

2016 Report of the Hopi Long-Term Monitoring Program for Öngtupqa (the Grand Canyon)

**Prepared by:
Michael Yeatts and Kristin Harned**

**Produced by the Hopi Cultural Preservation Office
P.O. Box 123
Kykotsmovi, Arizona 86039**

Prepared for the Grand Canyon Dam Adaptive Management Program
with funding provided through Bureau of Reclamation
grant No. **R13AP40002**
under Park Service Research and Collecting Permit
GRCA-2016-SCI-0009

October 2016

ACKNOWLEDGEMENTS

This work could not have been carried out without numerous other people. First and foremost are the Hopi participants who freely shared their cultural knowledge and understanding of the world, and making concepts that are second nature to any Hopi child understandable to the non-Hopi researchers. Of particular note are the Hopis who have placed themselves at spiritual risk by entering *Öngtupqa* and enduring the hardships of being away from their families and home to further their stewardship role.

Without the funding support of the Bureau of Reclamation, through the Glen Canyon Dam Adaptive Management Program, and the efforts of scientists and other personnel at the Grand Canyon Monitoring and Research Center and Grand Canyon National Park, none of this work could have been accomplished.



Hopi 2016 monitoring group

TABLE OF CONTENTS

Acknowledgements i
Table of Contents iii
List of Figures iv
List of Tables v
Introduction 1
 Guiding Philosophy 1
 Protocols 2
 2016 Annual River Monitoring Trip 3
Data Analysis 3
 Resource Trends 5
 Overall Health 6
 Recent changes 7
 Archaeological Sites 8
 Marshes 10
 Birds 10
 Öönga (Hopi Salt Mines) 12
 Willows 13
 Animals 15
 Native Fish 15
 Snakes 17
 Insects 18
 Springs and seeps 19
 Trends for Management Activities 21
 Hopi Involvement in the AMP 21
 Recreation 22
 Treatment of Eroding Archaeological Sites 23
 Mechanical Removal 25
 Non-native species 26
 Demographic Analyses 27
 General versus Post-trip comparison 28
 Single versus Multiple Trips 29
Discussion and Recommendations 30
Referenced Cited 32
Appendices 33
 General and post-trip survey instruments from 2015 33

LIST OF FIGURES

Figure 1. Trends for Overall Health.....	7
Figure 2. Trends for Changes in Recent Years.....	8
Figure 3. Trends in Archaeological Site Health	9
Figure 4. Trends in Marsh Health.....	11
Figure 5. Trends in Bird Health.....	12
Figure 6. Trends in <i>Öönga</i> Health	13
Figure 7. Trends in <i>Qahavi</i> Health	14
Figure 8. Trends in <i>Tuutuvost</i> Health.....	16
Figure 9. Trends in Native Fish Health.....	17
Figure 10. Trends in Snake Health	18
Figure 11. Trends in Insect Health.....	19
Figure 12. Trends in Spring and Seep Health.....	20
Figure 13. Trends in Opinion About Recreation	23
Figure 14. Trends in Opinion for Mechanical Removal of Non-native Fish	26
Figure 15. Trends in Opinion About Non-native Species.....	27

LIST OF TABLES

Table 1. Summary of all Survey Data	4
Table 2. Summary of Responses.....	5
Table 3. Is <i>Öngtupqa</i> Better Cared for Now than in the Past.....	6
Table 4. Have There Been Changes in Recent Years	7
Table 5. Are Archaeological Sites Healthy	9
Table 6. Are Marshes Healthy	10
Table 7. Are Birds Healthy	11
Table 8. Is <i>Öönga</i> Healthy.....	12
Table 9. Is <i>Qahavi</i> Healthy.....	14
Table 10. Is <i>Tuutuvost</i> Healthy	15
Table 11. Are Native Fish Healthy	16
Table 12. Are Snakes Healthy	17
Table 13. Are Insects Healthy	18
Table 14. Are Springs and Seeps Healthy	20
Table 15. Should Recreation be Allowed in <i>Öngtupqa</i>	22
Table 16. Total Responses for Treatment of Archaeological Sites	24
Table 17. Treatment of Archaeological Sites	24
Table 18. Mechanical Removal of Non-native Fish	25
Table 19. Do Non-native Species Have A Role	26
Table 20. Response Frequencies from Before and After a Monitoring Trip.....	28
Table 21. Raw Data for Single and Multiple Trip Responses	29

INTRODUCTION

This report reflects the tenth year of implementing 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 restricts 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 assertion of the Hopi Long-term Monitoring Program is that the physical "state" of a resource and its "health" are two separate concepts, and it is towards the measurement of the second

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, *et cetera*. Whether a given resource “state” is “healthy,” however, is a cultural evaluation, drawing on the cultural understanding of the ecosystem and the roles the resource plays within the ecosystem and the 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 illuminates 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*. The general surveys are conducted subsequent to a standardized presentation about the current 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.

In addition to the general surveys, a more detailed survey is 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 (GCMRC) 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 key component 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 Nvivo 10® 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.

2016 Annual River Monitoring Trip

From May 24 through June 02, 2016, ten Hopi cultural consultants, one boatman, and two Hopi Cultural Preservation Office researchers participated in the annual Hopi monitoring river trip. The nine-day motorized trip ran from Lees Ferry to Diamond Creek, on the Hualapai Reservation. While the Hopis participating on the monitoring trips have long stated a preference for the row trips, funding realities have dictated a shift to motor trips in most years.

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.

Hopi participants on the trip were:

Ernest Nahnacassia, Jr.	Coyote Clan	Kykotsmovi village
Frederick Koruh, Sr.	Spider Clan	Mishongnovi village
Vince Youvella	Water Clan	Tewa village
Eric James	Corn Clan	Hotevilla village
Clyde Lomayakewa	Sun forehead Clan	Shungopavi village
Merv Yoyetewa	Rattlesnake/Sand Clan	Mishongnovi village
Lauren Koinva, Jr.	SnowClan	Shungopavi village
Marvin Talayumptewa	Sun Forehead Clan	Sipaulovi village
Daniel Sorenson	Hopi biologist	
Richard Jeanne	consulting geologist for Hopi Tribe	

The staff and crew on the trip were:

Lynn Roeder	Boatman
Kristin Harned	Co-PI
Michael Yeatts	PI

DATA ANALYSIS

Data collected in the form of surveys or interviews is entered into the Nvivo 10® database for further processing, consolidation, trend analysis, pattern searching, and ultimately statistic analysis. Since the beginning of the monitoring program, 270 surveys have been completed and entered into the database and form the basis for this analysis. This includes information from 148 Hopi individuals, and 13 non-Hopis (only the information collected from Hopi participants is included in the subsequent analyses in this report). 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
GC River Trip 2013	7	14
GC River Trip 2014	11	22
GC River Trip 2015	11	21
GC River Trip 2016	8	16
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	13	15
Total Hopi	148	255
Total people including non-Hopi	161	270

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 serves as an introduction to the response categories that are used throughout 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

Table 2 also highlights some issues that are a byproduct of the iterative process by which the survey instrument (questionnaire) was developed. First, the numbers of responses to any given question are always less than the total number of surveys that have been completed by Hopi participants (compare with Table 1). This is a result of some questions being added or dropped during the development of the survey program, or having 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. Continuing with the approach started in 2015, the first two years (2003 and 2004) of surveys are not included in the individual resource analyses. During these first two years, the survey instrument and monitoring protocols were in flux, so the data collected tended not to be comparable to that collected later. Since 2006, the survey questions and monitoring protocols have asked have remained constant.

During the development of the survey instrument, a number of questions asked that were focused on the survey instrument itself (as feedback in order to improve it). Most of these are no longer included on the survey. While Questions Q02, Q03, and Q04 could be considered of this

category, they have been retained 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).

Table 2. Summary of Responses

	Yes	No	Yes and No	Don't Know	Blank	Total responses
Q01 Overall health	146	17	10	67	6	246
Q02 Hopi involvement	232	1	1	7	5	246
Q03 Importance of information	240	1	0	3	2	246
Q04 Relation to cultural teachings	218	3	1	3	3	228
Q05 Recent changes positive	133	2	0	56	3	194
Q06 Marshes	134	39	6	24	9	212
Q07 Birds	167	14	2	25	4	212
Q08 Recreation	106	66	37	20	17	246
Q09 Trout removal	85	83	11	11	12	202
Q10 Non-native species	121	70	4	11	6	212
Q11 Archaeological sites	119	60	8	18	7	212
Q14 Öönga, Hopi Salt Mines	86	20	2	10	1	119
Q15 Willow	85	14	3	14	3	119
Q16 Animals	93	6	1	15	4	119
Q17 Native fish	52	21	1	37	8	119
Q18 Snakes	74	5	1	29	10	119
Q19 Insects	96	4	0	15	4	119
Q20 Springs and seeps	82	14	7	12	4	119
Total Cumulative Percentages (inclusive of 2016)	68.99%	13.38%	2.89%	11.46%	3.28%	Total 3289
Results of 2016 only	79.31%	9.91%	3.45%	5.17%	2.16%	

Broadly, Table 2 shows that the condition of the resources overall continues to be viewed as positive (a “Yes” response) and that there is strong support for continuance of the monitoring program. The percentage of respondents in 2016 expressing an overall positive view of resource health was considerably greater than the long-term trend. Not surprisingly, those who consider the overall health of the system to be negative is less than the long-term average. There is also less uncertainty reflected in the smaller number of “Don’t Know” and “Blank” responses this year.

Resource Trends

While a summary of all of the data provides a good broad-brush snapshot of what the data tells us, it is the temporal trends for the individual resources and activities that are important in assessing whether ongoing management of *Öngtupqa* is being implemented successfully. A resource that appears healthy when all data is averaged 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 since 2006 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 current 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 portrays the normalized response rates for each question [$(\text{number of responses in category})/(\text{total responses to question})$]. This was done to make inter-annual comparisons equivalent given that different numbers of people respond to the survey in different years.

It should also be noted that for the graphical representation of the data, the response categories of “**Don’t Know**,” “**Yes and No**” (when both responses were given to a single question), and “**Blank**” (where no response was given to a question) are grouped together into a single “**Other**” category. This was done because all of these types of responses indicate a hesitancy to evaluate the resource as either good or bad, and therefore can be considered as a similar, separate category of response.

Overall Health

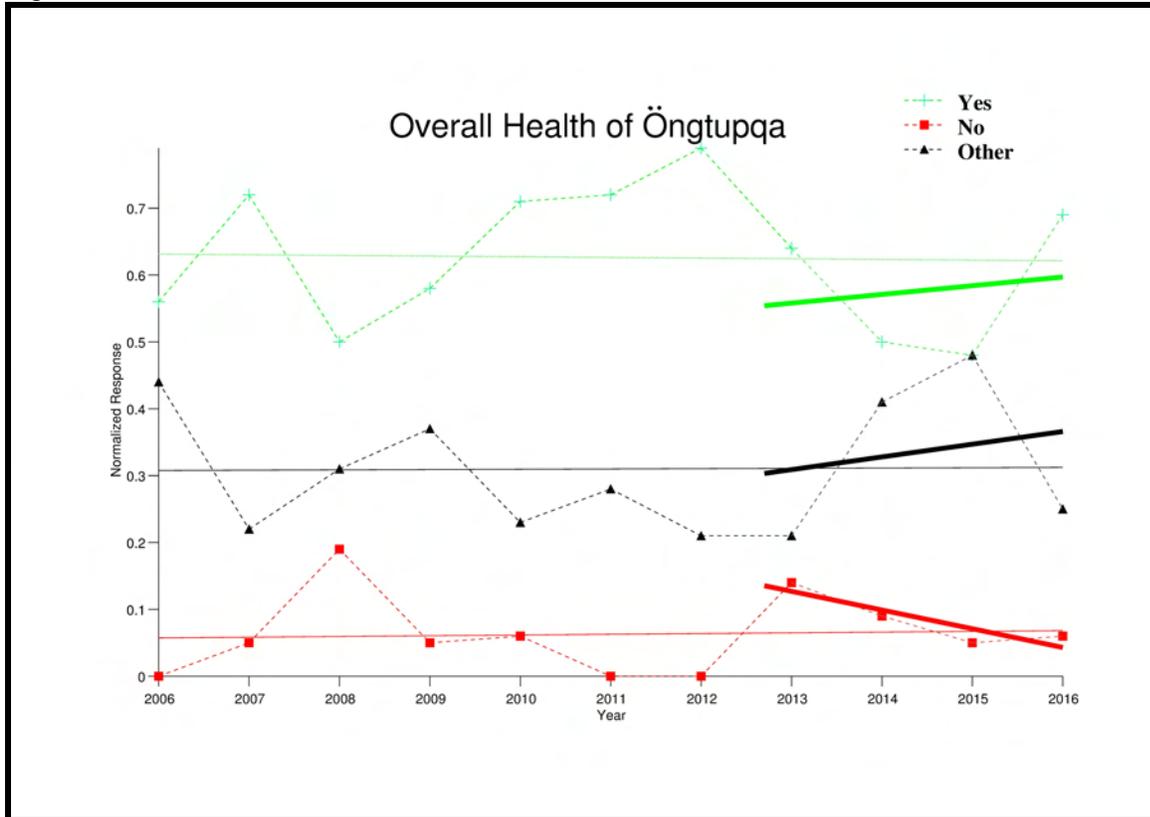
Survey Question:

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

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

	Yes	No	Yes and No	Don't know	Blank
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
2013 surveys	9	2	1	1	1
2014 surveys	11	2	2	7	0
2015 surveys	10	1	1	9	0
2016 surveys	11	1	0	4	0
Total	128	12	8	54	3
Percent	62.44%	5.85%	3.90%	26.34%	1.46%

Figure 1. Trends for Overall Health



The perceived decrease in overall health of *Öngtupqa* observed over the past several years has reversed this year (Table 3, Figure 1). While the percentage of Hopis who feel that the overall health of *Öngtupqa* is not good has remained quite constant, the decreased number of those who are unsure has resulted in the increase in the positive health response. Most of the comments regarding why *Öngtupqa* is viewed as healthy cite increased involvement of the Hopi Tribe in monitoring and management decisions, the concern shown for *Öngtupqa* by the NPS and other management agencies, and recreational users treating the area with respect and not “trashing” the place.

Recent changes

This question serves somewhat as a baseline indicator: if *Öngtupqa* is perceived as not changing, then any “changes” to the health of the individual resources must be reflecting changing cultural values for what is considered healthy rather than being attributable to physical changes occurring to the resources themselves.

Survey Question:

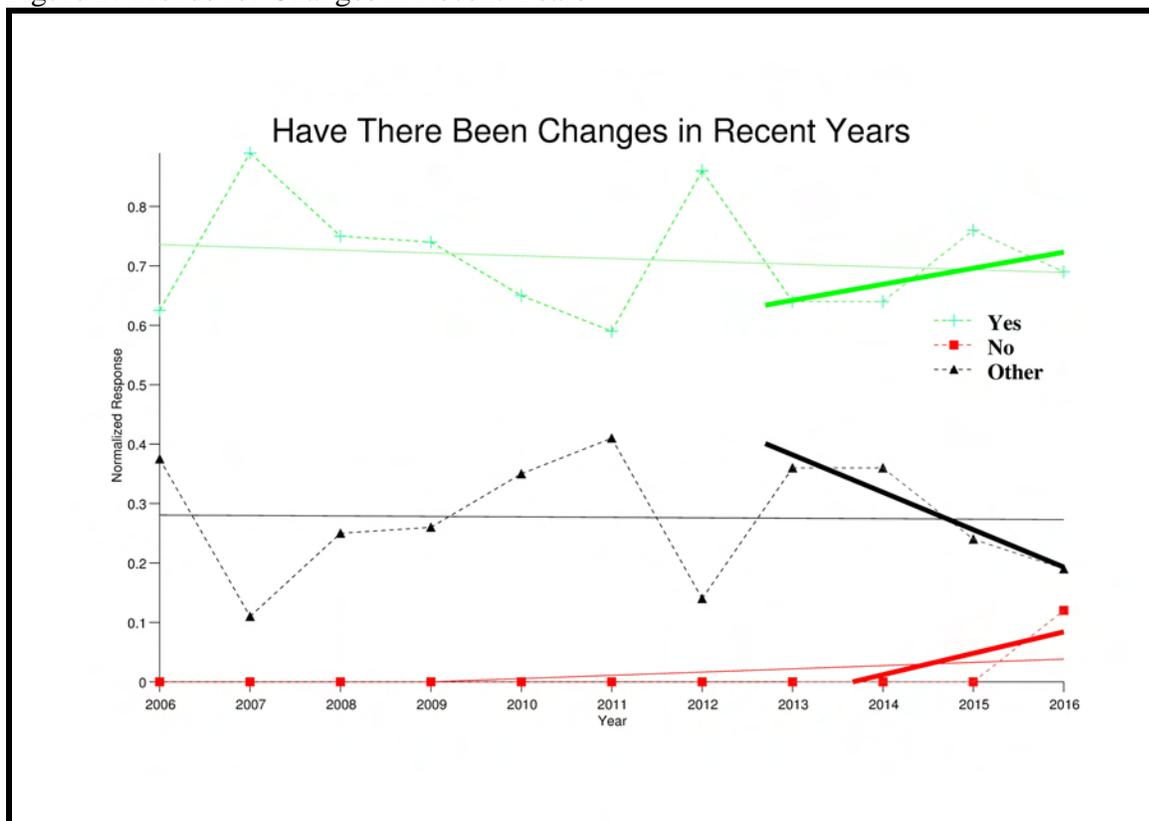
- Do you think there have been changes in *Öngtupqa* in recent years?

Table 4. Have There Been Changes in Recent Years

	Yes	No	Yes and No	Don't Know	Blank
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
2013	9	0	0	4	1
2014	14	0	0	8	0
2015	16	0	0	4	1
2016	11	2	0	3	0
Total	131	2	0	52	3
Percentage	69.68%	1.06%	0.00%	27.66%	1.60%

Figure 2. Trends for Changes in Recent Years



This was the first year that any respondents indicated that they did not think that changes occurred in *Öngtupqa* (Table 4, Figure 2). One respondent gave his reply in the specific context of *Öönga* (the Salt Mine), noting that it is the same because it replenishes itself. The other may have been a mis-reading of the question, because the associated comment indicated that erosion was occurring at archaeological sites, which clearly is change.

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.

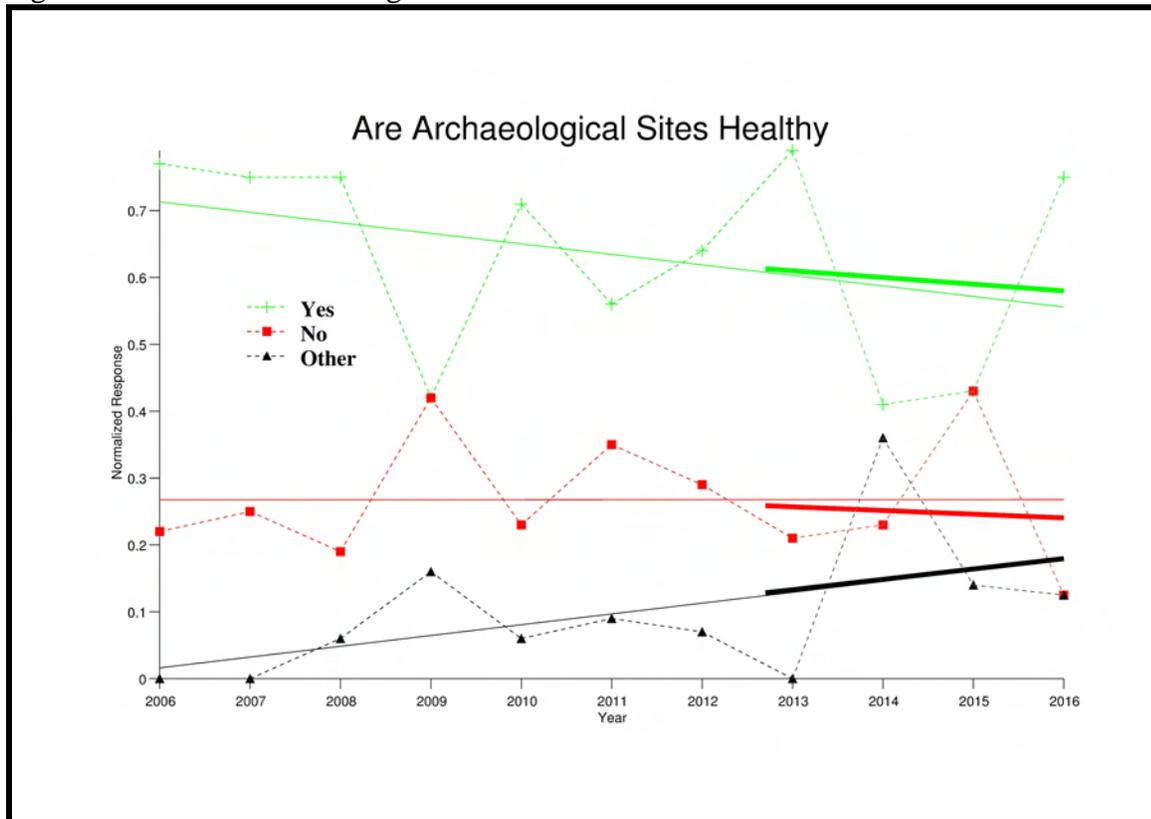
Survey Question:

- Archeological sites in Grand Canyon are healthy?

Table 5. Are Archaeological Sites Healthy

	Yes	No	Yes and No	Don't know	Blank
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
2013	11	3	0	0	0
2014	9	5	3	3	2
2015	9	9	1	2	0
2016	12	2	1	0	1
Total	113	53	8	7	7
Percentage	60.11%	28.19%	4.26%	3.72%	3.72%

Figure 3. Trends in Archaeological Site Health



This year, the percentage of respondents who thought that the archeological sites were healthy was considerably higher than in the last couple of years (Table 5, Figure 3). This was due to a

decrease in the percentage of people who felt the sites were unhealthy rather than changes in the percentage of those who were unsure. Reasons cited for why the sites were viewed as healthy included the on-going monitoring by the Hopi tribe and education of the public about the importance of the sites and the need to keep them from being vandalized. Even while viewing the sites as generally healthy, there was concern expressed about ongoing erosion and impacts from visitation and the desire to keep the sites preserved. The long-term and short-term trends remain essentially parallel.

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 specifically undertaken in the AMP in recent years, assessment is being made primarily on the field observation by the Hopi monitors and an understanding of possible succession scenarios of marsh habitats under current flow regimes.

Survey Question:

- 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?

Table 6. Are Marshes Healthy

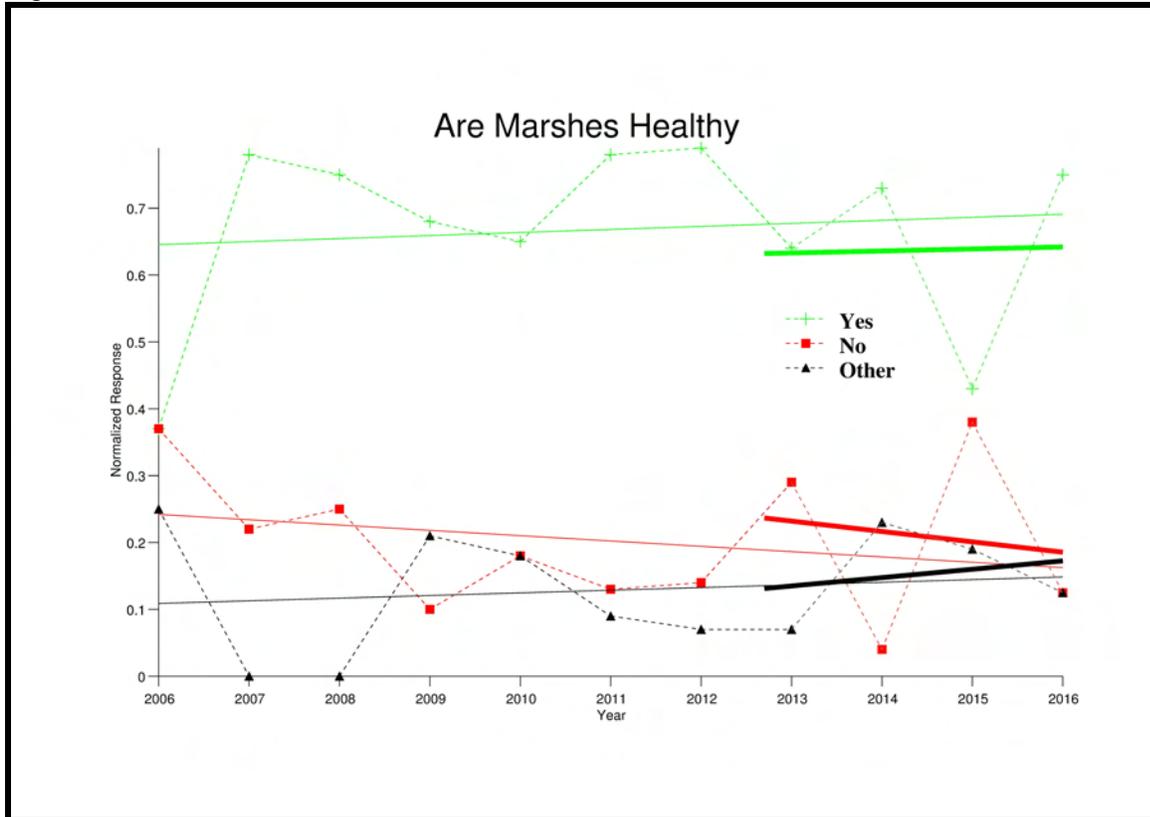
	Yes	No	Yes and No	Don't know	Blank
2006	3	3	1	1	0
2007	7	2	0	0	0
2008	12	4	0	0	0
2009	13	2	0	3	1
2010	11	3	0	2	1
2011	25	4	0	1	2
2012	11	2	0	0	1
2013	9	4	1	0	0
2014	16	1	1	2	2
2015	9	8	2	2	0
2016	12	2	0	1	1
Total	128	35	5	12	8
Percentage	68.09%	18.62%	2.66%	6.38%	4.26%

The steep drop in perceived marsh health seen last year was reversed this year, with the percentages returning to approximately the long-term trend averages (Table 6, Figure 4). The biggest concern expressed about marsh health was with regard to non-native species occupying habitat that could be used by native plants. Also, a couple of people noted that cattail was relatively rare, but what they did see seemed healthy.

Birds

Birds, including some of the migratory species, figure prominently in Hopi culture. Unfortunately, in recent years, monitoring of birds in the AMP has been nonexistent. Therefore, interpretation of bird health is informed solely by those observed during the monitoring trip.

Figure 4. Trends in Marsh Health



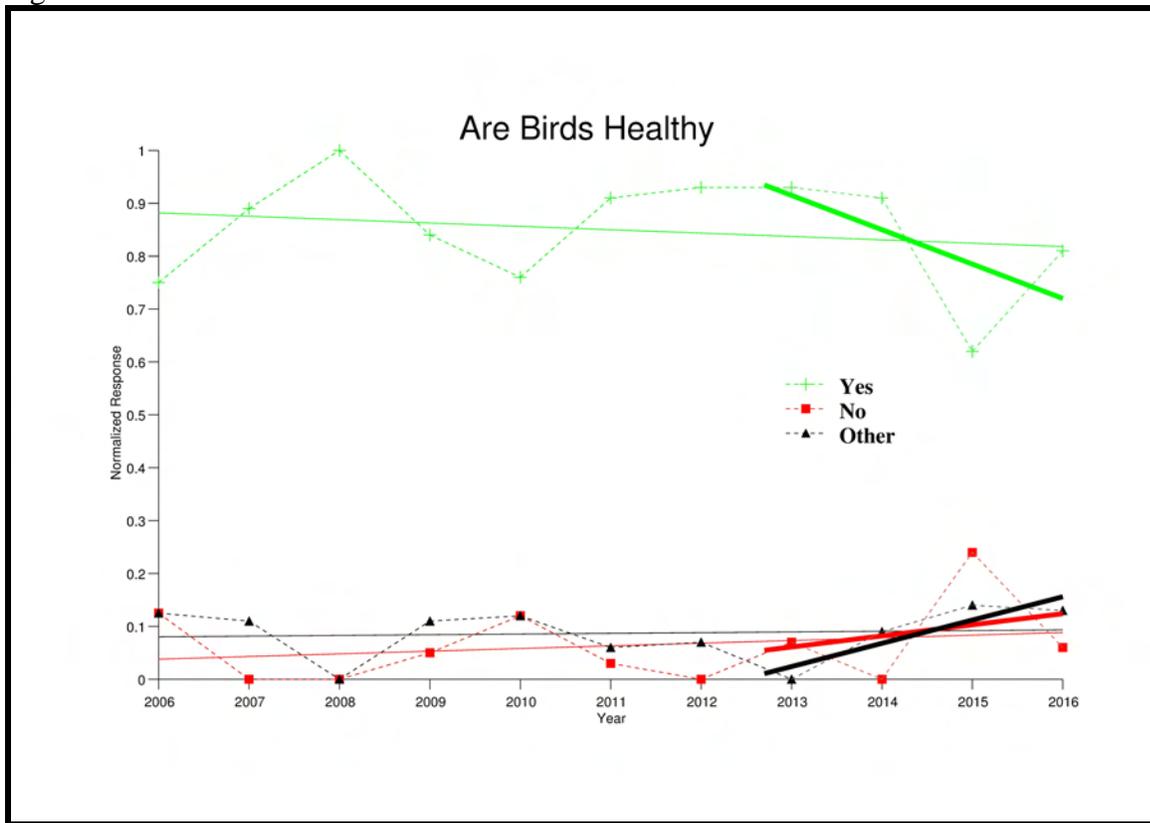
Survey Question:

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

Table 7. Are Birds Healthy

	Yes	No	Yes and No	Don't know	Blank
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
2013	13	1	0	0	0
2014	20	0	0	2	0
2015	13	5	1	2	0
2016	13	1	0	1	1
Total	160	12	1	11	4
Percentage	85.11%	6.38%	0.53%	5.85%	2.13%

Figure 5. Trends in Bird Health



From the perspective of the Hopis, bird health remains very good, though there is still a slight drop in the short-term trend line (Table 7, Figure 5). Most respondents commented on both the number and diversity of birds seen, including many culturally important species. One person noted that he saw more birds this trip than during his previous trip, four years earlier.

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 this location, but ceremonial activities that occur at the Hopi villages and by the Hopis when they are in *Öngtupqa* also 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 (and all subsequent resource questions) are only asked of people who have been to the site.

Survey Question:

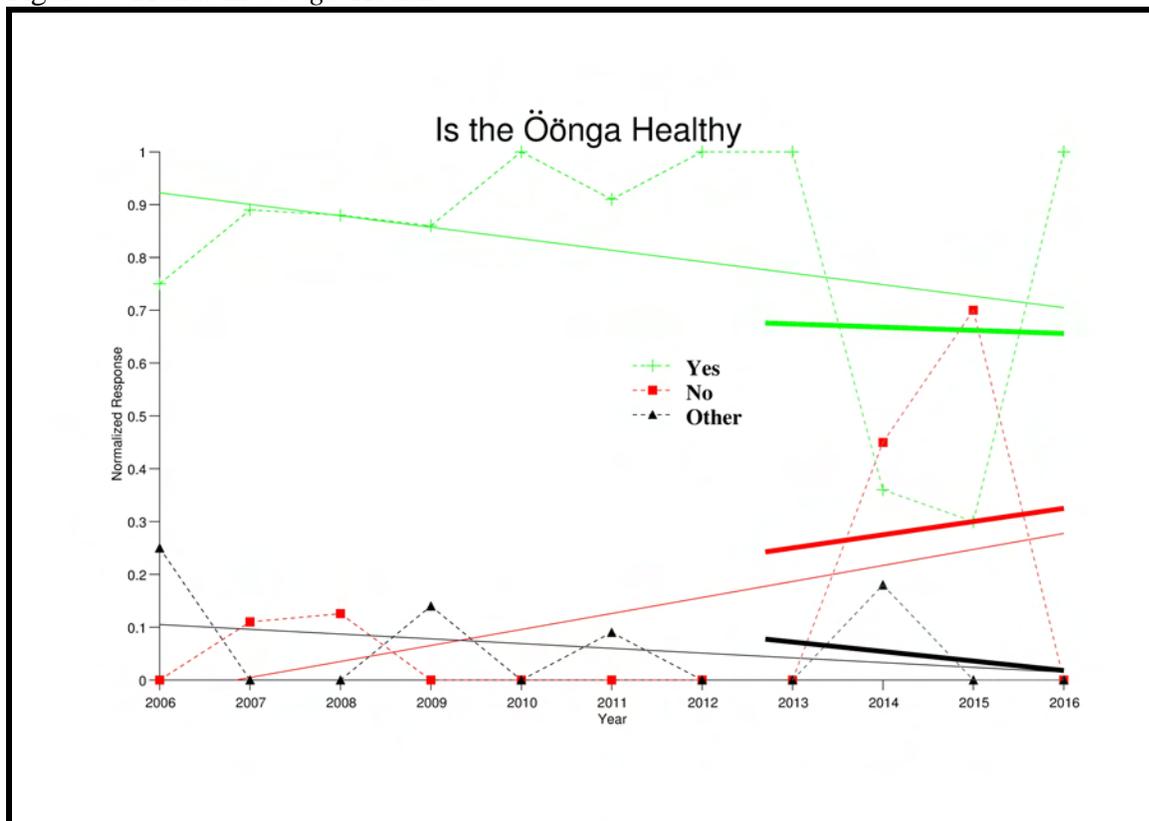
-*Öönga* (Hopi Salt Mines) is healthy?

Table 8. Is *Öönga* Healthy

	Yes	No	Yes and No	Don't Know	Blank
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
2013	7	0	0	0	0
2014	4	5	0	2	0
2015	3	7	0	0	0
2016	8	0	0	0	0
Total	75	14	2	3	1
Percentage	78.95%	14.74%	2.11%	3.16%	1.05%

Figure 6. Trends in *Öönga* Health



This year, *Öönga* is viewed as being dramatically better than it has been for the last two years (Table 8, Figure 6). As with previous years, the principal concern for the management of *Öönga* continues to be over-collection. This concern is tempered by the knowledge that *Öönga* replenishes as long as conditions remain favorable (including maintaining appropriate ceremonial and behavioral responsibilities). Because there were no other tribal trips immediately preceding the Hopi trip this year, *Öönga* likely had time to replenish, leading to the favorable assessment. One person specifically noted that *Öönga* was better than he remembered from four years ago.

Willows

Willows are a culturally important species in their own right and they serve as an indicator species for the post-dam riparian zone. Monitoring of this component of the ecosystem is beginning under a new protocol and results have not yet been reported to 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.

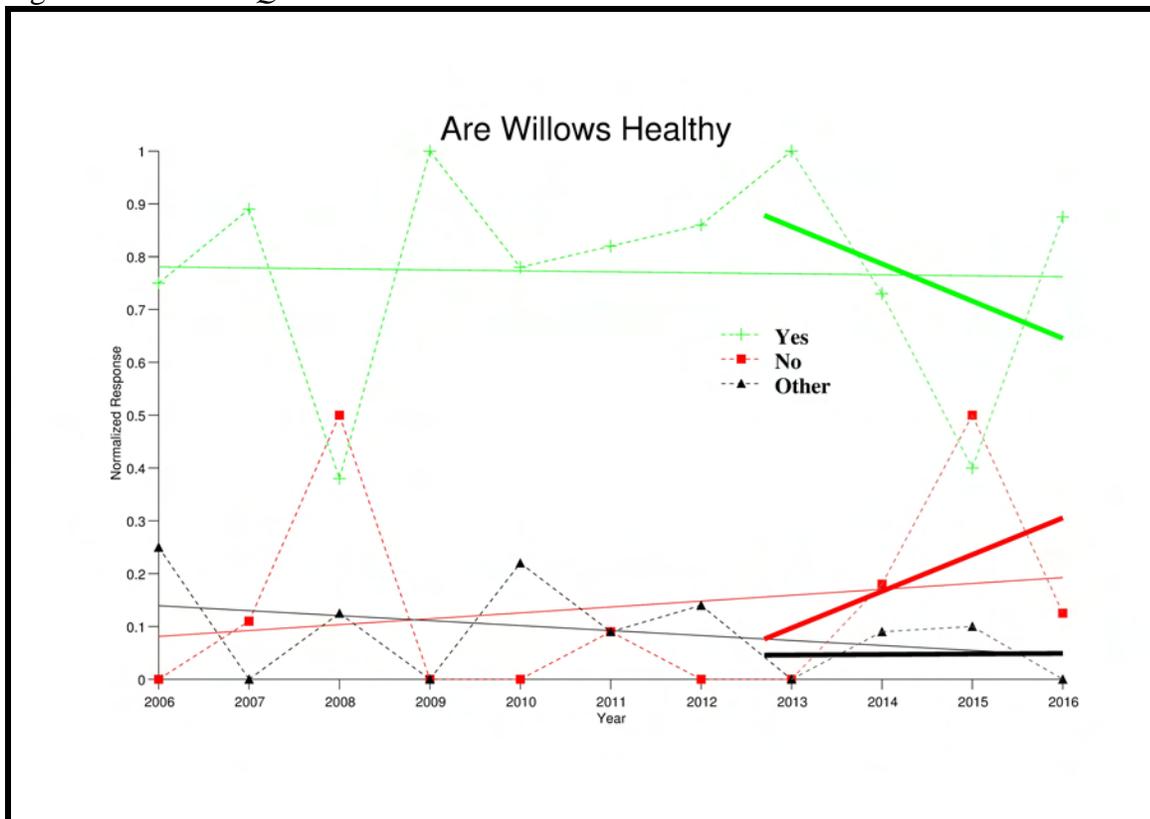
Survey Question:

-*Qahavi* (willow plants) in Grand Canyon exist in a healthy state?

Table 9. Is *Qahavi* Healthy

	Yes	No	Yes and No	Don't know	Blank
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
2011	9	1	0	0	1
2012	6	0	0	0	1
2013	7	0	0	0	0
2014	8	2	0	1	0
2015	4	5	0	1	0
2016	7	1	0	0	0
Total	65	13	1	5	3
Percentage	74.71%	14.94%	1.15%	5.75%	3.45%

Figure 7. Trends in *Qahavi* Health



The health of willows was assessed to be quite good this year, a sharp reversal from the assessment of last year (Table 9, Figure 7). The comments were nearly unanimous that the willows looked like they were healthy and getting plenty of water. Some people wondered whether there was

competition from non-native plants for nutrients and if they were being replenished frequently enough since there are not many flows that deposit new sediment.

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.

Survey Question:

-*Tuutuvost* (animals) in Grand Canyon exist in a healthy state?

Table 10. Is *Tuutuvost* Healthy

	Yes	No	Yes and No	Don't know	Blank
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
2013	6	0	0	0	1
2014	9	1	0	1	0
2015	7	3	0	0	0
2016	7	0	1	0	0
Total	81	5	1	5	3
Percentage	85.26%	5.26%	1.05%	5.26%	3.16%

Based on what was seen during the river trip, there was almost unanimous agreement that the animals were doing well (Table 10, Figure 8). Numerous bighorn sheep were seen, including young, and the Hopis reported that they seemed healthy and had a good supply of food and water. Some Hopi expressed disappointment that they did not see any deer.

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.

Survey Question:

-Native fish called the Humpback chub exist in a healthy state in Grand Canyon?

Figure 8. Trends in *Tuutuvost* Health

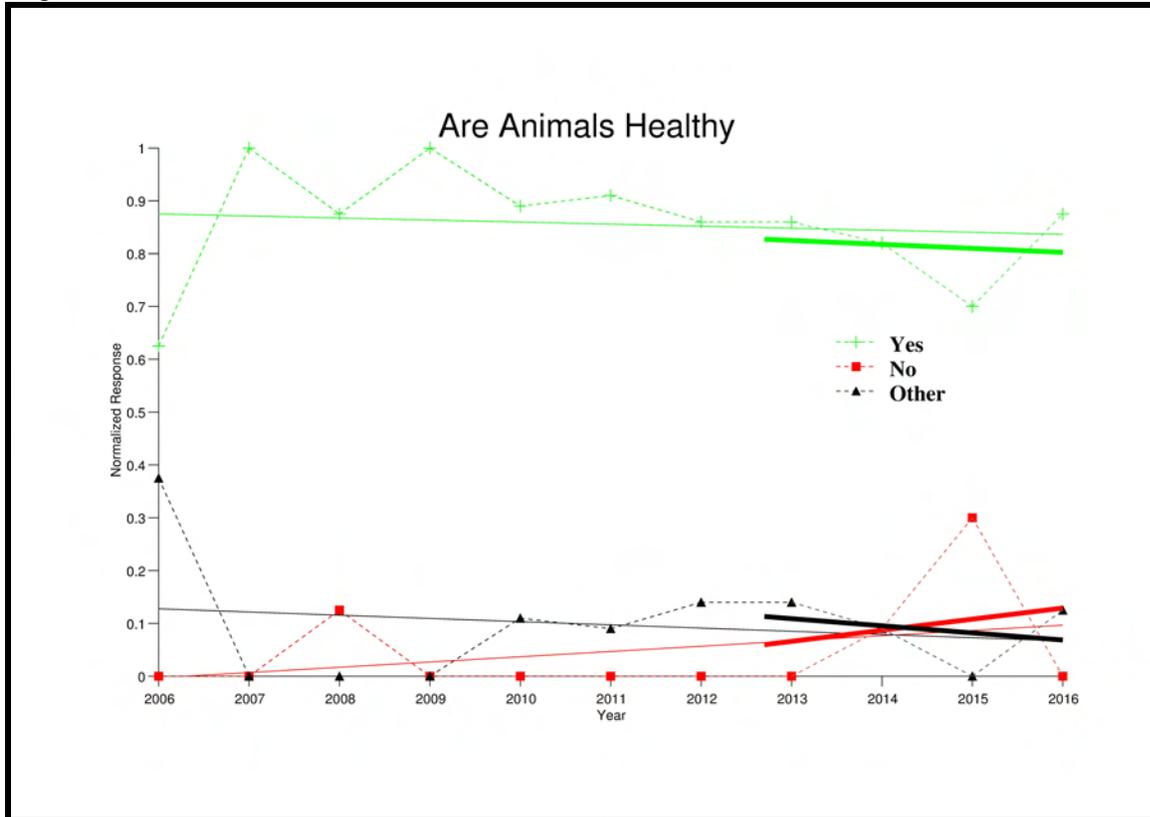
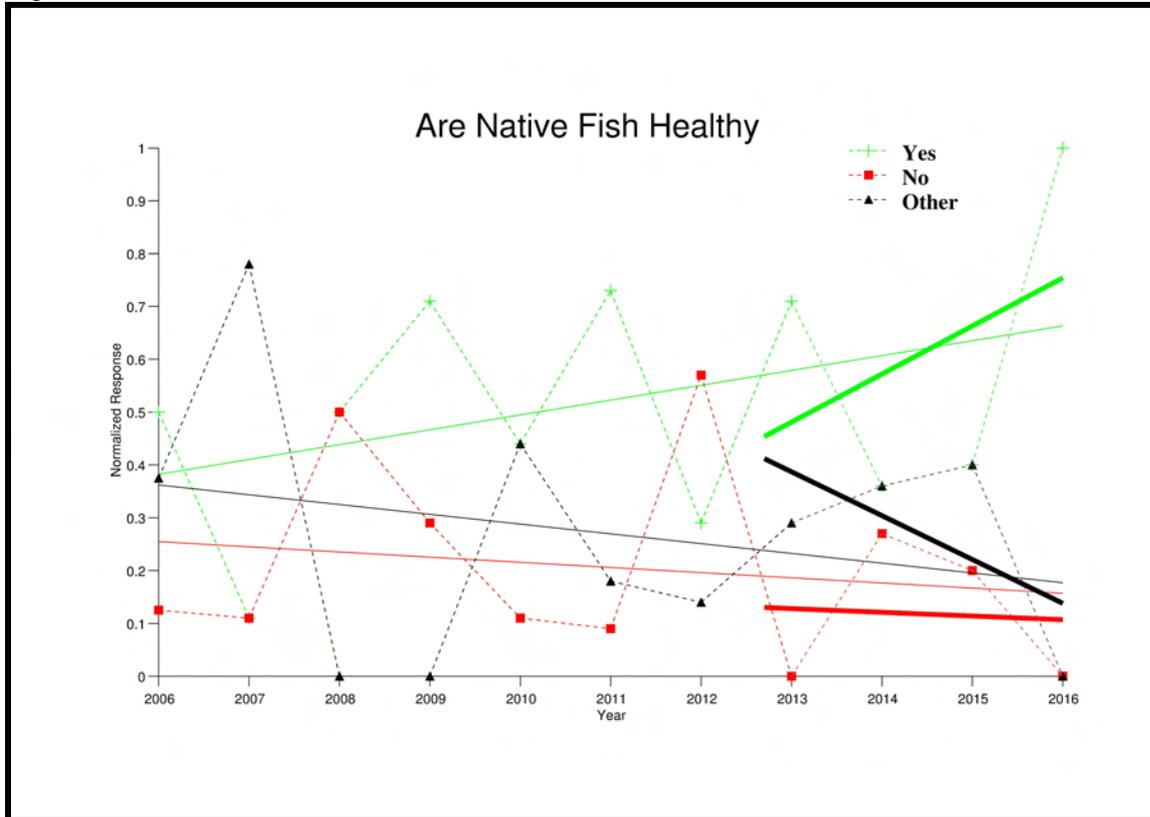


Table 11. Are Native Fish Healthy

	Yes	No	Yes and No	Don't know	Blank
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
2013	5	0	0	1	1
2014	4	3	0	4	0
2015	4	2	1	3	0
2016	8	0	0	0	0
Total	49	19	1	19	7
Percentage	51.58%	20.00%	1.05%	20.00%	7.37%

This is the first year that the Hopi respondents unanimously reported that the native fish were healthy (Table 11, Figure 9). The Hopis were able to talk with a fish monitoring trip in the western Grand Canyon and see what they were doing and recording. While no humpback chub were captured while the Hopis were present, the scientist did discuss their findings from earlier in the trip. The Hopi were glad to hear that the numbers of humpback chub and other native fish seem to be increasing and based their evaluation largely on this information. There continues to be a large amount of variability in year-to-year response for this resource category.

Figure 9. Trends in Native Fish Health



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.

Survey Question:

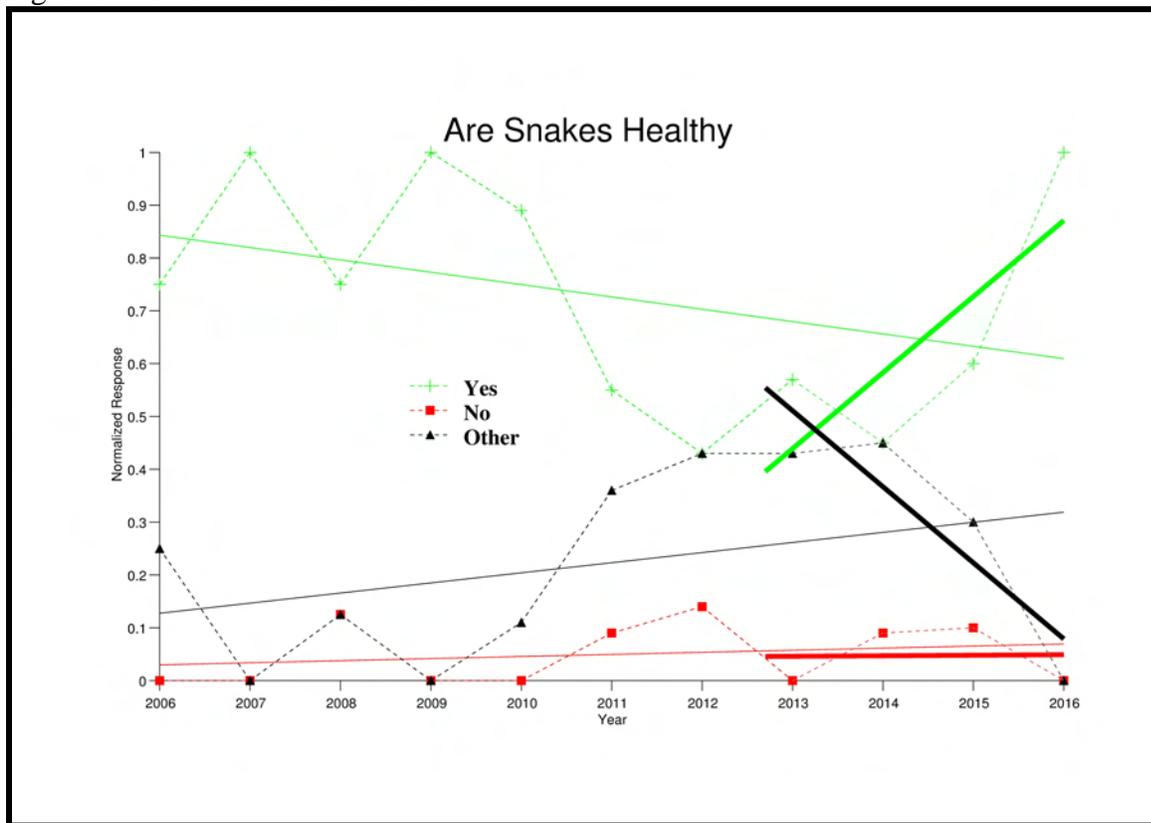
-Snakes in Grand Canyon exist in a healthy state?

Table 12. Are Snakes Healthy

	Yes	No	Yes and No	Don't know	Blank
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
2013	4	0	0	0	3
2014	5	1	0	4	1
2015	6	1	1	2	0

2016	8	0	0	0	0
Total	68	5	1	12	9
Percentage	71.58%	5.26%	1.05%	12.63%	9.47%

Figure 10. Trends in Snake Health



As with the response for native fish, the Hopis unanimously reported that the snakes were in good health (Table 12, Figure 10). Two rattlesnakes were seen, including one that was guarding *Sipapuni*. One Hopi noted that the rattlesnakes were calm and respectful and another noted that they had a good food supply.

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 while there is now a strong “citizen science” project collecting insects, results have not been synthesized regarding any population trends. Therefore, Hopi responses are based principally on field observations during the monitoring trips and older monitoring data.

Survey Question:

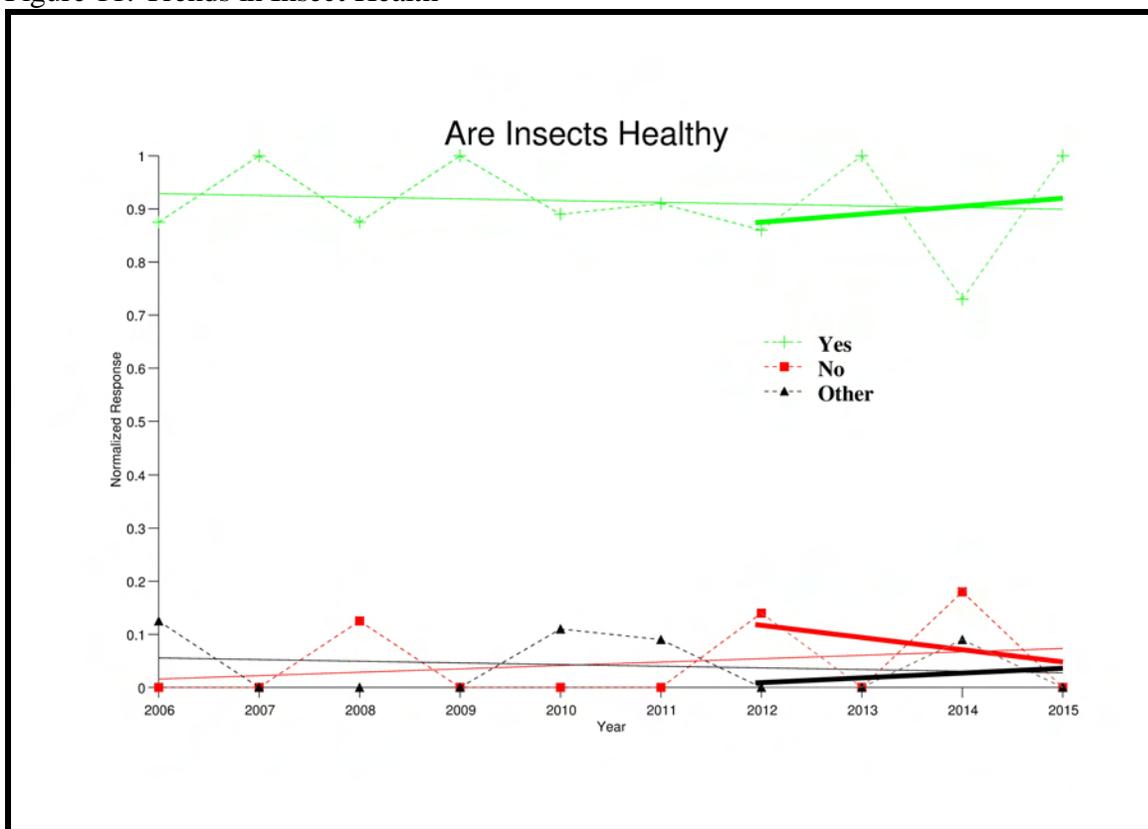
-Insects in Grand Canyon exist in a healthy state?

Table 13. Are Insects Healthy

	Yes	No	Yes and No	Don't know	Blank
--	-----	----	------------	------------	-------

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
2013	7	0	0	0	0
2014	8	2	0	0	1
2015	10	0	0	0	0
2016	8	0	0	0	0
Total	87	4	0	2	2
Percentage	91.58%	4.21%	0.00%	2.11%	2.11%

Figure 11. Trends in Insect Health



Insect health has been consistently viewed as positive since the beginning of the monitoring and this year is no exception with all Hopis reporting that the insects were healthy (Table 13, Figure 11). The comments noted that many insects were seen and many different types were present. One person was very thankful that biting insects seemed to be rare!

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.

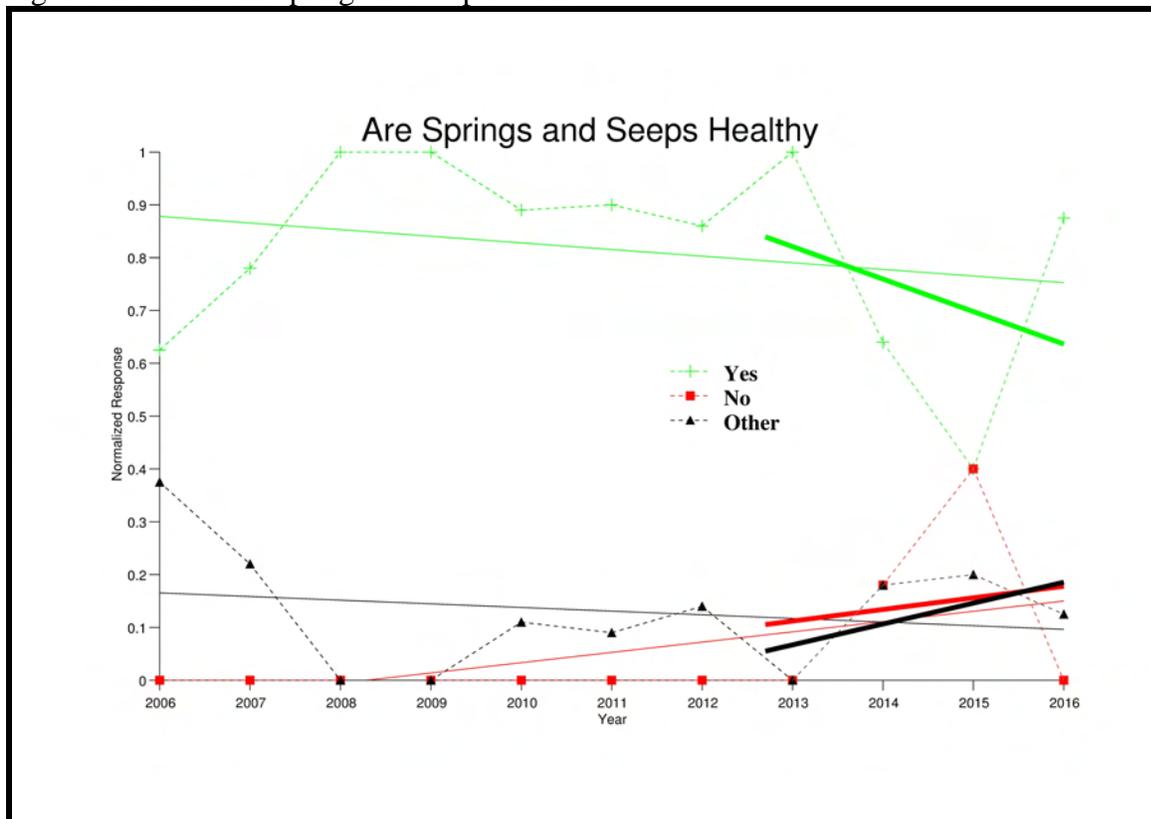
Survey Question:

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

Table 14. Are Springs and Seeps Healthy

	Yes	No	Yes and No	Don't know	Blank
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
2013	7	0	0	0	0
2014	7	2	0	1	1
2015	4	4	1	1	0
2016	7	0	1	0	0
Total	76	6	5	5	3
Percentage	80.00%	6.32%	5.26%	5.26%	3.16%

Figure 12. Trends in Spring and Seep Health



The decline in perceived spring health over the last three years was reversed this year (Table 14, Figure 12). This year, none of the respondents reported bad spring health. Many of the comments reflected that even though little water was flowing at a number of springs (such as Vaseys Paradise), this was a natural phenomenon due to limited rain/snow and was not interpreted as indicating bad spring health. One person did note that too much usage of ground water in the region could adversely affect spring health.

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:

Survey Question 02:

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

Survey Question 03:

-Is this information about *Öngtupqa* important to you?

Survey Question 04:

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

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, spiritual, and political ramifications associated with *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. Said another way, 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 three questions have been asked, 720 responses have been received, all of which have been overwhelmingly positive (see Table 2). To the first question, regarding whether Hopi should be involved in the management of *Öngtupqa*, 246 responses have been received and there has only been 1 negative response and 13 unsure about whether Hopi should be involved; all responses in 2016 said that Hopi should be involved in the management of *Öngtupqa*.

As to the second question (again out of 246 total responses), 240 responses have identified that the information about *Öngtupqa* is important to them; only one response said that it wasn't and 5 were uncertain. In 2016, all respondents said the information was important to them.

The responses to the third question are similar: out of 228 total responses, 218 have said that the information is relevant to their cultural teachings, 3 have said that is not relevant, and 6 were uncertain. In 2016, all but one response confirmed that the information was relevant to their cultural

teachings. The single person who was unsure if the information was relevant only answered this way prior to the river trip. He noted in his comments that he needed to ask questions [to determine relevancy], but that likely the information was going to be relevant.

Overall, there continues to be overwhelming support for the Hopi tribe to continue its participation in the AMP and that the work being conducted is culturally relevant and important to the Hopi people.

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 trampling, vegetation damage, introduction of exotic species, damage to archaeological resources, littering, etc. Second, the Hopi feel that 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. Without doing this, people are placing themselves in a risky situation, and this is troubling to the Hopi.

Survey Question:

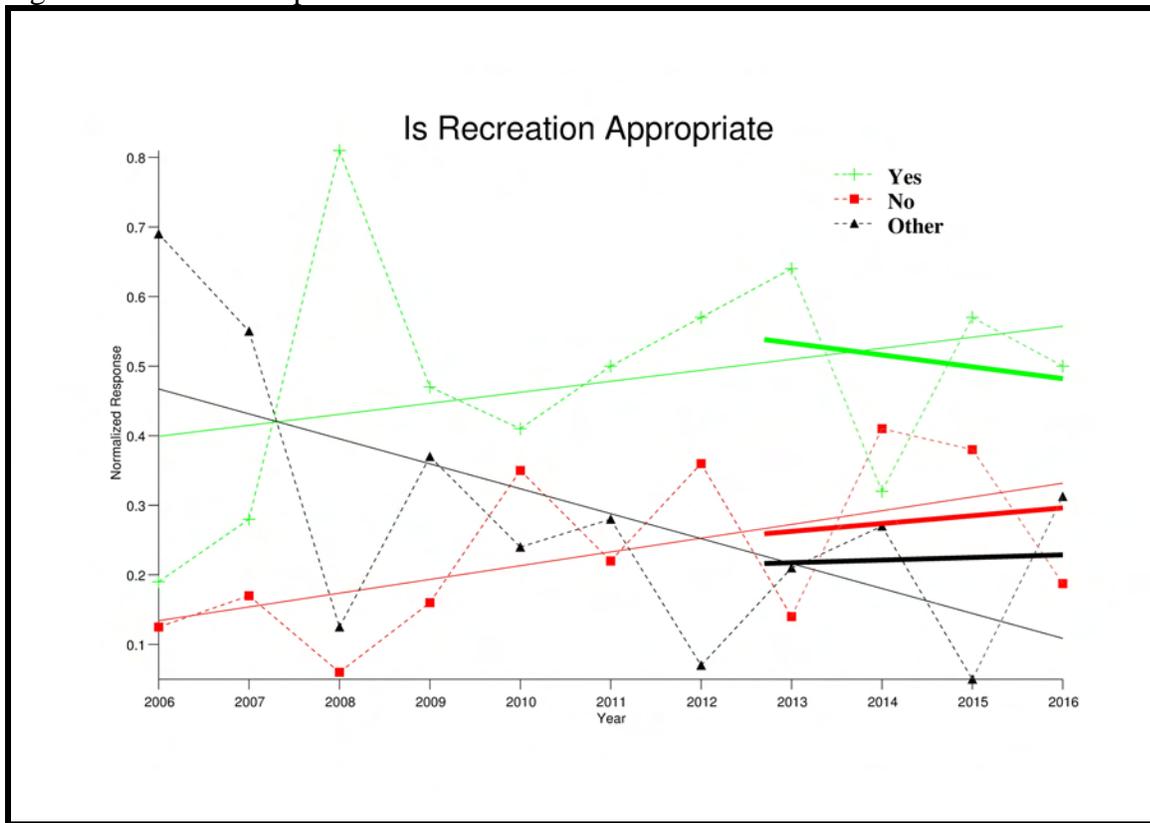
-The National Park Service allows recreational visitation in *Öngtupqa* (Grand Canyon) on river trips. From your perspective, is this right or wrong?

Table 15. Should Recreation be Allowed in *Öngtupqa*

	Yes	No	Yes and No	Don't know	Blank
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
2013	9	2	1	0	2
2014	7	9	4	0	2
2015	12	8	0	1	0
2016	8	3	4	0	1
Total	97	49	31	13	15
Percentage	47.32%	23.90%	15.12%	6.34%	7.32%

There continues to be slightly more support for recreational use of *Öngtupqa* than opposition, but it is clear that this is still a troublesome topic. This year, fewer respondents indicated that recreation was bad, but more were uncertain (Table 15, Figure 13). Many of the “uncertain” responses were weighing the tradeoff between negative impacts on the sacred aspects of the place and impacts to cultural resources with the beneficial educational and healing aspects of a river trip. A common thread was once again the need to show proper respect for *Öngtupqa*, including keeping the place clean, not impacting archaeological sites or visiting sacred places such as *Öönga*. One person said alcohol should not be allowed and a number of respondents said there should be fewer people overall on river trips. One suggestions was to have native guides on all river trips to help educate the passengers.

Figure 13. Trends in Opinion About Recreation



Treatment of Eroding Archaeological Sites

Archaeological sites are one of the types of “footprints” left by the Hopi ancestors, so site preservation has been an important objective of the Hopi Tribe since it became involved in the management activities surrounding the operations of Glen Canyon Dam. The overwhelming consensus is that archaeological 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. When the survey questions were being developed, it was noted that a distinction was sometimes made between human caused impacts to archaeological sites and those that are due to “natural” processes. Therefore, two separate questions are posed on the questionnaire:

Survey Question 1:

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

Survey 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**

It should be noted that respondents often selected more than one of the three specified responses to each question, creating various combinations of treatments, and in two cases, added their own response category (**Monitor** and **Educate the Public**). Table 16 shows the various combinations of responses that have been received for all of the monitoring that has occurred. The colors in the table group categories of responses that represent the same philosophical approach to site management.

Table 16. Total Responses for Treatment of Archaeological Sites

	Excavate	Let erode	Rebury	Excavate & let erode	Excavate & rebury	Rebury & let Erode (added 2014)	Excavate, rebury & let erode	Preserve	Blank	Don't know	Monitor (added 2013)	Educate Public (added 2014)
Q12 Eroding arch sites	43	65	47	7	7	5	7	2	4	6	1	0
Q13 Human caused erosion	43	40	73	0	12	1	6	2	10	6	0	1

Table 17 takes the data from Table 16 and consolidates it back into the three categories queried in the original questions: **Excavate**, **Let erode**, or **Rebury**. For grouping purposes, the assumption is made that a recommendation combining **Excavation** with some subsequent action is still fundamentally a recommendation for excavation (blue columns in Table 16). Similarly, **Preserve** was combined with any form of **Rebury** that did not include excavation (green columns in Table 16). A fourth, **Other** column was added to reflect those responses that don't identify any form of treatment; it includes the responses of **Blank**, **Don't know**, **Monitor**, and **Educate the Public**. Regrouping the data was done in order to more easily examine whether there are significant differences in responses between the treatment of sites eroding due to human causes versus those viewed as "natural" erosion.

Table 17. Treatment of Archaeological Sites

	Excavate	Let erode	Rebury	Other
Q12 Eroding arch sites	64 (32.99%)	65 (33.50%)	54 (27.84%)	11 (5.67%)
Q13 Human caused erosion	61 (31.44%)	40 (20.62%)	76 (39.18%)	17 (8.76%)

Looking at Table 17, it is clear that there is a base level of support for excavation, whether the impact is viewed as natural or human caused. The difference in recommended approaches is seen primarily when looking at the response rates for letting the site **Erode** versus **Reburying** the site.

When the erosion is not specifically identified as being caused by human actions, there is a greater preference for letting the site **Erode** rather than **Reburying** it. When the erosion was caused by human activities, preferences shift with the majority seeking to stem the impacts through **Reburial**, rather than just letting the site **Erode**. The preference for reburial seemed to be predicated on the view that if people were causing the impact, then they were responsible and capable of ending the erosion.

Viewed in a couple of other ways, whether erosion is attributed to human agency or not, only about one-third of the Hopi respondents recommend that excavation be employed to recover information that would otherwise be lost. However, when the responses of **Excavate** and **Rebury** are viewed together as a call for management intervention (as opposed to **Let Erode**, which is a hands-off approach), then about 61% of the responses call for some form of intervention in the case of a generic eroding site and nearly 71% feel some form of intervention is appropriate when the erosion is attributed to human causes. This continues the response trend seen in previous years. A χ^2 analysis conducted on the distribution of responses between these two questions, indicates that there

is a statistically significant difference in the response patterns ($\chi^2=11.033$, $\rho=0.0115$). This provides some confidence that the cause of the erosion is being considered when Hopis are making management recommendations, and that the recommendations are different for different erosional scenarios.

Mechanical Removal

Mechanical removal of trout was tested as an approach for reducing rainbow trout populations beginning in 2002 and then later proposed as a management action. Because killing a large number of rainbow trout was of concern to the Hopi Tribe, a question concerning whether this is an appropriate management action within the context of benefiting the humpback chub was incorporated into the questionnaire. Mechanical removal is now an aspect of the Non-Native Fish Control EA, a part of the Park Services’ Comprehensive Fisheries Management Plan, and will likely be adopted in the Long Term Experimental and Management Plan EIS, and mandated in the Biological Opinion, this question is still very relevant, particularly in light of the adverse affect its implementation has on *Öngtupqa* as a Hopi Traditional Cultural Property. Viewed more broadly, the question also provides insight regarding killing large numbers of any species in order to benefit another.

Survey Question:

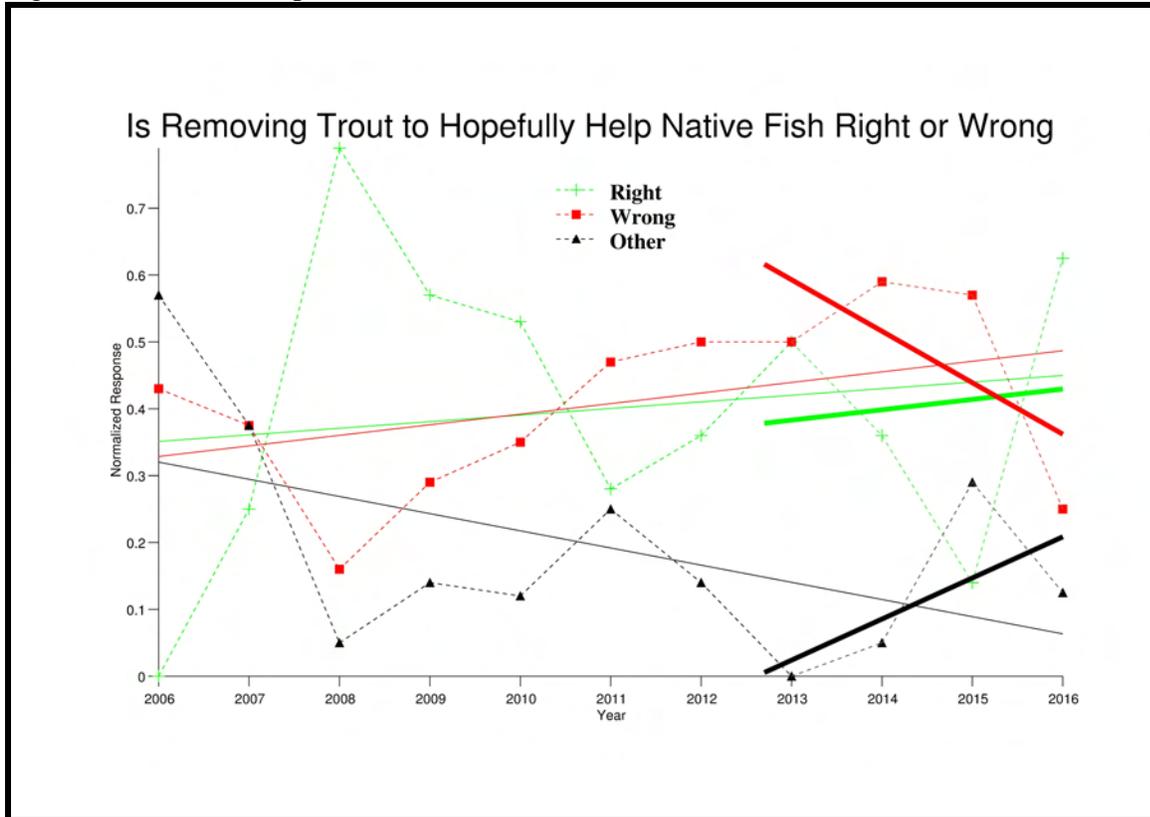
-Non-native trout and other fish are being killed to hopefully help native fish. From your perspective, is this **Right** or **Wrong**

Table 18. Mechanical Removal of Non-native Fish

	Right	Wrong	Right and Wrong	Don't know	Blank
2006	1	4	2	0	1
2007	3	4	0	0	2
2008	13	2	0	1	0
2009	11	5	0	2	1
2010	9	6	1	1	0
2011	9	15	1	3	4
2012	5	7	1	0	1
2013	7	7	0	0	0
2014	8	13	0	0	1
2015	3	12	4	2	0
2016	10	4	1	0	1
Total	79	79	10	9	11
Percentage	42.02%	42.02%	5.32%	4.79%	5.85%

The perspectives recorded this year reversed a trend begun in 2008 that suggested that killing trout was the wrong management approach to take (Table 18, Figure 14). This year, nearly 2/3 of the responses indicated that killing the trout to benefit native fish was supported. A number of the statements supporting killing of non-native fish had caveats that it needed to actually benefit the native species and that it shouldn’t be done if the natives and non-natives could coexist. There was concern that the native species did not go extinct and a suggestion that the trout be moved elsewhere. Others said that all of the species deserved to live. The long-term trend line and overall average responses indicate an almost even split between those supporting and those opposed to killing rainbow trout.

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



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.

Survey Question:

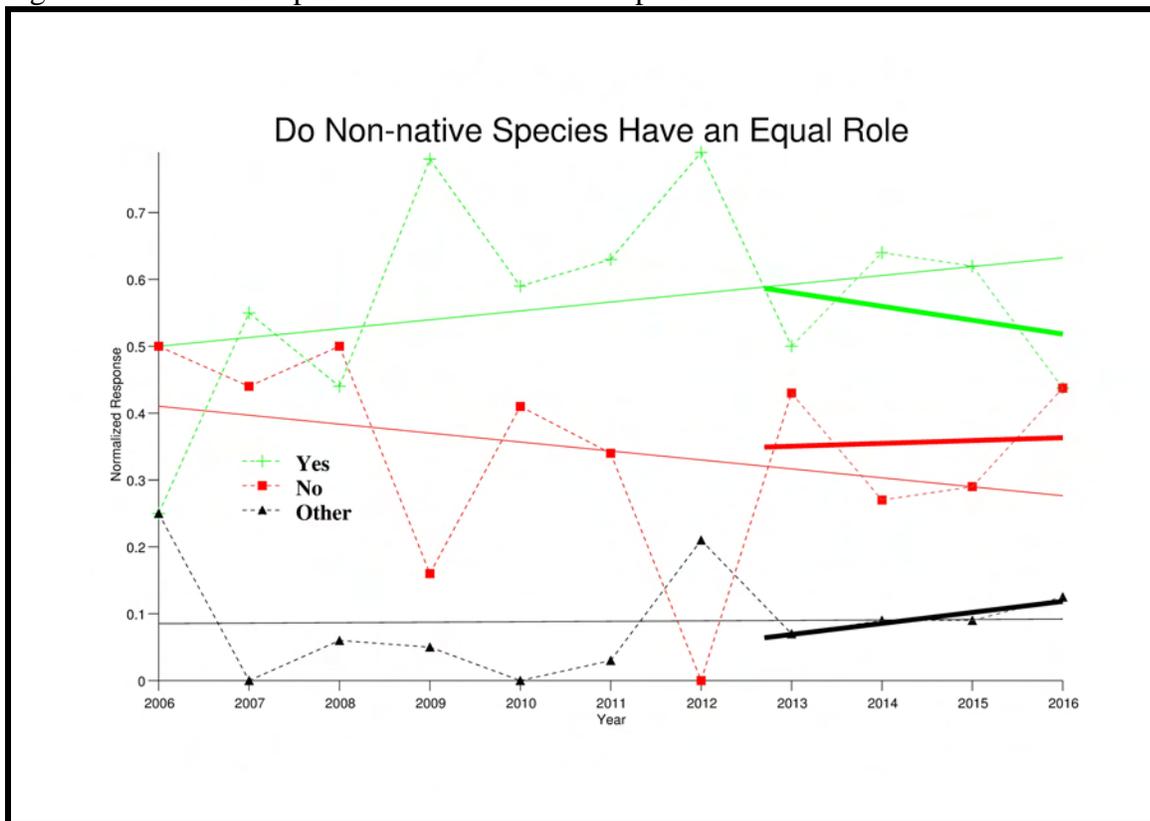
-Non-native species (such as tamarisk) and native species (such as cottonwood) have an equal role in the balance of the natural world?

Table 19. Do Non-native Species Have A Role

	Yes	No	Yes and No	Don't know	Blank
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
2013	7	6	0	1	0
2014	14	6	1	0	1
2015	13	6	0	1	1

2016	7	7	0	2	0
Total	111	62	3	7	5
Percentage	59.04%	32.98%	1.60%	3.72%	2.66%

Figure 15. Trends in Opinion About Non-native Species



While both the long-term and short-term trends still indicate that slightly more respondents view non-native and native species having an equal role, this year there was an even split of opinions (Table 19, Figure 15). This result pairs well with that for the previous question regarding killing non-native fish. Numerous people responded that coexistence is the best outcome. The non-natives have come to serve a role in the ecosystem, but should not be allowed to replace the native species.

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 cultural 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 permitted 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. In addition, only questions 1 through 11 are included in this analysis as they are the only ones which area asked both before and after a trip. 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	77	10	48	69	7	35
Q02 Hopi Involvement	131	0	4	101	1	9
Q03 Importance of Information	132	1	1	108	0	4
Q04 Relates to Cultural Teachings	120	2	3	98	1	4
Q05 Recent changes	57	0	34	76	2	25
Q06 Marshes	63	16	23	71	23	16
Q07 Birds	79	6	16	88	8	15
Q08 Recreation	53	43	41	57	27	28
Q09 Trout removal	44	35	14	42	49	19
Q10 Non-native species	63	31	8	58	39	13
Q11 Archaeological sites	53	31	18	67	30	14

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. 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 “**Yes**” and “**Other**” response categories show the greater response variability, but they still are internally consistent and would not be interpreted as a different response pattern.

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

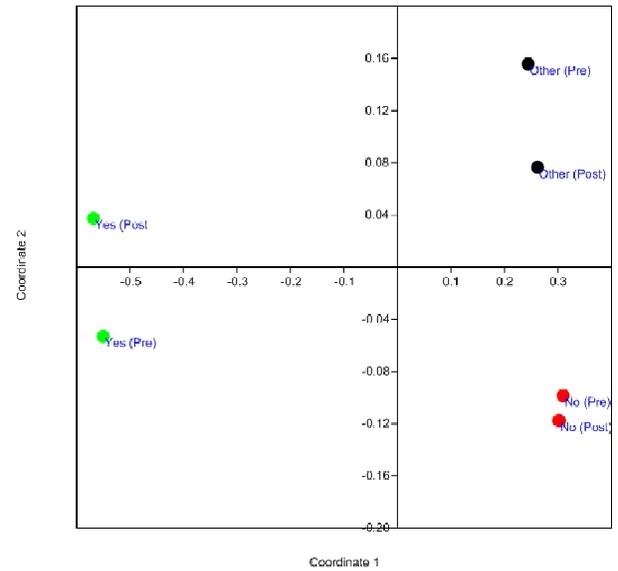


Figure 15. Pre-trip versus Post-trip MDS plot.

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	91	13	56	55	4	27
Q02 Hopi Involvement	155	0	5	77	1	8
Q03 Importance of Information	158	1	1	82	0	4
Q04 Relates to Cultural Teachings	146	1	2	72	2	5
Q05 Recent changes	81	1	41	52	1	18
Q06 Marshes	83	29	22	51	10	17
Q07 Birds	103	11	20	64	3	11
Q08 Recreation	70	44	46	36	22	28
Q09 Trout removal	59	51	17	26	32	17
Q10 Non-natives	83	39	12	38	31	9
Q11 Archaeological Sites	70	42	22	49	18	11
Q14 Öönga	48	11	7	38	9	6
Q15 Willow	46	8	12	39	6	8
Q16 Animals	54	4	8	39	2	12
Q17 Native fish	27	14	25	25	7	21
Q18 Snakes	40	3	23	34	2	17
Q19 Insects	49	4	13	47	0	6
Q20 Springs	46	9	11	36	5	12

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 shows a comparable 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.

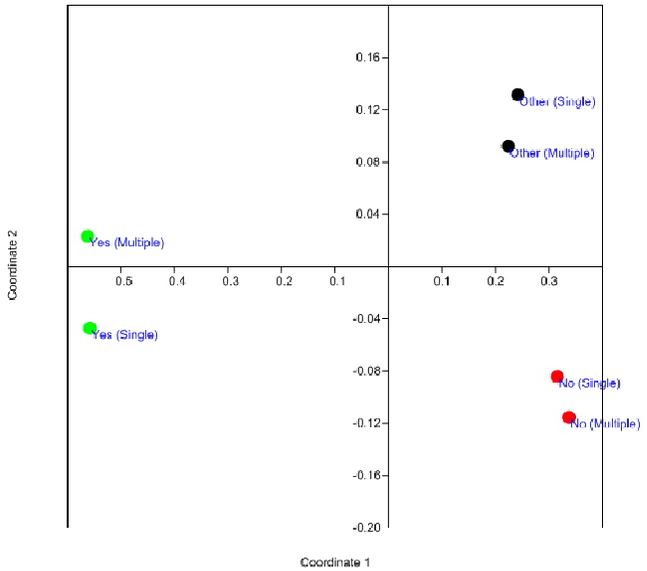


Figure 17. Single/Multiple Trip MDS Plot

DISCUSSION AND RECOMMENDATIONS

An ongoing issue, repeatedly identified in previous Hopi monitoring reports is the limited amount of new information coming out of the AMP related to the state of terrestrial resources, including both biological species and archaeological sites. 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 GCMRC 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 the description of vegetation structure and composition changes have not been summarized in many years. 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. As also has been stated previously, the Hopi Tribe continues to recommend 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. Hopefully, this broader ecosystem view will be better incorporated into the LTEMP monitoring and the next budget and work plan cycle.

The Hopi consultants continue to be unanimous in their desire to see the Hopi Tribe continue and expand its role in the monitoring of culturally important resources and to work collaboratively with the federal agencies in management responsibility for *Öngtupqa*. The Hopi were given stewardship responsibility by *Masaw* and a larger role in the management of *Öngtupqa* is seen as a way of furthering this responsibility. *Öngtupqa* is first and foremost a Hopi cultural property and the Hopi would like to assume the primary management authority or ownership of such places as *Öönga* and *Sipapuni*. Overall, cultural sites and resources should be maintained and preserved. More broadly, there is recognition and strong support for the overall monitoring being undertaken by GCMRC and NPS as it shows a commitment for *Öngtupqa* and the resources.

The gains made by the native fish viewed as a positive accomplishment of the AMP and it is hoped that the gains can continue into the future. Also, the increased amount of riparian vegetation is seen in a positive light.

There continues to be concern about the amount of recreational and tourism activity that occurs in *Öngtupqa* and the potential for impacts to cultural sites. This also includes the intrusive nature of overflights. A number of people commented on maintaining or restricting access to important cultural sites to only culturally affiliated tribal members. Further, educating the public about the importance of *Öngtupqa* as a cultural property of the Hopi people is seen as a way to help protect it and ensure that visitors behave in an appropriate manner. It was again suggested that more Hopi be trained as river guides to better help interpret the importance of the place.

There is still extremely strong opposition to the proposed Navajo Escalade (Confluence “tramway project”) development. The position expressed by participants was that it should not be constructed. *Öngtupqa* is a sacred space and developments aimed at making money are sacrilegious.

Finally, concern about over collection at *Öönga* and the hematite mine was expressed by a number of people. It is recommended that amounts be limited to what would be collected traditionally and that it only be collected by those with the traditional responsibility to do so.

REFERENCED CITED

Hammer, Ø., Harper, D.A.T., and P. D. Ryan

2001 PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontologia Electronica* 4(1): 9pp. http://palaeo-electronica.org/2001_1/past/issue1_01.htm

Huisinga, Kristin and Michael Yeatts

2003 *Soosoy Himu Naanamiwiwyungwa: An Analysis of the Grand Canyon Monitoring and Research Center's Terrestrial Monitoring Program and the Development of a Hopi Long-term Plan*. Prepared for Grand Canyon Monitoring and Research Center under Cooperative Agreement No. WRSA0358. Report on file at Grand Canyon Monitoring and Research Center, USGS, Flagstaff, Arizona.

Romney, A. Kimball, Susan C. Weller, and William H. Batchelder

1986 Culture as Consensus: A Theory of Culture and Information Accuracy. *American Anthropologist* 88: 313-338.

Yeatts, Michael and Kristin Huisinga

2007 *A Hopi Long-Term Monitoring Program for Öngtupqa (the Grand Canyon)*. Prepared for Bureau of Reclamation under Contract No. 06-SQ-40-0180. Report on file at Upper Colorado Region, Bureau of Reclamation office, Salt Lake City, UT.

2009 *Report of the Hopi Long-Term Monitoring Program for Öngtupqa (the Grand Canyon)*. Prepared for Bureau of Reclamation under Contract No. 06-SQ-40-0180. Report on file at Upper Colorado Region, Bureau of Reclamation office, Salt Lake City, UT.

APPENDICES

General and post-trip survey instruments from 2015

Hopi Long-Term Monitoring Program (May 24-June 2, 2016 Trip)

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 Chub and the numbers are stable or increasing. Other native fish are also increasing in numbers. They are now the most common fish in the lower part of *Öngtupqa*. The non-native rainbow trout, which mostly spawn above Lees Ferry, are dropping in number over the last year. Some trout move into the Little Colorado River area and may affect the Chub population; the extent of this affect is still uncertain. In the past, large quantities of trout have been killed, to hopefully help the Chub.

Yamtaqa, Vasey's Paradise: *Yamtaqa* is a spring that is a traditional cultural property (TCP) for Hopi. Flows from this spring vary from year to year but it 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 the shores along it 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 flows can put new sand on some areas along the river ("beaches"), but whether it is enough sand to offset the erosion is being studied. There is 10-year commitment to conduct high flow experiments when sand comes in the Paria river. The beaches along the river are used by river runners for camping, serve as plant and animal habitat, and may help protect archaeological sites.

Archaeological sites: Archaeological sites along the river probably continue to erode as there is limited 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. There has been no monitoring of the archaeological sites by the Adaptive Management Program since 2006 and no excavations at eroding sites since 2008.

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).

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. **Eagles:** *Nuva'kwaahu* (bald eagle) and *kwaahu* (golden eagle) are both occasionally seen along the river. Birds are not regularly monitored.

Plants: Without the pre-dam spring floods through *Öngtupa*, native and non-native plants have greatly increased along the shoreline. The most obvious plant, tamarisk, is a non-native. A non-native beetle may now be killing them. Plants are now growing in areas that used to be open sand (which reduces camping areas).

Wipho'qölö, Cattail marsh and Paaqap' qölö, Reed marsh: Marshes have decreased in number and size with current operations of Glen Canyon Dam. *Paaqavi* is increasing and *Wipho* is decreasing in abundance. 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?

***** General Survey *****
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 24-June 2, 2016 Trip)

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 Chub and the numbers are stable or increasing. Other native fish are also increasing in numbers. They are now the most common fish in the lower part of *Öngtupqa*. The non-native rainbow trout, which mostly spawn above Lees Ferry, are dropping in number over the last year. Some trout move into the Little Colorado River area and may affect the Chub population; the extent of this affect is still uncertain. In the past, large quantities of trout have been killed, to hopefully help the Chub.

Yamtaqa, Vasey's Paradise: *Yamtaqa* is a spring that is a traditional cultural property (TCP) for Hopi. Flows from this spring vary from year to year but it 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 the shores along it 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 flows can put new sand on some areas along the river ("beaches"), but whether it is enough sand to offset the erosion is being studied. There is 10-year commitment to conduct high flow experiments when sand comes in the Paria river. The beaches along the river are used by river runners for camping, serve as plant and animal habitat, and may help protect archaeological sites.

Archaeological sites: Archaeological sites along the river probably continue to erode as there is limited 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. There has been no monitoring of the archaeological sites by the Adaptive Management Program since 2006 and no excavations at eroding sites since 2008.

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).

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. **Eagles:** *Nuva'kwaahu* (bald eagle) and *kwaahu* (golden eagle) are both occasionally seen along the river. Birds are not regularly monitored.

Plants: Without the pre-dam spring floods through *Öngtupa*, native and non-native plants have greatly increased along the shoreline. The most obvious plant, tamarisk, is a non-native. A non-native beetle may now be killing them. Plants are now growing in areas that used to be open sand (which reduces camping areas).

Wipho'qölö, Cattail marsh and Paaqap' qölö, Reed marsh: Marshes have decreased in number and size with current operations of Glen Canyon Dam. *Paaqavi* is increasing and *Wipho* is decreasing in abundance. Woody plants that like drier conditions are moving into the marsh areas.

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.

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*?

22. What is your feeling about visiting *Öngtupqa* and what one thing would you tell others back at Hopi about your experience?

23. 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 (including this trip) _____

Other visits to *Öngtupqa*: Canyon Rim _____

Hiking into Canyon _____