native. A non-native beetle is now killing them. Plants are now growing in areas that used to be open sand (which reduces camping areas). Scientists have greatly reduced the number of studies of the plants and animals that live around them.

Wipho'qölö, cattail marsh and Paaqap' qölö, reed marsh: Marshes have decreased in number and size with current operations of Glen Canyon Dam. Woody plants that like drier conditions are moving into the marsh areas.

***** General Survey *****
General Questions

1. Do you think *Öngtupqa* (Grand Canyon) is better cared for now than in the past?

Yes No Don't Know (Circle one)

Comment:

2. Should Hopi be involved in stewardship and management of *Öngtupqa* (Grand Canyon)?

Yes No Don't Know (Circle one)

Comment:

3. Is this information about *Öngtupqa* important for you?

Yes No Don't Know (Circle one)

Comment:

4. Does this information about *Öngtupqa* relate to your cultural teachings?

Yes No Don't Know (Circle one)

Comment:

5. Do you think there have been changes in *Öngtupqa* in recent years?

Yes No Don't Know (Circle one)

Comment:

5a. What changes do you like?

5b. What changes do you dislike?

5c. If you could change something, what would it be?

5d. If you wanted to make sure something stayed the same, what would it be?

Specific Resource Questions

6. From what you have heard, *Wipho'qölö* (patches of *wipho* or cattail) and *paaqap'qölö* (patches of *paaqavi* or reed) in Grand Canyon exist in a healthy state.

Yes No (Circle one)

Comment:

7. From what you have heard, *Tsirot* (birds) in Grand Canyon exist in a healthy state.

Yes No (Circle one)

Comment:

8. The National Park Service allows recreational visitation in *Öngtupqa* (Grand Canyon) on river trips. From your perspective, is this: **right** or **wrong (Circle one)**.

Comment:

9. Non-native trout and other fish are being killed to hopefully help the native fish. From your perspective, is this: **right** or **wrong (Circle one)**.

Comment:

10. Non-native species (such as tamarisk) and native species (such as cottonwood) have an equal role in the balance of the natural world.

Yes No (Circle one)

Comment:

11. From what you heard, archaeological sites in Grand Canyon are healthy.

Yes No (Circle one)

Comment:

12. Should eroding archaeological sites be:

a. left alone to erode b. be reburied c. be excavated (Circle)

Why?

13. If an archaeological site is impacted because of human actions, should they be:

a. left alone to erode b. be reburied c. be excavated (Circle)

Why?

Background Information

Village _____ Clan _____

Hopi/Tewa Religious or Cultural Societies _____

Name _____ Age _____

Gender **Male** **Female** (Circle one)

Are you a tribal Employee? Yes No (Circle one)

If yes, what Tribal department _____

Are you a CRATT member? Yes No (Circle one)

Number of visits to *Öngtupqa* (Grand Canyon) on a river trip _____

Other visits to *Öngtupqa*: Canyon Rim _____
Hiking into Canyon _____

Hopi Long-Term Monitoring Program (May 2012 Trip)

_____name

Based on research by scientists, this is the current state of things in *Öngtupqa*:

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Archaeological sites: Archaeological sites continue to erode along the river and because of the limited amount of new sand available to rebury them. In the past, the Park Service has tried to slow erosion at some of the sites using traditional Zuni check dams. The high flow experiments may help protect some archaeological sites. Some archaeological excavation has been conducted at sites where erosion can't be stopped in order to recover information about the past before it is lost. To date, the tribal role in these excavations has been limited. For the past for years, there has been no monitoring of the sites in the Adaptive Management Program and no excavation of eroding sites.

Tuutuvost, animals: Scientists know very little about how Glen Canyon Dam operations affect the game animals that are seen along the river. The two most common types are *pangwu* (bighorn sheep) and *sowi'ngwa* (mule deer).

Kwaahu, eagles: *Nuva'kwaahu* (bald eagle) and *kwaahu* (golden eagle) are both occasionally seen along the river. Bald eagles are rarely seen now that trout (a favorite food) can't spawn in Nankoweap Creek because of flash floods.

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Plants: Withou natural floods, native and non-native plants have greatly increased along the shoreline. The most obvious plant, tamarisk, is a non-native. A non-native beetle is now killing them. Plants are now growing in areas that used to be open sand (which reduces camping areas). Scientists have greatly reduced the number of studies of the plants and animals that live around them.

Wipho'qölö, cattail marsh and Paaqap' qölö, reed marsh: Marshes have decreased in number and size with current operations of Glen Canyon Dam. Woody plants that like drier conditions are moving into the marsh areas.

***** POST-trip Survey *****
General Questions

1. Do you think *Öngtupqa* (Grand Canyon) is better cared for now than in the past?

Yes No Don't Know (Circle one)

Comment:

2. Should Hopi be involved in stewardship and management of *Öngtupqa*?

Yes No Don't Know (Circle one)

Comment:

3. Is this information about *Öngtupqa* important for you?

Yes No Don't Know (Circle one)

Comment:

4. Does this information about *Öngtupqa* relate to your cultural teachings?

Yes No Don't Know (Circle one)

Comment:

5. Do you think there have been changes in *Öngtupqa* in recent years?

Yes No Don't Know (Circle one)

Comment:

5a. What changes do you like?

5b. What changes do you dislike?

5c. If you could change something, what would it be?

5d. If you wanted to make sure something stayed the same, what would it be.

*** POST-trip Survey ***
Specific Resource Questions

6. *Wipho* 'qölö (patches of *wipho* or cattail) and *paaqap* 'qölö (patches of *paaqavi* or reed) in *Öngtupqa* exist in a healthy state.

Yes No (Circle one)

Comment:

7. *Tsirot* (birds) in *Öngtupqa* exist in a healthy state.

Yes No (Circle one)

Comment:

8. The National Park Service allows recreational visitation in *Öngtupqa* on river trips. From your perspective, is this **right** or **wrong (Circle one)**.

Comment:

9. Non-native trout and other fish are being killed to hopefully help the native fish. From your perspective, is this **right** or **wrong (Circle one)**.

Comment:

10. Non-native species (such as tamarisk) and native species (such as cottonwood) have an equal role in the balance of the natural world.

Yes No (Circle one)

Comment:

11. From what you heard, archaeological sites in *Öngtupqa* are healthy.

Yes No (Circle one)

Comment:

12. Should eroding archaeological sites be:

a. left alone to erode b. be reburied c. be excavated (Circle)
Why?

13. If an archaeological site is impacted because of human actions, should they be:

a. left alone to erode b. be reburied c. be excavated (Circle)
Why?

14. *Öönga* (Hopi Salt Mines) is healthy.

Yes No (Circle one)

Comment:

15. *Qahavi* (willow plants) in *Öngtupqa* exist in a healthy state.

Yes No (Circle one)

Comment:

16. *Tuutuvost* (animals) in *Öngtupqa* exist in a healthy state.

Yes No (Circle one)

Comment:

17. Native fish called the Humpback chub exist in a healthy state in *Öngtupqa*.

Yes No (Circle one)

Comment:

18. Snakes in *Öngtupqa* exist in a healthy state.

Yes No (Circle one)

Comment:

19. Insects in *Öngtupqa* exist in a healthy state.

Yes No (Circle one)

Comment:

20. Springs and seeps in *Öngtupqa* are healthy.

Yes No (Circle one)

Comment:

21. What should the Hopi role be in the management of resources in the *Öngtupqa*? (Explain in the space below.)

22. Other comments:

Background Information

Village _____ Clan _____

Hopi/Tewa Religious or Cultural Societies _____

Name _____ Age _____

Gender **Male** **Female** (Circle one)

Are you a tribal Employee? Yes No (Circle one)

If yes, what Tribal department _____

Are you a CRATT member? Yes No (Circle one)

Number of visits to *Öngtupqa* (Öngtupqa) on a river trip _____

Other visits to *Öngtupqa*: Canyon Rim _____

Hiking into Canyon _____