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A Further Analysis of the Verde River Watershed Ecovalues

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Introduction

“Perhaps the strongest conclusion from the analysis is that people value the river as a place and not just a thing. It is not simply a thing where they acquire goods and services; rather it is a place where they do activities.” (West *et al.*, 2009b)

The Verde River flows 170 miles through central Arizona lands managed by diverse stakeholders: private property, local, state, tribal, and federal land. The River is the last remaining mostly free-flowing river in otherwise arid Arizona. The challenges facing the stakeholders of the river and its watershed are numerous and complex. The issues of population growth, industrial growth, drought and climate change all challenge the future of the watershed. As such stakeholders of the watershed should gain an understanding of the importance (or lack thereof) of the watershed to their communities.

This research functions as an extension to research previously performed by Patricia West, Dean Howard Smith, and William Auberle of Northern Arizona University’s Landsward Institute (formerly the Ecological Monitoring and Assessment Program)The previous research team conducted interviews with 35 anonymous community leaders who live, work, or manage some aspect of the watershed. These interviews resulted in a large list of values for the watershed, and provided a starting point for the current study. This valuation study further analyzes the data set collected from West *et al.* (2009a) and is the conclusion of the first phase of studies to value the ecosystem services of the Verde River and its watershed. To the authors’ knowledge, this is the first application of the MEA tool to link ecosystem services to human well being. West *et al.* (2009b) analyzed the interview data using a two stage classification system.

In this study we conduct a strategic environmental assessment using a more complex third classification of the data to evaluate how the services identified by the respondents correspond to human well-being. The Millennium Ecosystem Assessment (MEA, 2003) has identified key components to human well being: basic material needs for a good life, freedom and choice, health, good social relations, and personal security. Ecosystems provide these services in a multitude of ways. The current analysis uses definitions of constituents of well being as presented by the MEA. The third more detailed classification is important because it shows not only *what* is important, but *why* it is important.

Data Sources

In order to determine the various uses and values for the Verde River watershed, a survey instrument was developed.² This questionnaire consists of two parts. The first part was a survey completed by mail, and the second part was a semi-structured interview completed using individually recorded interviews. The survey instrument is straightforward and requires little additional discussion. A total of 35 individuals knowledgeable of the watershed and current issues were interviewed. In order to protect the anonymity of the respondents, all personally identifiable information is maintained by the research team.³ The data set used for both the initial analysis in West *et al.* (2009b) as well as this analysis is comprised of the nearly 500 responses identified by the respondents of the survey and can be found in raw form in West *et al.* (2009a). All classification rubrics were taken from the framework established by the MEA 2003.

The data set specifically includes the responses to questions 3 and 6 in the questionnaire:

3. How do you use the river?
 - a. What plants and animals that rely on the river are important to you?
 - b. Do you collect or use any plants or animals that rely on the river? If so, which ones?
 - c. Do you have a spiritual, religious, or personal connection to the river? If so, could you describe this connection?
 - d. Are there certain locations that you value most on or near the river?
6. What do you feel you want to protect and preserve in the river corridor?

Summary of Earlier Findings

The initial study utilized a two-stage classification of the values indicated by the interviewees. First, the responses using the traditional total-willingness-to pay (TWP) framework. Values can be considered use, non-use, or option use. The table below shows each kind of use designation, and its prevalence within the data set.

Table 1: Use Designations; Source, West *et al.* 2009b

Value Designation	Percent of total values
Use: Benefits are obtained from these values by direct usage of or access to the resource. Examples of these values include water for irrigation and consumption, recreational activities, and tourism.	89%
Non-use: These benefits are obtained from indirect consumption of ecosystem values. An example is wildlife habitat, and biodiversity. Though we do not directly use wildlife habitat, their existence benefits us in indirect ways.	8%
Option: These values can be use or non use in nature, but are desired to be in existence in the future. ⁴	3%

² The full questionnaire is available at the website for the full report.

<http://www.emaprogram.com/emaweb/ema/site/index.asp>

³ Due to the small size of the community of people directly involved with the Verde Watershed our Institutional Review Board requires us to maintain the complete anonymity of the respondents. As such, we are unable to provide even the most cursory descriptors for the interviewees

⁴ Specific option use values were not enumerated as very predominant within the data set; however, it is likely that a vast majority of the values the interviewees identified as “use”, will also be valuable in the future, and are therefore also “option” values.

Each of the nearly 500 responses was further categorized according to the services they provide to the natural and human environment. Defined, ecosystem services are “the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life” (West *et al.*). Using the rubric developed by the MEA (2003) these values were identified as being cultural, regulating, provisioning or supporting in nature. The table below describes the characteristics and functions of each type of service, and its prevalence within the Verde River Ecosystem Values study.

Table 2: **Types of Ecosystem Services; Source, West *et al.* 2009b**

Service	Percent of total values
Cultural: These services provide non- material benefits to the participant. Such benefits could include enjoyment of recreation activities, educational experiences, as well as personal, aesthetic and religious values.	43%
Regulating: These services provide benefits that are obtained from the regulation of ecosystem processes. Examples of regulating services include climate control, water regulation, and pollination. These services are necessary for the continuation of ecosystem conditions.	38%
Provisioning: These are products/experiences that are physically obtained, from the ecosystem. Examples of this are water, timber, fiber, food and fuel, and witnessing nature. ⁵	18%
Supporting: These services are necessary for the production of all the other ecosystem services. Within our study the value of “hydrological services” was placed into this category. ⁶	1%

This initial two stage analysis of the data showed that of all the responses to the survey instrument, a majority of the values were associated with cultural and regulating resources or values. The original analysis also cross filtered the data between the two rubrics. This finding led the research team to conclude that “the most valued aspect of the river is not a place to get things from, but as an entity that is valued for its very existence for a wide variety of reasons” (West *et al.*, 2009b).

A Further Assessment

The third classification of the data is an important addition to the previous analysis. By assigning each of the responses into the third group we create a clearer picture of the linkages between ecosystem services, and their effect on human wellbeing. The goal of this stage of the analysis is to be able to draw incremental conclusions from the survey by identifying 1) What people value 2) What services do those values provide, and 3) How do these services affect human well being.

The analysis develops an important tool to be implemented by future researchers, policy makers, educators and community stakeholders. The investigation paves the way for a future studies to make more in depth analyses of the ecosystem and peoples’ associated values. A future analysis could include a contingent valuation study to further aid decision makers in determining what the stakeholders most value, and what values are most critical for human survival and well being.

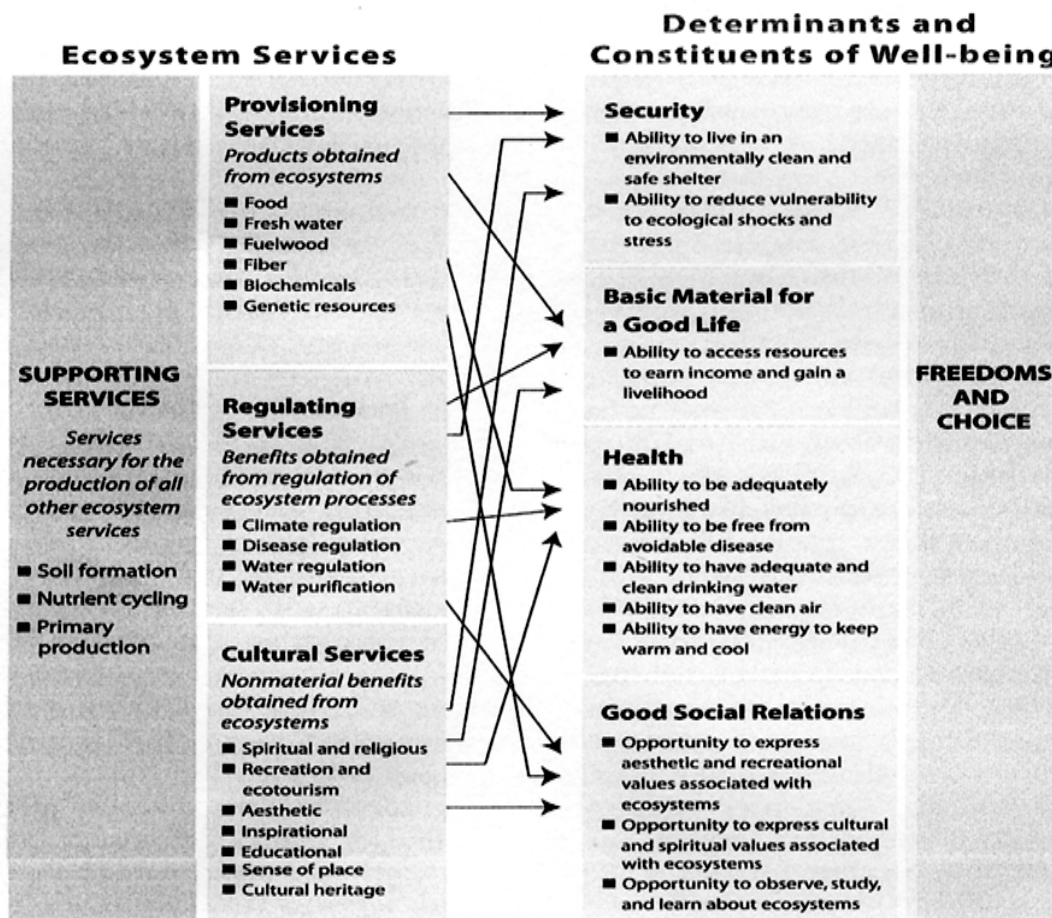
⁵ Responses of interviewees involving recreation/ personal experiences were handled on a “case- to-case” basis. Depending on the exact phrasing of their statement, recreation and personal experiences were categorized as either cultural or provisioning. Generally, the provisioning category was reserved for values involving a physical extraction.

⁶ It is difficult to make perfect distinctions about ecosystem values and the categories into which they best fit. For example, “pollination” could be viewed as both a regulating and supporting service.

Methodology-Constituents of Human Well-Being

The data processing methods for this analysis followed the classification rubric outlined by the MEA. As shown in Figure 1, the MEA methodology requires a linking between the Services rubric explained above (cultural, provisioning, regulating and supporting) with a second classification system. The MEA has identified several key components to human well being (HWB): basic materials needed for a good life, freedom and choice, health, good social relations, and personal security. These are the elemental requirements needed to have a successful society. They include basic needs for survival such as water, food, and shelter, as well as more complex issues such as freedom to express cultural beliefs. Unlike the TWP and Services classification, the HWB classification system provides for a complexity since each of the previous categories falls into each of the HWB categories.

Figure 1. Ecosystem Services and Their Links to Human Well-Being (Millennium Ecosystem Assessment 2003, page 5)



Data Processing

As in the second stage classification, the boundaries between the categories are often unclear. In many instances, more than one category was appropriate for a single response. For example, one of the values identified by a respondent was the riparian channel. The “riparian channel” has many functions in the ecosystem such as filtering water (provisioning), reducing stream bank erosion (regulating), providing shelter for wildlife (supporting), and providing opportunity for recreational activities (cultural). This broad array of multi-faceted values associated with the riparian channel fits into all categories of ecosystem services. Expanding the analysis further to investigate how the riparian channel affects human

well being only complicates the issue. Sorting out the best way to classify each respondent's response was at best difficult. The individual components which affect well being are all closely related and a change in one can and often will bring change in others.

Ultimately, each value response was classified according to the most reasonable fit with the constituents of well being, and was denoted "primary." Values that had relevance in multiple categories were further described according to how they secondarily contribute to human well being. Like the branches of a tree, this classification structure can quickly become extremely complex. For sake of brevity, and ease in interpretation, only the primary designations have been analyzed thus far.

Basic Materials

Anything that is reasonably considered a necessary material for a good life is considered a basic material. The ability to access the resources necessary to earn an income and gain a livelihood, as well as the ability to have enough food, shelter, clothing, access to goods and services fall into the basic materials category. For the Verde River watershed, this includes a wide variety of tourism and economic activities.

Some of the responses categorized primarily as basic materials included farms, vineyards, agriculture, gravel and mineral extraction, tourism, real estate, and honey production. Responses categorized at the secondary and tertiary level for basic materials included wildlife habitat for visitors, recreation, outreach and education, ground water, and irrigation water. Of the nearly 500 responses 52 were designated as a basic material for a good life.

Health

The health of an ecosystem contributes significantly to the health of humans and wildlife within the ecosystem. Basic health requirements such as nourishment, clean drinking water, clean air, and the ability to be free from avoidable disease are provided by and maintained within ecosystems. The respondents to the survey identified a multitude of values associated with the river that contribute to human health. Drinking water, clean air, provision of plant and animal matter, a "calming effect", recreation-physical health, and agriculture were some of the most common responses among the interviewees. There are 35 documented responses categorized as a constituent of well being via the health category within the data set.

Security

Security is another important constituent of human well being; it is derived from the ability to reduce one's vulnerability to ecological shocks and stress. The analysis of the data showed that there is a high proportion of values involving the security of the ecosystem. Of the nearly 500 responses, 174 were primarily categorized as contributing to the part of human well being involving security. These services included water availability, wildlife habitat, biodiversity, ecosystem function, and corridors. This category depicted not only what respondents identified as values, but also threats to the watershed. Water base pumping, endangered birds, seed dispersal, and encroachment were all identified as being a threat to overall river health.

Good Social Relations

Good social relations involve the ability to express aesthetic, recreational, educational, spiritual, and cultural values with nature. Forty-five percent of all responses were categorized as being primarily a part of good social relations. Within this category, there were many recurring topics involving personal connection to the river, religious values, educational purposes, and recreational uses. This category picked up the aesthetic and intrinsic value of the river as place, and not just a thing.

Freedom and Choice

Finally, "freedoms and choice" are an important aspect of human well being. This includes the ability to experience freedom by having some control over the future, and the ability to choose what we do, and who we will be. Deciding which responses should be designated in this category was difficult. This category of HWB functions very strongly as an overarching umbrella relative to the categories. Only

9 of the responses were categorized as primarily dealing with a value reflecting freedom and choice; however, nearly every response represents a value of freedom and choice. Nearly every response reflects the desire to have the freedom to be able to experience the watershed now and in the future.. This category functions similar to the option values in the data set. As its own separate category it represents a minuscule portion of the data however theoretically it underpins the entire data set.

Once the data had been filtered through the third and final rubric, it was necessary to find an effective way to visually organize the results on paper. This way, patterns could be discerned across the entire data set.

Table 3: **The constituents of human well being, and their prevalence within the data set**

	Good Social Relations	Security	Health	Basic Materials	Freedom & Choice
Total 491	221	174	35	52	9
Percent of Total	45%	35.4%	7.1%	10.6%	1.8%

Table 4: **The data set across each of the three rubrics of classification**

			Good Soc Relations	Security	Health	Basic Materials	Freedom and Choice
Use	2	Supporting	0	2	0	0	0
Non-Use	1	<i>3 Total</i>	0	1	0	0	0
Option	0	<i>0.60%</i>	0	0	0	0	0
		Total	0	3	0	0	0
Use	47	Regulating	1	41	1	1	0
Non Use	38	<i>91 Total</i>	6	31	1	1	0
Option	8	<i>18.50%</i>	0	7	1	0	0
		Total	7	79	3	2	0
Use	185	Provisioning	41	83	25	36	0
Non Use	0	<i>188 Total</i>	0	0	0	0	0
Option	3	<i>38.30%</i>	0	1	1	1	0
		Total	41	84	26	37	0
Use	204	Cultural	169	7	6	13	9
Non Use	3	<i>209 Total</i>	3	0	0	0	0
Option	2	<i>42.60%</i>	1	1	0	0	0
493		Total	173	8	6	13	9
Total							
<u>491⁷</u>			221	174	35	52	9
Percent of Total			45.00%	35.40%	7.10%	10.60%	1.80%

⁷ Two of the values identified by the respondents were not able to be placed through the third filter. These were “all of them, everything,” and “slows the water down.” These comments were dropped from the third classification.

Each of the types of value according to TWP is indicated with regard to how the response filtered into the ecosystem services. Directly under the service type, is the total number of responses falling into that category. For example, there were three total responses categorized as supporting ecosystem services. Of the three, two were use designated, and one was non-use. Farther still to the right are the constituents of human well-being across the horizontal axis. The same three supporting services are distributed further across to the constituents of well-being categories. All three of the supporting services contributed to security. This table can be used to detect larger patterns, or to draw out smaller observations. For example, following the GSR column to the bottom of the table we see that across all uses and services, a total of 221 or 45% of the values were categorized as contributing to human well-being via good social relations. Following the provisioning services rightward, we see that there were 188 total; 41 were considered to contribute to good social relations, 84 to security, 26 to health, 37 to basic materials, and 0 to freedoms and choice.

Findings

This section discusses the overall findings drawn from Table 4. When examining the distribution of the data throughout the table, there are a number of occurrences that seem significant.

First, supporting values represent the smallest percentage of total values, making up less than 1% of the entire data set. Each of these values was further classified as contributing to security in the constituents of well being. Why did so few respondents identify servicing values of the ecosystem? There are a couple of explanations for why this may have occurred. One interpretation may be that the respondents do not place a significant value on supporting service aspects of the Verde River watershed. Respondents may value these services; however, they did not recognize them as frequently because they do not directly experience them as they do with cultural values for example.

The regulating services category displays the first substantial value count with 91 total values. These regulating values are distributed across most categories, however strongly filters into only one well-being category, security. We also see that this is true for use, non-use and option-use values. This connection between regulating ecosystem services and a sense of security for the human environment is to be expected. Regulating services maintain ecosystems functions in ways such as regulating climate, pollinating, and filtering water. Without these regulating services, the human environment would be potentially damaged by ecological shocks. Here the data set displays an important link between ecosystem services and human well-being.

Provisioning services, where value is placed when something is obtained from the environment, represented about 38% of the data set. These 188 various provisioning services were distributed across nearly all well-being categories. All but three were identified as being a use value. We conclude from the data that the kinds of “things” people take from the environment are applied in a wide variety of contributors to well-being. People obtain values that contribute to good social relations such as education, and recreation. Provisioning values relating to sense of security were predominantly focused on water resources for irrigation and consumption. Multiple values contributing to health such as medicinal plants, food, and clean water are provisioned from the Verde River. Honey production, wineries, agricultural activities, and tourism provide economic viability to the area near the Verde River watershed. An important distinction to make about provisioning services is that they include not only physical *items* but *experiences* and *feelings* that people take away.

Second to provisioning services, cultural services had the highest frequency. Of 199 total cultural values, 172 were further classified as contributing to good social relations. These values related to religious values, personal attachment, education, recreation and aesthetic qualities of the Verde River watershed. Values that were linked as cultural and security included the Park Service, and values placed on open space. Some respondents experienced a cultural service that directly contributed to their health. These people identified spiritual and personal connections that helped relieve stress, gave them a sense of place, and overall made them feel good. Basic materials were included in the cultural category by way of tourism and even collaboration in the community, and also included spiritual tours.

Three responses were grouped as 1) non-use 2) cultural, 3) good social relations, a somewhat surprising result. What are cultural values that we do not use, but contribute to good social relations? These responses were based on philosophical values, and expressed the belief that nature has rights, humans should strive for balance within ecosystems, and that people who live outside of Arizona also value the watershed.

There were only 9 responses specifically involving freedom and choice, all of which were classified as being cultural. These comments pertained to experiences people enjoy, and the desire they have to access places with special memories.

Conclusions

Three questions were posed at the onset of this phase of the research. What do people value? What services do these values possess? How do these services affect human well-being? The survey instrument identified an extensive list of the values that stakeholders place on the Verde River watershed. Some of the most prominent and recurring responses pertained to personal/religious experiences with the river, educational resources, recreational activities, water for irrigation and consumption, and flora and fauna. These values provide namely cultural provisioning and regulating services, with the highest emphasis on cultural and provisioning. Cultural services contribute to human well-being mostly through facilitating good social relations. These cultural services are what allow people to interact with themselves, each other, and the environment in a positive and meaningful way. Access to provisioning services like collecting food, fuel, and memorable experiences contribute to our sense of security in our natural environment. We found the MEA tool useful to accomplish answering these questions.

The Verde River watershed provides much more value to society in terms of contributing to human well-being than simply being a source for water. The access to water for a variety of uses is vitally important to the stakeholders within the watershed; however, the myriad other aspects of the watershed are also very important to the same stakeholders. As the possible threats to the Verde River and its watershed increase at an increasing rate, the stakeholders need to address these threats.

Recommendations for Further Research

This study has documented the important resources and issues concerning the Verde River watershed. The data suggest that future research be focused into these areas that are identified as especially important by the initial respondents. Future research teams may also set out to find out why some issues were not prevalent in the study, and perhaps designate specific survey questions targeted at supporting services, to determine if these ecosystem services of value to the stakeholders. Cultural, educational, and recreational values may want to be investigated further with other survey instruments. The initial set of interviews was conducted using anonymous, but specifically targeted group of respondents with knowledge of the watershed. A broader understanding can be developed using a random sampling of residents and other stakeholders of the watershed.

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