Attitudes Towards Ecosystem Services in Urban Riparian Parks

by

Lea Ione Wilson

A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Science

Approved July 2012 by the
Graduate Supervisory Committee:

Daniel L. Childers, Chair
Kelli Larson
Juliet Stromberg

ARIZONA STATE UNIVERSITY

August 2012

ABSTRACT

Urban sustainability is a critical component of sustainable human societies. Urban riparian parks are used here as a case study seeking to understand the social-ecological relationships between the subjective evaluation of ecosystem services and the vision and management of one kind of green infrastructure. This study explored attitudes towards ecosystem services, asking whether 1) the tripartite model is an effective framing to measure attitudes towards ecosystem services; 2) what the attitudes towards ecosystem services are and whether they differ between two types of park space; and 3) what the relationship is between management and the attitudinal assessment of ecosystem services by park users. A questionnaire was administered to 104 urban riparian park users in Phoenix, AZ evaluating their attitudes towards refugia, aesthetics, microclimate and stormwater regulation, and recreational and educational opportunities. The operationalization of the tripartite model was validated and found reliable, but may not be the whole story in determining attitudes towards ecosystem services. All components of attitude were positive, but attitudes were stronger in a habitat rehabilitation area with densely planted native species and low flows, than in a more classic park with mowed lawns and scattered vegetation, a mix of native and non-native species, and open water. Park users were more positive towards refugia, stormwater regulation, recreation, and educational opportunities in the habitat rehabilitation area. On the other hand, microclimate regulation and aesthetic qualities were valued similarly between the two parks. Most attitudes supported management goals, however park users valued stormwater regulation less than managers. Qualitative answers suggest that the quality of human interactions differ between the parks and park users consider both elements of society and the physical environment in their subjective evaluations. These findings reveal that park users highly value ecosystem services and that park design and management mediates social-ecological relationships, which should at least underlie the context of economic discussions of service value. This study supports the provision of ecosystem services through green infrastructure and suggests that an integration of park designs throughout urban areas could provide both necessary services as well as expand the platform for social-ecological interactions.

ACKNOWLEDGMENTS

I would like to acknowledge and thank sincerely my committee for their time, advice and, most importantly, their flexibility in this process. I hope I have produced something interesting for all parties concerned.

I would also like to thank the representatives of Phoenix Rio Salado and Tempe Town Lake who were willing to sit down with some random grad student and give me an insider's perspective on their beloved park spaces.

Finally, collecting the survey data would have been a wildly different experience without my champion volunteers who collectively gave me 31.5 hours of their lives. I hope I repaid the favor.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Problem

Ecosystem services are the benefits to humans of the complex interactions of matter and energy in ecosystems, some of which we readily perceive and some of which we do not (Costanza 2008). Ecosystem services are of course not new; people have been managing ecosystems for services, or to avoid disservices, at least since the dawn of agriculture. Rather, the modern dialogue on ecosystem services stems from a concern that we are losing them at an alarming rate (MEA, 2005). Yet despite the dependence of ecosystem services on the structure and function of natural systems, the 'ecosystem service' construct is inherently anthropocentric (Dailey et al., 1997) and it is people who explicitly evaluate and benefit from them.

The gap between human values and healthy ecosystems may exist for a variety of reasons. Some believe single-service management (e.g., optimizing for board-feet; Holling, 1995; Martin, 2010) or unplanned habitat fragmentation (Benedict and McMahon, 2002) is detrimental to the system as a whole. Others note a deepening loss of ecological knowledge and personal and cultural identity driven by modernization and urbanization (Cronon, 1996; White, 1996; Miller 2005; Kumar & Kumar, 2007; Pilgram, 2007). Mooney & Ehrlich (1997) place blame on the failure of ecologists to communicate their rapidly accumulating knowledge. Gobster et al. (2007) focus on the disconnect between the "visual" and the "ecological" aesthetic. No doubt all these reasons play a part in the management of ecosystems today, but it is ultimately human psychological and social-psychological values, perceptions, and attitudes that serve as a feedback between structure of ecosystems and the evaluation of benefits, since it is these attitudes which guide the care and management of ecosystems. A "cultural sustainability" is possible whereby long-term care and management can be fostered by positive human attitudes towards ecological function (Nassauer, 1997; Nassauer 2011b). Such an understanding of sustainability would need to be cognizant of both the ecological sciences, the understanding of ecosystems as complex, self-organizing, multifunctional systems (Costanza, 1992; Brandt & Vejre, 2004; Costanza, 2008), and the social psychology of people (Nassauer, 2011a) or the attitudinal preferences they hold. Ecosystem services – dependent on ecosystem structure and function as well as the benefits attached to them by people – provide an obvious language for describing such a relationship and sustainable human societies should make ecosystem services central in their planning and decision-making (Benedict & McMahon, 2002; Ehrlich et al., 2012).

'Urban' is an increasingly important descriptor not only for humans, but for the waterways that run through and are altered by urban activities (Meyer et al., 2005). These growing urban areas are covering more of the planet's surface, are housing more of its people, and are altering the terms on which we interact with our environment. Cities are traditionally thought of as net importers of ecosystem services, but cities are ecosystems as well (Pickett et al. 2001; Grimm et al., 2008) and there is a growing realization that many services do (or could) originate *within* cities (Bolund & Hunhammar, 1999; Niemelä et al., 2010). Urban waterways are central in understanding the challenges of sustainable human society as they are sensitive to urbanization and they provide ecosystem services *in situ* as well as downstream (Palmer et al., 2004). Many cities are built around waterways to capitalize on these services and thus urban waterways are ubiquitous and are being altered (or have been in the past) in ways that change their structure and may ultimately affect their function, and thus their ability to provide ecosystem services, especially those managers have not previously recognized as important (Alberti et al., 2004; Meyer et al., 2005; Walsh et al., 2005). Urban riparian areas, as any human-modified system, are actively managed based on human values and goals (Wallace 2012), and these values and goals constitute the subjective benefits derived from ecosystem structure and function. Subjective evaluation of benefits leads to different management regimes, which will support some structures and functions while minimizing others. Ecosystem services provide a useful language for translating this relationship between management decisions and the different resultant energy and resource use, opportunities and barriers for urban dwellers, and implications for ecosystem service provision and non-human life.

Much of the ecosystem services literature has focused on economic valuation of ecosystem services, perceiving the current loss as a failure of the market to internalize the true costs (Costanza et al., 1997; Dailey 1997; Costanza, 2000; Loomis et al., 2000; de Groot 2002; de Groot, 2006; Balmford et al., 2009; Daily et al., 2009). While an economic approach clearly has a place in the evaluation of ecosystem services, it is easily misused when those applying the values do not understand the assumptions and limitations made in deriving economic figures (Kumar and Kumar, 2007). Economic valuation assumes a kind of objectivity in valuing ecosystems that is simply not possible for biophysical, social, or even economic reasons and reduces value to market demand (Spangenberg & Settele, 2010). Moreover, the commoditization of nature allows for a mentality of substitution, which fails to appreciate the complexity and uniqueness of ecosystems and may distract from the necessity of protecting existing ecosystems. Perhaps most telling, however, is the observation that rationality and utility, which serve as the foundation of economic theory, do not accurately reflect people's behavior towards the environment (Spash et al., 2005). For example, Spash et al. (2005) found that social-psychological variables had greater predictability for willingness to pay (a standard economic measurement) for improved biodiversity than did the social-economic variables traditionally employed. Kahnemna et al. (1999) remarked that such findings, so "anomalous" to economists, are in fact perfectly sensible from the psychological perspective of judgment and valuation. Even Dailey, who has championed economic valuation, notes a need to establish a nonmonetary means for ecosystem service valuation (Dailey et al., 2009). A broader conceptualization of ecosystem services is therefore necessary to include subjective evaluations of how people value ecosystems. There are many potential avenues for exploring the subjective evaluations of ecosystem services beyond economic models. This research uses attitudes as a measure of subjective evaluation, exploring the effectiveness of the tripartite model – affect, cognition, and behavior (Eagly & Chaiken 1993; Dunlap & Jones, 2002)– in capturing attitudes towards ecosystem services in urban riparian parks.

Sustainability, then, depends on a socio-ecological integrity that bridges the gap between social values and "healthy" ecosystems (Costanza, 1992; Gibson, 2006; Nassauer, 2011a). As such, my research asks both theoretical and practical questions: Can the tripartite theory of attitudes be used to describe the subjective evaluation of ecosystem services from urban riparian parks? Do attitudes towards ecosystem services differ between two urban riparian parks? What is the relationship between management practices, the attitudinal assessment of their value, and the socio-ecological context of both?

This research contributes a new perspective to the ecosystem services literature and seeks an interdisciplinary understanding between ecology, social psychology, and management. The findings will fit in with a dialogue already present in such journals as *Landscape and Urban Planning*, *Environment and Behavior*, *Urban Ecosystems*, and the *Journal of Environmental Psychology*. It provides a deeper understanding of how attitude theory could provide a more robust understanding of ecosystem services and, in turn, how the ecosystem services language informs a deeper understanding of the social-ecological integrity of urban riparian areas.

Definition of Terms

Depending on the familiarity of the reader with any of the topics of ecosystem services, economics, social psychology, or sustainability in general, there is a tremendous amount of jargon. Some of it, common words like "attitude" that seem straightforward have long histories of research and theory in the social sciences and different specifics depending on the theory in question. Another, like green infrastructure, which sounds a bit more technical is actually a broad and non-specific term, used for living structures providing ecosystem services and commonly used at all scales, from a single urban tree to an entire extra-urban forest. The reality of jargon of course makes communication to a broad range of stakeholders difficult. In this thesis, I will use several terms that may need definitions:

Attitudes are subjective judgments – positive or negative – held towards some object or concept (Eagly & Chaiken, 1993). Here, attitude will refer specifically to the tripartite model of attitudes, the theory of which is expanded on below. It is a specific model of subjective evaluations describing an attitude as composed of three components: affect, cognition, and behavior.

Ecosystem Services are the benefits to people provided by the structure and functioning of ecosystems that "sustain and fulfill human life" (Daily, 1997, p. 3). The term commonly describes both the structure and function ecosystems, i.e. the goods *and* services. There is some debate in the literature as to whether this is an inappropriate mixing of means and ends, e.g. should the oxygen and the lumbar and the shade all be counted, or just the trees? (Wallace, 2007; Boyd & Banzhaf, 2007; de Groot et al., 2006). For the purposes of this thesis, ecosystem service is left as an umbrella term encompassing both.

Green Infrastructure is a term used quite broadly for living, ecological infrastructure maintained for the provision of ecosystem services (e.g. Benedict & McMahon, 2002; 2006). The term is used to describe infrastructure from forests to ecoroofs, and derives itself in opposition to built or "grey" infrastructure, such as sewer lines or road networks.

Parks, Green Space, and Open Space are all referred to somewhat interchangeably in both academic literature and the colloquial white papers and policy briefs from cities and environmental organizations (e.g. American Planning Association, 2003; Balram & Dragićević, 2005; Home et al., 2010; NYC Green Infrastructure Plan, 2010). In this thesis, an effort is made to use only the term "park" for consistency. "Park" was chosen because it is readily recognizable and refers to areas that are managed for human use. I debated for some time whether to use this word, as parks are often associated with specific features, such as manicured lawns or children's play equipment, and I think to many are (often) the antithesis of "natural." Green space and open space on the other hand are less restricted by specific maintenance regimes. Green space was avoided in this thesis mainly because of the desert environment of Phoenix and to avoid the mis-implication that a "green" space must be green, implying irrigation. Open space does not come with any such lush implications, but it also does not come with any implications of ownership or maintenance.

Restoration is a common word for the practice of rehabilitating a degraded site. There is a long debate in the literature over whether restoration is an appropriate word or even a desirable outcome of human intervention (Restoring what? To when? Who decides?) (Gobster & Hull, 2000; Newman, 2008). Restoration is an extremely subjective process that at its best brings people together with their environment and at worst leads to messy fights over competing visions and values for the land (Gobster & Hull, 2000). In this thesis the term "rehabilitation" is used in acknowledgement of these subtleties and the restoration debate. In my research I use two different park designs as case studies to further explore the differences in restoration and classic aesthetics.

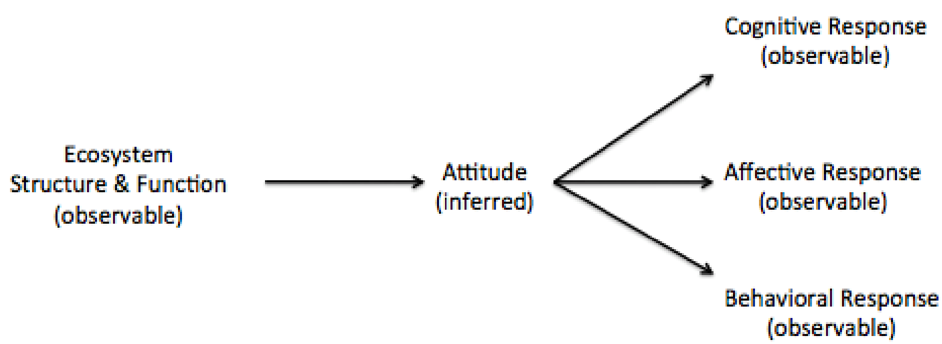
CONCEPTUAL APPROACH

Many potential avenues exist for psychological and social-psychological theory to enrich our understanding of the benefits and values of ecosystems. Spash et al. (2005) used the theory of planned behavior to understand what motivated willingness to pay for biodiversity. Dunlap et al. (2000) suggested that attitudes, beliefs, and behaviors towards the environment may be motivated by an underlying ecological worldview, and Kumar & Kumar (2007) suggested reciprocity and our personal "ecological identity," or extension of attitudes, social, and value systems to include the environment, are central for understanding how people value ecosystems. A body of literature already exists on the aesthetic preferences of people towards content and spatial configuration of nature (Ulrich, 1986; Kaplan & Kaplan, 1989). It tells us, for example, that people prefer views with water (e.g. White et al., 2010) and a maintained appearance (e.g. Nassauer et al., 2001). But there is also evidence to suggest some preferences may be changing. For example, though traditional aesthetics research describes a preference for an open understory, Bjerke et al. (2006) found an increased appreciation for dense vegetation in recreational areas in a European community, which they partly correlated to positive ecological worldview. Home et al. (2010) found that preference for green spaces in urban areas emerged as an alignment between cultural and biological preferences. Such observations speak positively towards the opportunity to link social preference with ecological functionality, especially as an increasing portion of people live in cities. The rest of this thesis will explore how the classic tripartite model of attitudes can contribute to a better understanding and a robust evaluation of ecosystem services in a manner relevant for social-ecological integrity and cultural sustainability. Measuring the subjective 'attitudinal' valuation of ecosystem function in terms of affect, cognition, and behavior provides a robust theoretical and empirical approach for understanding where attitudes towards ecosystem function provide opportunities or barriers to the sustainable management of ecosystems for a variety of services.

Attitudes and Environmental Concern

Attitudes are judgments towards and evaluations of some "object" or concept of interest (Eagly & Chaiken 1993), in this case, towards the potential benefits that emerge from the structure and function of ecosystems. The tripartite model of attitudes has a long history of use in social psychology (Eagly & Chaiken, 1993), in addition to extensive use in measuring environmental "concerns" more specifically (Dunlap & Jones, 2002). The tripartite model (Figure 1) describes attitudes as multidimensional, formed from the three components of affect, cognition, and behavior. Affect is the emotional component of attitude, including the moods and feelings associated with the attitude object (Eagly & Chaiken, 1993). Cognition is the belief component of attitude, or the thoughts or ideas that form a connection between an attitude object and an attribute, which may range from knowledge of empirical fact to an expression of norms (Dunlap and Jones 2002). Finally, the behavioral, sometimes called conative, component of attitude refers to the action or intent to act in regard to the attitude object (Eagly & Chaiken, 1993). Behavior may be expressed in the individual or public realm, as in taking an action personally versus supporting policy (Dunlap & Jones ,2002). Overall, attitudes are evaluative measures or judgments about some phenomenon. Attitudes have direction; thus emotions may be positive or negative, beliefs may be associated with favorable or unfavorable attributes or outcomes, and actions may support or oppose the attitude object (Eagly & Chaiken, 1993).

Figure 1: The tripartite model of attitudes, modeled from Eagly & Chaiken (1993), Fig. 1.2



The tripartite attitudinal model provides grounds for the conceptualization of both ecosystem services and disservices from human interactions with ecosystems. An evaluation of ecosystem services might be expressed, for instance, in terms of concern about the urban heat island (affective), the belief that vegetation is an effective agent for ameliorating heat (cognition), and maintenance of a grassy yard to mitigate heat (behavior). Or, an ecosystem disservice may be expressed as a concern about safety at a particular park (affective), the belief that a park provides a threat because of unmonitored space for dangerous people to congregate (cognition), and the avoidance of a park to stay safe (behavior).

The three components of attitude are distinct, but may be synergistic or conflicting in forming an attitude (Bagozzi et al., 1979; Eagly & Chaiken, 1993). In some cases, the strength of one component may be expressed more strongly than the others (Eagly & Chaiken, 1993). In other cases, the components may be difficult to distinguish from each other. For example, distinguishing between affect and cognition on environmental matters can be difficult when not explicitly measuring factual knowledge (Dunlap & Jones, 2002). The researcher should clearly express whether cognition is being measured as fact (which may be compared to an objective reality) or principle (a subjective measure) (Gray, 1985). In this study, for example, cognition is measured as belief that a site provides a service. Potentially, this belief could be compared to an objective measurement of the service. The design of studies and the analyses, therefore, may affect whether all three components are observed distinctly (Eagly & Chaiken, 1993) and impress the importance of validity and reliability testing, as well as perhaps exploratory factor. These cautions go to show the complexities of attitudes and highlights the importance of a robust, multidimensional approach to understanding them. The tripartite conceptualization is an important and proven model for understanding 'attitude' as a multidimensional and subjective response to environmental stimuli (Bagozzi et al., 1979; Eagly & Chaiken, 1993; Dunlap & Jones, 2002).

The biophysical world makes for a complex attitude object, in part because of social-ecological system dynamics and feedbacks; as such, the onus is on the researcher to organize the complexity into a manageable and measurable construct (Dunlap & Jones, 2002). For example, the attitude object might be approached as elements composing the environment, functions of the environment, or the outcomes of human activities on the environment (Dunlap & Jones, 2002). How the components of attitude theory are operationalized also affect the practical application of the research outside of academia. For example, in two recent studies Larson et al. (2009; 2011) used water scarcity (an environmental outcome) as an object and operationalized affect, cognition, and behavior as the concern over water scarcity issues, the believed causes of water scarcity, and the policy actions supported (or not) as appropriate for managing water resources. The tripartite approach provided a more robust way of understanding the subjective dynamic of water scarcity issues than any one of these measures would alone. They used this framing in part to identify opportunities and barriers to potential decisions, providing relevant information for decision-makers about how viewpoints among diverse stakeholders converge or diverge in understanding and evaluating water scarcity.

In another example, Jorgensen & Stedmen (2001) explored sense of place (an ecosystem service) as an attitudinal construct via attachment (affect), identity (belief), and dependence (behavior). The application of this research is theoretical in nature, seeking synergy between two bodies of literature, but it does not provide a practical conclusion for decision-makers.

These two examples highlight the wide, flexible application of the tripartite model and the different means by which researchers captured complex biophysical objectives with two different constructs. As sustainability should be action-oriented, it is important to frame the identification of attitudes towards ecosystem services in such a way that is relevant for realizing synergistic, simultaneous goals in social-ecological systems (Selman 2008).

Urban Riparian Parks

It has long been known that humans have a special preference for water (White et al., 2010) and it has been suggested that people have different aesthetics depending on if they are in an urban or rural context. In this way, urban riparian areas offer an intriguing blending of preferences (Home et al., 2010). Public riparian areas come in a variety of forms and the terms we use to describe them, such as "park" or "restoration" articulates the different expectations – for aesthetics, management goals, or vegetated characteristics – intrinsic to their design, which may alter the attitude towards the usefulness of a site for providing different services.

An extensive body of literature exists on the preferences of people towards content and spatial configuration of nature, such as open understories, the presence of scattered trees, and a desire to understand what they are looking at (Ulrich, 1986; Kaplan & Kaplan, 1989). Cues such as manicured lawns, painted fences, and monuments or educational signs indicate to the public that an area is an object of intention and care (Nassauer, 2011a; Nassauer, 2011b). However, there is some evidence to suggest that preferences in urban green space are more complex and may be changing. For example, Home et al. (2010) showed that preference for green spaces in urban areas seemed to emerge as an alignment between cultural preferences more characteristic of urban areas and biological preferences more characteristic of rural settings. Bjerke et al. (2006) concluded a preference for denser, more diverse vegetation might be correlated to a more positive ecological worldview. These observations suggest subjective evaluations of urban green space could be shifting to support goals for habitat or ecological restoration projects and more diverse uses for public space than aesthetics or recreation.

In contrast to "park", 'restoration' (rehabilitation) is a growing phenomenon in urban areas, especially along urban river corridors, with goals such as invasive species removal, native habitat renewal, pollution mitigation, and "day-lighting" of buried rivers (Palmer et al., 2004). Yet many of these so-called ecological restoration projects in fact have many social goals – such as providing educational and recreational opportunities, improving the aesthetic quality of a neighborhood and attracting tourists (Rio Salado, n.d.; Buchholz and Younos 2007; Lundy and Wade 2011). The decisions made about what, why, and how to "restore" an ecological system are in fact deeply rooted in cultural contexts and selective cultural knowledge and ideals about nature and the area to be restored (Gobster, 2001; Newman, 2008). The term restoration itself has been challenged in the literature as a more holistic social-ecological perspective complicated by the need for a perfect reference ecosystem (Dufour & Piégay 2009). As such, though management goals may vary between parks and restoration areas, they both constitute important areas of social and ecological interactions in an urban context with the potential to provide many ecosystem services.

Outside the semantics of academia, a more pragmatic, benefit-centered approach to urban green and riparian areas is beginning to manifest itself in terms of a "green infrastructure." Green infrastructure is a term still gaining traction, but it is based on the concept that a living, ecological infrastructure can and should be integrated more carefully and fully with human systems for the mutual benefit of people and conservation (see for example Benedict & McMahon, 2006; Tzoulas et al., 2007; Ignatieva et al., 2011). For example, ecoroofs may insulate buildings, reducing energy needs, reduce the speed and volume of runoff, and provide habitat. An ecoroof has the potential then to be a multifunctional infrastructure for the prevision of multiple ecosystem services. The term is meant to contradict "grey infrastructure," which refers to the highly engineered and optimized single-function systems, such as sewer systems, that many cities are built upon and can cause as many problems as they solve (erosion, flooding, habitat loss). Many city and regional governments are beginning to see the benefit of the green infrastructure view, rehabilitating or designing new patches and networks of living infrastructure to provide multiple ecosystem services, from pollution removal to aesthetics (Dockside Green 2011; NYC Green Infrastructure Plan 2010; Martin 2010; Firehock and Hefner 2008; Nelson County 2011; Environment Agency 2009; City of Portland 2009; American Planning Association 2003). Green infrastructure may be designed on its own or in synergy with grey infrastructure. Such efforts are recognition not only of ecosystem services but that people are a major part of urban ecosystems, which speaks positively to the opportunity to link social preference with ecological functionality.

Urban riparian parks provide many ecosystem services to urban dwellers, whether they are explicitly designed to or not (Bolund & Hunhammar, 1999). There is some evidence to suggest that urban dwellers are aware of and generally positive about services provided by nature (Jim & Chen, 2006). Ultimately, it is the social context, the attitudes, and the patterns of urban life that determine which structures and functions are determined services or disserves by urban dwellers (Lyytimäki et al., 2008). Therefore understanding the subjective attitudes of urban dwellers using public spaces towards ecosystem services is imperative.

METHODS

Research Questions

Given the potential of the tripartite model for measuring subjective attitudes towards ecosystem services, and the importance of urban green infrastructure, specifically parks and rehabilitation areas, for the provision of ecosystem services, this research seeks to address three major questions:

- Q1. Efficacy of the tripartite model: Can the tripartite model of attitudes be used to describe the subjective evaluations of park users towards ecosystem services?
- Q2. Attitudes: What are attitudes towards ecosystem services and do attitudes towards ecosystem services differ between two urban riparian parks – an open understory with non-native species and open water versus a denser brushy park with native species and low flows?
- Q3. Attitudes and management: What is the relationship between management practices, the attitudinal assessment of a park's value, and the social-ecological context of both? Do the subjective assessments match efforts by park designers and managers to provide services and avoid disservices?

Study Sites

My research measured the attitudes of user groups at two urban riparian parks in the Phoenix, Arizona greater metropolitan area – Tempe Town Lake and the Phoenix Rio Salado Restoration Area (Table 1). Tempe

Town Lake serves as an example of a more classic aesthetic, with open water and open mowed lawns and scattered vegetation, introducing both native and non-native species to the park. Phoenix Rio Salado is an example of rehabilitation aesthetic, with denser shrubs for habitat, native species, and lower flows. Phoenix is a hot, arid city located in the Sonoran Desert of the Southwestern United States. Annual precipitation is approximately 180mm (7 in) mainly within two wet periods, a summer monsoon and a winter rainy season (Larson et al., 2005). Between 1978-2007, the city averaged 110 days a year with highs over 100°F/38°C (NOAA, n.d.).

Both parks are situated on the now-ephemeral Salt River, where upstream dams control and reduce regular flows through the City of Phoenix. The diversion of the Salt led to a near complete loss of the riparian and wetland habitat, a unique and important habitat in the Sonoran Desert (US ACE, 1997). In addition, a booming housing industry beginning in the 1950s and '60s lead to gravel mining in the Salt River channel. Mine pits were then backfilled, resulting in 11 urban landfills (D. Kaminski, City of Tempe, personal communication, May 18, 2012; US ACE, 1997). As far back as the 1970s, community leaders began thinking about rehabilitation of the river and the restoration of the Salt was at least a popular theme in ASU professor Jim Elmore's landscape architecture classes during the '70s (S. Porter, AZ Audubon, personal communication, May 18, 2012). Following major flooding in the '70s, '80s continued channelization and bank stabilization efforts were planned for the river as it ran through the city to contain and direct stormwater (City of Tempe, 2012b). Flood control is thus flood *prevention* as opposed to management for appropriate flood levels in designated space.

Neither park space actually provides the ecosystem service of flood control, though they do not hinder it either (F. Terry, Maricopa Flood Control District (FCD), personal communication, May 22, 2012). The dynamic between ecosystem service and engineered grey infrastructure make it somewhat difficult to discuss stormwater management at these sites or objectively measure its provision. People may correctly perceive that the site provides flood control, and the park managers and Army Corps may think of these sites in terms of flood control, however the extent to which this is an ecosystem service is debatable and may differ between parks. A more detailed analysis of this dynamic could be quite interesting.

Tempe Town Lake.

Tempe Town Lake area features a 220-acre lake that opened to the public in 1999 along with 25 acres of open space. Development of the lake had four desired outcomes. The primary goal of management at Tempe Town Lake is not to interfere with flood control, followed by economic development, recreation, and environmental rehabilitation (US ACE, 1997; D. Kaminiski, City of Tempe, personal communication, May 18, 2012). Tempe Town Lake features a two-tiered levee system to adequately contain a 100-year flood based on historical records. The park itself is a semi-sacrificial space, as the outside edges are ringed with an additional levee meant to contain water within the park in the event of a greater than 100 year flood, protecting built infrastructure further inland (N. Ryan, City of Tempe, personal communication, May 4, 2012). These levees restrict the planting that is allowed, as any trees forming deep root balls could damage the levees if they were ripped out during a flood (N. Ryan, City of Tempe, personal communication, May 4, 2012).

The lake level is maintained by a system of inflatable rubber bladders, which can be fully de/inflated in 45 minutes (Tempe Town Lake, n.d.). Lake levels are maintained in careful communication with the Salt River Project and expected flows from upstream dam releases and storm events (Tempe Town Lake, n.d.; N. Ryan, City of Tempe, personal communication, May 4, 2012). The current inflatable dam system experienced a major failure in 2010, however, and a new system is currently being designed. The lake is expected to be expanded and the new system will be introduced at that time (D. Kaminski, City of Tempe, personal communication, May 18, 2012). A combination of bedrock, clay, and high groundwater keep much of the lakewater from being lost through seepage; the groundwater table is also kept high by upstream releases from the Mesa water treatment facility. Together, these two elements help minimize losses to Temp Town Lake. A pump system is in place to recycle water seepage when the water table is low (D. Kaminski, City of Tempe, personal communication, May 18, 2012).

Figure 2: A view of Tempe Town Lake from the north shore, looking towards the performing arts center and new pedestrian bridge.

The open space surrounding the lake generally has a more classic park aesthetic with smooth, open lawns in Beach Park, and rolling grassed hills along the southern water's edge, as well as scattered trees with little undergrowth (Ulrich, 1986). The vegetation in the park is a mix of native and non-native species and the landscaping on the north side of the lake is notably less formal than the south side. Fishing is an extremely popular activity and the lake is stocked with rainbow trout. However bass, sunfish, catfish, and other species have come in when the lake was filled (N. Ryan, City of Tempe, personal communication, May 4, 2012). The lake features a marina and boat rental business, and has become extremely popular for rowing. In fact, there are now young Phoenicians going to out of state universities on rowing scholarships, a consequence of the lake never imagined (D. Kaminski, City of Tempe, personal communication, May 18, 2012). Swimming and wading in the lake are not allowed except during scheduled events (Tempe Town Lake, n.d.). The park also features recreational and community infrastructure including a splash pad, a performing arts center, and paved multi-use trails. The lake lies directly in the flight path of Phoenix Sky Harbor International Airport so bird populations must be monitored and actively managed through both intervention and design to avoid bird-aircraft collisions (Winterboer, 2003)

Phoenix Rio Salado Restoration.

Phoenix Rio Salado restoration area (Figure 3), approximately 11km downstream of Tempe Town Lake, is an effort to rehabilitate habitat and urban community along the Salt River in downtown Phoenix. The park contains 595 acres of habitat and open space including mesquite bosque, cottonwood/willow, wetland and aquatic, palo verde, and native brush (Rio Salado, n.d.). The area opened in 2005 and was developed through a collaboration among the Army Corps of Engineers, the city, and the county at a total cost of $100 million – roughly $65 million to carve the low flow channel, stabilize landfills and remove landfill debris, and $35 million to establish habitat (Rio Salado, n.d.; S. Porter, AZ Audubon, personal communication, May 18, 2012). The provision of habitat for wildlife by bringing back native riparian vegetation was the main goal of the project (R. Smart, Phoenix Parks personal communication, May 21, 2012).

The communities in south Phoenix in the vicinity of the project have long suffered from social segregation, a lack of development, and environmental injustices (Bolin et al., 2005). As such, economic development, infill, and increasing property values were of concern to the original Rio Salado Advisory Council and remain long-term goals of the project (S. Porter, AZ Audubon, personal communication, May 18, 2012; R. Smart, Phoenix Parks, personal communication, May 21, 2012). This rehabilitation of the river was also to improve the landscape of this "blighted urban core" (Rio Salado Restoration, n.d.). To this end, "*Beyond the Banks"* (City of Phoenix, 2003) was prepared as a vision and zoning overlay to guide development in the area away from industrial purposes and diversify land use, promote safety and community-oriented recreation, and enhance environmental education opportunities focused on the Phoenix Rio Salado (City of Phoenix, 2003). While some development began prior to the economic crash, the prevalence of brown fields complicates redevelopment and makes it expensive (S. Porter, personal communication, May 18, 2012).

Environmental education is an important immediate and ongoing goal for both the Phoenix Park Rangers and the Arizona Audubon, which is housed on site. Currently both Rangers and the Audubon focuses the bulk of their educational efforts on school-age children, providing field trips, outdoor classroom experiences, and summer day camps (R. Smart, Phoenix Parks, personal communication, May 21, 2012; S. Porter, AZ Audubon, personal communication, May 18, 2012). However, many community events were held in the park prior to budget cuts over the last couple years and as the city recovers economically, it hopes to begin to bring some of these back and draw in visitors from all over the city (R. Smart, Phoenix Parks, personal communication, May 21, 2012). Arizona Audubon also seeks to provide an "environmental home" to Phoenicians interested in urban nature, holding events such as Rail Birds and Birds & Beer (S. Porter, AZ Audubon, personal communication, May 18, 2012). The Audubon encourages stewardship at the core of its mission and holds volunteer events throughout the year (S. Porter, AZ Audubon, personal communication, May 18, 2012). Phoenix Rio Salado is also home to a small but dedicated group of Phoenix Park Stewards (R. Smart, Phoenix Parks, personal communication, May 18, 2012).

Phoenix Rio Salado features some recreational infrastructure including multi-use paths, and wildlife viewing. In addition, Audubon opened a facility in 2009 (Rio Salado Audubon, 2012). Park users are expected to remain on designated trails (City of Phoenix, 2011). As previously mentioned, the park is tiered, with all paved trails above and out of the flood channel. The park in many ways embodies the trade-offs of urban riparian restoration and conservation projects. While the park seeks to rehabilitate the populations of native flora and fauna and bring back some qualities of the pre-dam riparian habitat, flood control through channelization and continued protection of trails from washout guided the design and construction of this area.

Figure 3: A view of Phoenix Rio Salado from the south river trail, looking towards the channel.

Table 1: Management goals and ecosystem service potential characterization at Tempe Town Lake and Phoenix Rio Salado Restoration. Table presented as a synthesis of interviews, research, and observation.

Site Characteristics	Town Lake	Phoenix Rio Salado
Stated Goals	Stormwater management; economic development; recreational opportunities and encouraging an “active urban lifestyle”; environmental quality and restoration (Tempe Town Lake, n.d.; D. Kaminski, personal communication, May 18, 2012).	Restore native flora and fauna; improve “blighted urban landscape”; stormwater management; environmental education; economic development (Rio Salado, n.d.).
Refugia Characteristics	Mix of native and non-native vegetation on land; perennial lake without emergent vegetation or banks supports some species of birds but nesting locally and wading species of birds are actively discouraged to meet FAA bird strike prevention regulations	Emergent native riparian and wetland vegetation in low flow channel; demonstration ponds with emergent wetland vegetation on banks, native riparian forests including cottonwood, willow, and mesquite bosque (Rio Salado, n.d.). A pollinator and monarch butterfly

	(N. Ryan, personal communication, May 4, 2012; Winterboer, 2003). These regulations restrict habitat management activities. Herons are prevalent and hunt at the lake, but nest upstream (D. Kaminiski, personal communication, May 18, 2012). Doves and blackbirds are most common; other species include osprey and the occasional eagle (Carillo, 2008). Lake is stocked with Israeli Carp for biological control of mosquito and midge fly. Rainbow Trout is stocked by Arizona Fish and Game; supports 10 other species of fish that came in with fill including sunfish, bass, and catfish (N. Ryan, personal communication, May 4, 2012). Rabbits and coyotes also present, mostly on north side.	garden have been established for maintenance of special species of interest. Overall, the habitat supports over 200 species of migratory birds (up from 40-50 before habitat rehabilitation) in addition to fish, amphibians, reptiles, and mammals including hare, beaver, and coyote (R. Smart, personal communication, May 21, 2012).
Microclimate Regulation Potential	Large, open body of water (evaporation); some grass and few trees (evapotranspiration, shade)	Areas of dense riparian forest (evapotranspiration, shade), little open water
Stormwater Design	Channelized flood way; two-tiered levee system of cement-stabilized alluvium (CSA) for 10-year flows and rock-gabion mattress for 100-year floods (169,000 cfs). The current dam system can be completely deflated in 45 minutes (Tempe Town Lake, n.d.)	Reinforced low flow channel (LFC) to stabilize channel gradient for up to12,200 cfs typical SRP releases; LFC is bounded by planted terraces following the original high banks with minimal gabions; CSA was not used in this section of the river (D. Rerick, personal communication, June 25, 2012.
Recreational Opportunities	Multi-use trails; recreational fishing marina and watersports (no swimming); splash pad; arts center	Multi-use trails; wildlife viewing (no fishing); equestrian staging area; Audubon Center
Landscaping and Water Design	Grass and scattered trees near development and in Beach Park; desert scrub and cactus or no landscaping along trails in less developed portions. Lake is 220 acres, holding 300	Emergent wetland vegetation and native riparian forest and desert scrub (Rio Salado, n.d.). Perennial water in low-flow channel maintained by 5 non-potable groundwater pumps and

	acre-feet of water when full; lake is filled with Salt River Project water and releases from upstream dams (Tempe Town Lake, n.d.); pump system to capture water lost to seepage when water table is low (water table is currently high enough that pumps are turned off). By-pass system moves water from Mesa Treatment plant and freeway storm flow around the lake and re-releases it in channel west of lake (D. Kaminski, personal communication, May 18, 2012).	inflow from 22 storm drains; water recharged to aquifer and recycled through the wetland and demo recharge pond (R. Smart, personal communication, May 21, 2012).
Educational Opportunities	Interpretive signage in formal restoration area where Indian Bend Wash meets the Lake at north east corner; former Adopt the Lake Program to encourage stewardship along the lake discontinued (N. Ryan, personal communication, May 4, 2012); former "water in the desert" interpretive design of splash pad removed in equipment update (D. Kaminski, May 18, 2012).	Formal and central goal of park management. Informal opportunities provided through interpretive signage, demonstration ponds, and Audubon Center; Park Stewards program; formal educational classes and events through both Phoenix Parks Rangers and Audubon staff and volunteers (S. Porter, personal communication, May 18, 2012; R. Smart, personal communication, May 21, 2012). Budget cuts to the park system resulted in a loss of many community events.

Ecosystem Services Investigated

My study examined six ecosystem services (Table 2) selected to be representative of both a variety of ecosystem services and of specific salience to urban waterways and the arid urban locale. These six ecosystem services were: refugia, microclimate regulation, stormwater regulation, aesthetic values, recreational opportunities, and educational opportunities. The salience of these services arises from a number of considerations.

Refugia, or quality of the habitat for the needs of a variety of species is important both for common restoration goals (as in Rio Salado, n.d.) as well as the ability for a space to meet more general conservation goals (Benedict & McMahon, 2006) and provide a "refuge" in the urban environment for non-human species.

Microclimate regulation is important for mitigation of the urban heat island (UHI) in cities generally, but is of special importance in Phoenix' already hot desert climate where the UHI has increased steadily in recent decades (Brazel et al., 2007; Grimm et al., 2008).

Regulating stormwater runoff is of concern generally for many cities, and no less so for Phoenix, where desert hardpan and low urban infiltration contribute to flash floods. Both Tempe and Phoenix address stormwater regulation in their management plans for Tempe Town Lake and Phoenix Rio Salado, respectively (Tempe Town Lake, n.d., Rio Salado, n.d.).

Aesthetic qualities of a site are considered an ecosystem service to urban areas for a variety of reasons, including property values as well as inspiring long-term care (Nassauer, 1997; Luttik, 2000). Both Tempe Town Lake and Phoenix Rio Salado were constructed with image and development in mind (Tempe Town Lake, n.d.; Rio Salado, n.d.). Tempe Town Lake and Phoenix Rio Salado encapsulate two very different visions of the Salt River and it is relevant to compare park users' perceptions of their beauty and what makes them beautiful.

Recreation is an important service provided by any urban open space as these areas provide important opportunities for people to be outdoors, get exercise, socialize, and "restore" themselves mentally (Ulrich et al., 1991; Kaplan, 1995; Chiesura, 2004; Tzoulas et al., 2007).

Finally, as an increasing portion of the population lives in cities, the opportunities for formal and informal education and human development that comes from observation and engagement with the living, non-human world is swiftly diminishing, with uncertain consequences (Cronon, 1996; White, 1996; Thompson, 2002; Louv, 2005; Miller, 2005; Pilgrim 2007). Miller (2005) suggests that charismatic open space – as both Tempe Town Lake and Phoenix Rio Salado represent – are important for engaging people's thoughts and concerns and providing both formal and informal educational opportunities.

Table 2: Ecosystem services potentially provided by urban riparian parks (S=Supporting, R=Regulating, C=Cultural)

Ecosystem Services in Urban Riparian Parks	Service type (MEA, 2005)	Scale of Service (Costanza, 2008)	Definition	Definition Source or Background	Indicators
Refugia	S	Local Proximal	Habitat for resident and temporary or transient populations, such as nurseries, migratory or over-wintering species, and local native species	Costanza et al., 1997	Biodiversity; structurally diverse vegetation; presence of animals
Microclimate Regulation	R	Local Proximal	Capacity for ecosystem to influence climate as through vegetation characteristics and evapo-transpiration rates	de Groot, 2010; Bolund & Hunhammar, 1999	A climate refuge in the city with features such as vegetation or water (evaporative cooling); trees and other vegetation for shade to provide relief from the sun
Stormwater Regulation	R	Directional Flow Related	Capacity for stormwater capture, infiltration, and/or release	de Groot, 2010	Adaptive “sacrificial” space that can be flooded as a buffer; vegetated/permeable surfaces to capture, slow, and hold water
Aesthetic Values	C	User Flow	Access to a "beautiful" environment, which evokes an aesthetic response and adheres to norms of management and care	MEA, 2005; Nassauer, 1997; Nassauer, 2011b	Landscaping and views (especially of water) reported as beautiful by users
Recreation: psychological and physical health	C	User Flow	Opportunity to engage in activities for stress relief, exercise, and personal fulfillment	Kaplan, 1995; Tzoulas et al., 2009	Space and infrastructure supporting a variety of recreational activities, both passive and active
Knowledge and Education: formal and informal	C	User Flow/Global Non-Proximal	Opportunities for formal and informal education, training, and research	de Groot, 2010; Niemelä et al., 2010	Organized classes; presence of research; space for exploring and experiencing nature

Operationalization of the Tripartite Attitudinal Model

In order to operationalize the tripartite model of attitudes I framed the provision of each ecosystem service in terms of: care or concerns about ecosystem services provided by riparian parks (affect); the beliefs or ideas about how well the park actually provides the different services (cognition); and the support of, or opposition to, ongoing management practices at a park (behavior) (Table 2). Each service was framed in 2 ways (Table 4) resulting in 36 total attitudinal variables (6 services, framed 2 ways, for each of 3 components of attitude). The attitude object in this case is a function of the environment and attitudes are framed in such a way as to inform decision-makers whether attitudes towards the site correlate to the intentions of site design and management and which ecosystem services are most positively or negatively evaluated by user groups.

Table 3: Operationalization of the tripartite model of attitudes towards ecosystem services

Affect	Care or concern about ecosystem services provided by urban riparian parks
Cognition	Beliefs or ideas about the suitability of an urban riparian parks for delivery of ecosystem services
Behavior	Support for or opposition to management practices along urban riparian parks

Survey of Riparian Park Users

Attitudes were assessed with a self-administered, paper questionnaire (SAQ) given to adults over the age of 18 at both urban riparian parks. Presence of the interviewer increases response rate and inspires greater confidence in the legitimacy of the survey, however SAQs increase privacy in a public setting by not requiring individuals to answer out loud and be overheard by friends or strangers, which may also alter their answers (Groves et al., 2009). Each participant was approached by a researcher and provided with a brief verbal introduction to the project and asked whether they would like to participate. If they agreed, they were offered a survey and a formal cover letter explaining the project and securing their understanding (Appendix A). Both the letters and the survey were approved by the Institutional Review Board and were written to emphasize clear, simple language, communicating the usefulness of and appreciation for participation (Dillman, 2000). A log was kept of those who declined participation, noting their gender, group size, approximate age range, as well as a reason for not participating, if given. While many people were using the park alone, when groups were encountered all adults in the group were offered a survey. Any adults in a group who chose not to participate were marked as non-response. Adults in groups were asked to fill out the survey on their own to ensure their answers were their own. Group size was noted along with time and location of the survey. Following the survey, conversations between group members and the researchers on the history and features of the site as well as ecosystem services were common (though not recorded) and an interesting and (I think) positive outcome of interaction.

The heart of the survey (Appendix A) was the exploration of attitudes with a total of 36 rated statements: 12 statements describing the six ecosystem services for each component of attitude, affect, cognition, and behavior. Participants rated the intensity and direction of their attitude towards each statement on a Likert-style ordinal scale of 1-5 (Dillman, 2000). The questions and the scale were worded to allow for either a positive or negative association with the attitude to avoid bias, with a neutral in the middle and an option for uncertainty (Dillman, 2000) (Table 4). Affect, cognition, and behavior were represented by one question stem each, and ecosystem service statements were randomly ordered in each table of questions. In addition, the survey began with several open-ended questions to garner more insight into the service and attitudes about the park. These answers were coded based on ecosystem service and theme. The survey concluded with demographic questions, including age, gender, education, and income level, the frequency of park use, and zip code. These demographics allowed for further characterization of the captured population and the comparison of differences in attitude and usership between parks and with the census statistics for the area. Finally, a contact sheet was provided for (the few) participants who expressed an interest in receiving the results of the study.

Prior to delivering the survey, expert review of the questions (with my committee) and pretesting with 7 non-experts (with my peers) enhanced validity (Dillman, 2000). Pre-testing helped to avoid some language issues, as well as decrease the length of the survey and restructure abstract approaches to services, namely microclimate and storm flow regulation. Original attitude statements that were replaced through this process included the concepts of cooling from evapotranspiration for microclimate regulation, regional cooling of the city provided by green space, and the concept of adaptive public space for periodic flooding.

Table 4: Survey questions with question stems for each component of attitude.

Question Stem	**To what extent do you *care* or *not care* that this area currently provides the following things?**	**How much do you *agree* or *disagree* that this area currently provides the following things?**	**To what extent do you *support* or *oppose* the following management actions being taken in this area at present?**
Ecosystem Service	*Affect* *(Degree of Care or not)*	*Cognition* *(Agree/Disagree)*	*Behavior* *(Support/Oppose Management Practice)*
Refugia (biodiversity of vegetation)	1. A variety of trees and other plants	1. A variety of trees and other plants.	1. Planting a variety of trees and other plants in the area.
Refugia (wildlife habitat)	2. A place where birds and other wildlife can find food and shelter	2. A place for birds and other wildlife to find food and shelter	2. Providing good places for birds and other wildlife to find food and shelter
Climate control/UHI mitigation (general climate refuge)	1. A place to get away from the city heat	1. A place to get away from the city heat	1. Maintaining places to get away from the city heat
Climate control/UHI mitigation (shade specifically)	2. Trees and shade that provide relief from the sun	2. Trees and shade that provide relief from the sun	2. Establishing shade trees to provide relief from the sun.
Storm flow regulation (vegetation to slow and control storm flow)	1. Trees and plants to slow and control the flow of stormwater when it rains	1. Trees and plants to slow and control water when it rains	1. Maintaining trees and plants to slow and control water when it rains
Storm flow regulation (storage to protect from flood damage)	2. An area that stores flood water to protect streets and buildings from flood damage	2. An area that stores flood water to protect streets and buildings from flood damage	2. Managing the area to store flood water to protect streets and buildings from flood
Recreation (active)	1. An area for exercising or physical activities	1. An area for exercising or physical activities	1. Providing infrastructure and areas for exercise or physical activities
Recreation (passive)	2. A place to hang out and enjoy being outdoors	2. A place to hang out and enjoy being outdoors	2. Providing places for people to hang out and enjoy being outdoors
Aesthetics (landscaping)	1. Beautiful landscaping	1. Beautiful landscaping	1. Creating and maintaining a beautiful landscape
Aesthetics (views of water)	2. Nice views of water	2. Nice views of water	2. Creating and maintaining nice views of water
Education (formal education including classes and signs)	1. Educational signs, classes, or other opportunities to learn about the environment	1. Educational signs, classes, or other opportunities to learn about the environment	1. Providing educational signs, classes, or other opportunities to learn about the environment
Education (experiential learning)	2. A place for people to explore and experience the local environment	2. A place for people to explore and experience the local environment	2. Offer places to explore and experience the local environment

Sampling Design

Surveys were conducted using a two-stage stratified random sampling design (Gregoire & Buhyoff, 1999; White et al., 2005). The sample was stratified between the two urban riparian parks, and within each park the sampling frame captured weekends and weekdays as well as different times of day (Table 5). The stratification allowed for a greater potential precision in capturing the target population (urban riparian park users), while also taking a closer look at individual strata (two different urban riparian park designs) (Groves et al., 2009; Gregoire & Buhoff, 1999). To ensure statistical rigor, the two stages – day and time – were selected randomly using a randomized spreadsheet, as outlined by Gregoire & Buhoff (1999).

Though many research designs put a researcher at an entry point and approach individuals on their entry or exit from a park (Gregoire & Buhoff, 1999; White et al., 2005; Min 2011), both Tempe Town Lake and Phoenix Rio Salado are linear, highly porous parks and the time and resources to perform the study were limited. In addition, the parks were designed for different activities. Phoenix Rio Salado is larger, but is less developed and features more dirt trails for hikers and equestrian users. Fishing or water sports are not allowed (nor entirely feasible). Tempe Town Lake is smaller, but more highly developed, and water sports are allowed on the lake. Both parks are circumscribed by paved multi-use paths. Sampling was designed to capture this diversity for the greatest chance at a random sample of a representative variety of users, minimizing the chance a single kind of user is completely left out (in the language of stats: a non-zero, random, representative sample).

Each sampling window was 3 hours and researchers moved between different areas of each park (Figure 4) and approached individuals or groups as they were passed. In order to not over-sample any one area (defined by being north or south of the river and by any major features, such as marina or splash pad) and to have a somewhat random selection of individuals, for every three positive responses in one area, the researchers would move on to a new area. However, as Phoenix Rio Salado receives very few visitors, especially during the summer heat, this was not always possible and long stretches of time would go between seeing any visitors. In this case, nearly every visitor that it was possible and advisable to approach was approached. For safety reasons, researchers were advised not to approach anyone who made them feel unsafe.

A minimum goal of 30 surveys from each park was set to leave the option for parametric statistics open. An adequate number of surveys were collected at Tempe Town Lake over a single round of sampling (two weekdays and two weekend days, for a total of 12 hours). However, visitor numbers were so low at Phoenix Rio Salado that an additional 12 hours were necessary to collect a total of 38 surveys. These additional 12 hours occurred on randomly selected days but sampling was conducted from 7:30-10:30 to avoid the heat and when the most users were present.

The target population – all urban riparian park users – is of unknown size and characteristics. As such, the survey could not be designed in such a way as to capture a representative sample and the results only make valid statistical inferences for people using the park at the time of the survey. This means, strictly speaking, that the results cannot be generalized to a larger population. However, multi-staged, stratified random sampling is a rigorous approach that avoids the potential of "convenience sampling," which introduces bias (e.g. only sampling at convenient times) (Gregoire & Bhoff, 1999). In addition, the stratification acts as a multiple framing of the population, creating a diverse window to capture as much of this unknown population as possible (Groves et al., 2009).

Table 5: Two-stage stratified random sample design

Stratum	
Tempe Town Lake	Phoenix Rio Salado
Stages	
Weekdays Any Monday-Friday 1200-1500 1600-1900 Weekends Any Saturday/Sunday 0900-1200 1500-1800	Weekdays Any Monday-Friday 0730-1030 1200-1500 1600-1900 Weekends Any Saturday/Sunday 0730-1030 0900-1200 1500-1800

*4 were conducted at Phoenix Rio Salado

Figure 4: Sampling paths
(a) Tempe Town Lake sampling path: Researchers moved between the pedestrian bridge by the Tempe Arts Center and the marina, or began at the marina moving towards the pedestrian bridge; and (b) Phoenix Rio Salado Restoration sampling path: Researchers began at the parking and ramada at Central Avenue and circulated between the Audubon Center and the parking and ramada at 7th Avenue. Blue arrows indicate sampling path, dashed arrows indicate exploratory paths abandoned due to low visitor interaction, yellow circles indicate features of interest, and white border indicates the extent of the park considered for the survey.
(a)

(b)

Analysis

Quantitative data were analyzed with the Statistical Package for the Social Sciences (SPSS 20) using descriptive and non-parametric statistics and exploratory factor analysis. All raw data for attitudes were found to have a significant ($p<0.001$) Kolmogorov-Smirnov test statistic indicating normality cannot be assumed (Pallant, 2010).

Though Likert-style scales are linear, they are most correctly described as ordinal rather than interval data because it cannot be assumed the distance between, for example, *agree* and *strongly agree* are equivalent (Jamieson, 2004). There is some debate over the use of parametric versus non-parametric statistics with ordinal data. Though parametric statistics, such as analysis of variance, are most appropriately used for large sample sizes of normally distributed linear data (Jamieson, 2004; Pallant, 2010), the use of parametric statistics has become common practice with attitude scales (Jamieson, 2004). Advocates argue that many parametric tests have proven robust even with smaller sample sizes and with skewed distributions (Norman, 2010). Nonetheless, though skewed distributions are common in the social sciences (Pallant, 2009), the failure of the data to meet normality requirements in combination with small sample size and the ordinal nature suggested nonparametric statistics alone would be most appropriate.

Q1. Efficacy of the tripartite model of attitudes: Can the tripartite model of attitudes be used to describe the subjective evaluations of park users towards ecosystem services?

The survey was first validated using peer review and committee review. The reliability, or the internal consistency, was measured for both the attitude scales (by grouping affect, cognition, and behavior separately) and the ecosystem service scales (by grouping affect, cognition, and behavior for each service together) using Cronbach's Alpha where a value of or above was considered reliable (Pallant, 2010). This was necessary because attitudes are complex and multiple measures were used to construct the same attitude object. The use of the tripartite approach was considered appropriate therefore if a scale was found to be both valid and reliable.

To create a score for attitude as well as a composite score for each ecosystem service, the multiple measures were averaged for each construct. Responses of "don't know" were excluded from these composite scores. In addition, because all three components of attitude can be difficult to measure (see *Conceptual Approach*) principle component analysis (PCA) was used as an exploratory technique to look for disparities between the conceptualization of the tripartite model that would suggest there were either underlying components that might determine more appropriate grouping for the attitudes objects, or that a different conceptualization of components might be more appropriate.

Q2. Attitudes: What are attitudes towards ecosystem services and do they differ between the two urban riparian parks?

To answer this question, both opened-ended and close-ended attitudinal questions were used to better understand people's uses and subjective evaluations of each urban riparian park.

In order to evaluate whether significant differences existed between parks or among user groups, the Kruskal-Wallis test was used, which is the non-parametric alternatives to a one-way analysis of variance. The Kruskal-Wallis is an extension of the Mann-Whitney, but is designed for more than two variables (Pallant, 2010).

Q3 Attitudes and Management: What is the relationship between management practices, the attitudinal assessment of their value, and the socio-ecological context of both?

To better understand and characterize the relationship between ecosystem services, management practices, and the socio-ecological context of each urban riparian park, I used both interviews with park managers and the subjective, open-ended interview questions. I interviewed five individuals associated with the management and design of the parks, representing the City of Tempe, the City of Phoenix, the Arizona Audubon, and the Maricopa County Flood Control District. Interviewees were asked about park management goals and ongoing maintenance efforts, the major challenges and benefits of the riparian park space and adaptability of the management regime, and for their thoughts on how well the sites perform the ecosystem services under investigation.

Qualitative data were primarily useful for a more nuanced understanding of the ecosystem services provided by the urban riparian parks, which the objects in the attitude scale may or may not capture. Qualitative questions on the survey were coded for common themes as well as the dominant ecosystem service reflected in an answer. Coding gives a numerical data point to a non-numerical answer in order to run descriptive statistics (Groves et al., 2009). Normally it would be appropriate to use a Chi-square test for independence (Pearson's Chi-squared to look for differences between categorical variables). While some Chi-square analysis is presented, because of the small sample size, none of the questions met the necessary assumption that at least 5 cases be present in 80% of cells (Pallant, 2010).

Park users subjective evaluations of the sites, the insight from management, and literature review were synthesized to approach this question.

Limitations

The timing of the study was of mixed merits. In May the weather was beginning to transition from spring to summer and many sampling days were in the 90s° F (mid 30s° C). N. Ryan at the City of Tempe noted that my sample would have been very different had I conducted this research in March and April when Tempe Town Lake receives the bulk of its visitors (personal communication, May 4, 2012). Tempe Town Lake is a major event space, and the second most popular tourist destination in Arizona, after the Grand Canyon (D. Kaminski, personal communication, May 18, 2012) and so the demographics of participants also would have been quite different had the survey been conducted earlier in the year.

Non-response at Phoenix Rio Salado was often attributable to failure to provide a Spanish language survey. Given the location and history of the area, this is a major loss to the study. Had a Spanish survey been available the demographics would likely have been more strongly Latino and participation numbers slightly higher.

RESULTS

The results of the survey are presented in this section. Findings and comments from the interviews are included in "study sites" section above and in the *Discussion* following. Survey demographics are included in the *Appendix B.* A total of 104 surveys were collected, 66 from Tempe Town Lake and 38 from Phoenix Rio Salado, on randomly selected days from May 5-May19 2012 (see *Methods*). The response rates of people asked to participate were 50% at Tempe Town Lake and 37% at Phoenix Rio Salado. Non-respondents at Tempe Town Lake were 51% female with a mode for estimated age of 18-29. At Phoenix Rio Salado non-respondents were 65% male with a mode for estimated age of 30-39.

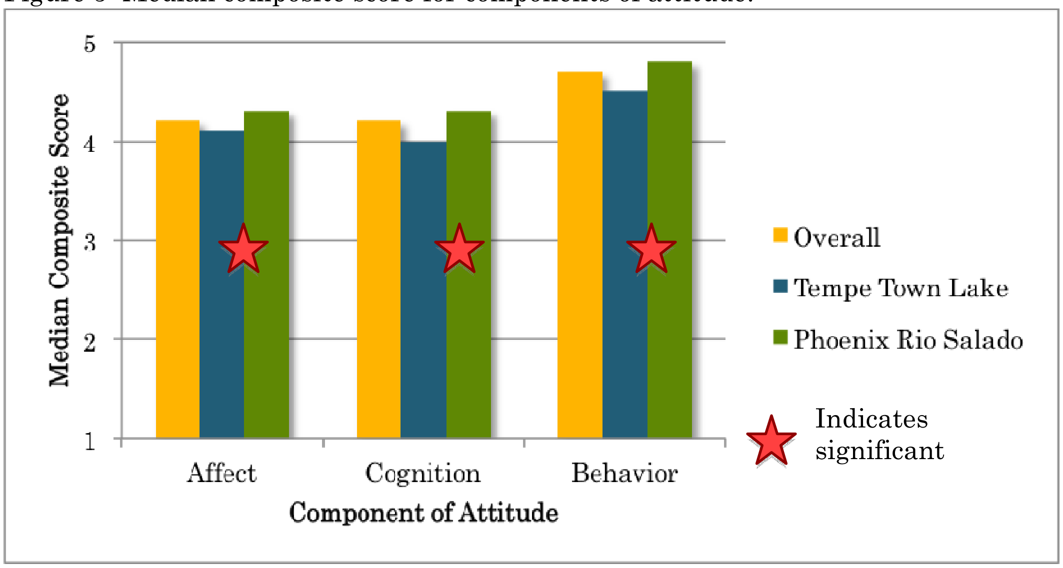
Q1. Efficacy of the tripartite approach

Cronbach's Alpha was used to measure the reliability of both the ecosystem services as well as the components of attitude. In general, the scales for both ecosystem services and attitude can be considered reliable, having Cronbach's Alpha values greater than 0.7 (Table 6). The exception to this was the scale for refugia with an Alpha value of only 0.66. Though 0.66 is not unacceptable, considering the small sample size and exploratory nature of the study, it does suggest the construct for refugia would need to be revisited for a future study.

All components of attitude were scored positively, and their distributions are skewed to the right of normal. The distribution of median composite scores at Phoenix Rio Salado differed significantly from Tempe

Town Lake (ρ<0.05) for affect, cognition, and behavior (Figure 5). The mean rank for all three components of attitude was higher at Phoenix Rio Salado. In addition, the indices for refugia and stormwater regulation were significantly correlated with age across all users, with the highest mean ranks in participants born before 1963 (Appendix C).

Figure 5: Median composite score for components of attitude.



Q2. Attitudes towards ecosystem services and differences between parks

Most ecosystem services were scored positively, and their distributions are skewed to the right of normal. The distributions of median composite scores at Phoenix Rio Salado differed significantly from Tempe Town Lake (ρ<0.05) for refugia, stormwater regulation, recreational opportunities, and educational opportunities (Table 6); the mean ranks for which were higher at Phoenix Rio Salado. Overall, stormwater regulation and educational opportunities were less cared about, seen as present, and supported at both parks than microclimate regulation, recreation, refugia, or aesthetics (Figure 6).

Figure 6: Median composite scores for ecosystem services between Tempe Town Lake and Phoenix Rio Salado.

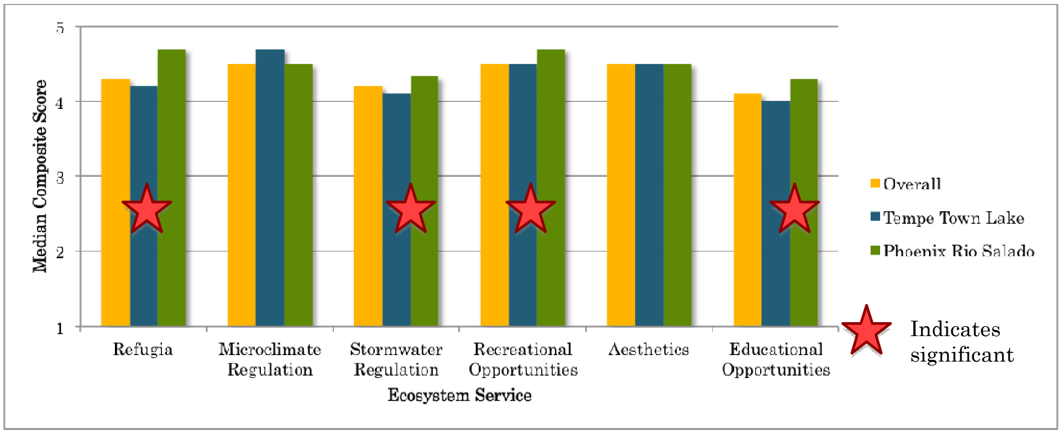


Table 6: Reliability and median composite scores for scales for ecosystem services and components of attitude. *Note that number of cases is not consistent between scale and composite scores as composite scores may include averages where a single response was missing.*

Ecosystem Service	**Number of cases**	**Number of items**	**Cronbach's Alpha**	**Median Composite Score** (n=104*)	**Median Composite Score** TTL (n=66)	RSR (n=38**)	**Kruskal-Wallis Results** χ^2 (df)	ρ
Recreational Opportunities	103	6	0.72	4.5	4.5	4.7	**4.042 (1)**	**0.044**
Microclimate Regulation	103	6	0.75	4.5	4.7	4.5	0.355 (1)	0.551
Aesthetics	103	6	0.73	4.5	4.5	4.5	0.100 (1)	0.752
Refugia	103	6	0.66	4.3	4.2	4.7	**13.862 (1)**	**0.000**
Stormwater Regulation	103	6	0.78	4.2	4.1	4.3	**5.111 (1)**	**0.024**
Education	97	6	0.78	4.1	4.0	4.3	**14.589 (1)**	**0.000**
Component of Attitude	**Number of cases**	**Number of items**	**Cronbach's Alpha**	**Median Composite Score** (n=104*)	**Median Composite Score** TTL (n=66)	RSR (n=38**)	**Kruskal-Wallis Results** χ^2 (df)	ρ
Affect	101	12	0.84	4.2	4.1	4.3	**3.700 (1)**	**0.054**
Cognition	103	12	0.84	4.2	4.0	4.3	**5.109 (1)**	**0.024**
Behavior	103	12	0.85	4.7	4.5	4.8	**3.719 (1)**	**0.054**

*n= 103

**n=37 for stormwater regulation and affect

48

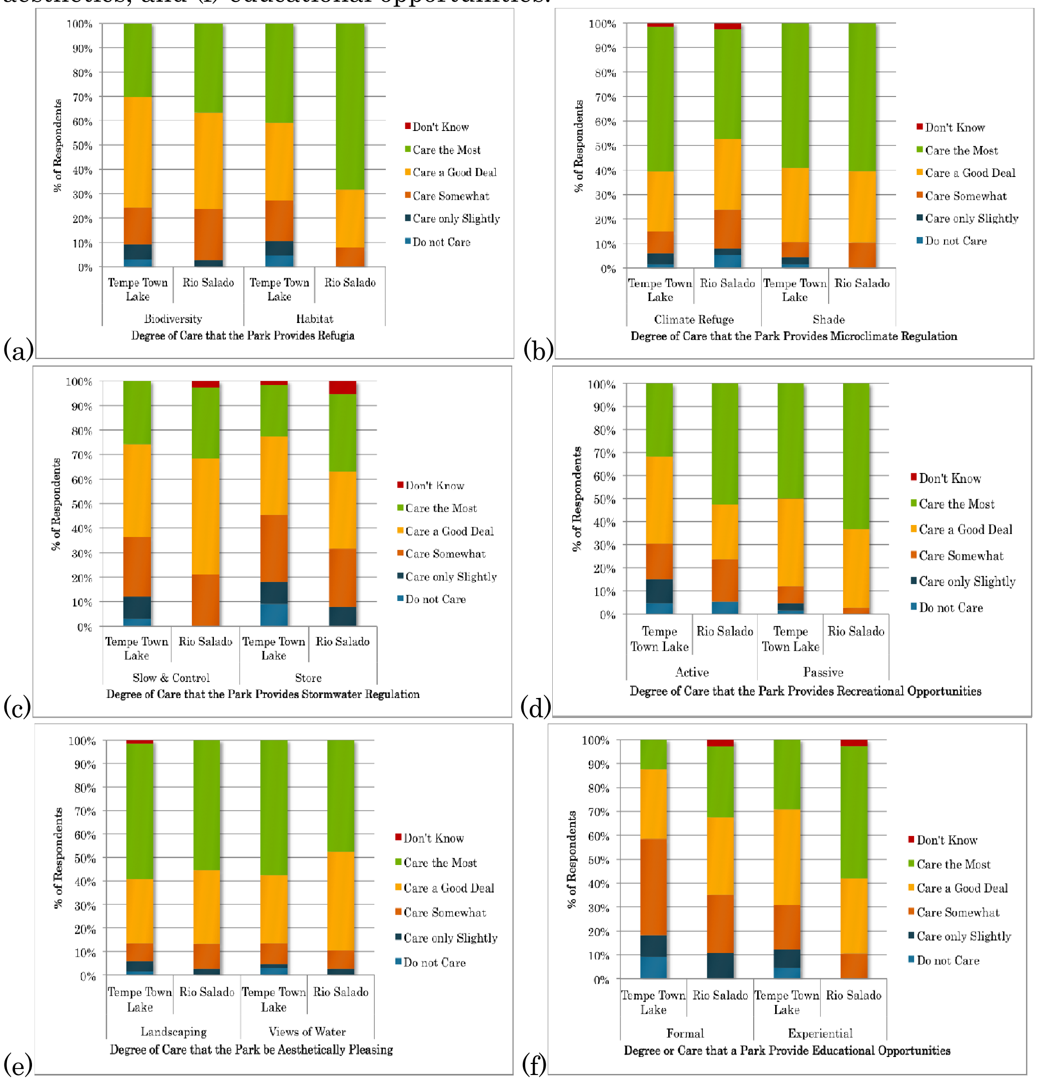
Affective Care about Ecosystem Services.

Twelve questions on the survey rated the degree to which participants cared or did not care about each ecosystem service. As the concept of ecosystem services is complex and the language is not part of an everyday vocabulary, each construct was described in two ways (see *Methods*). Cronbach's Alpha suggested that these scales were reliable; however, the distribution of answers did vary slightly (Figure 12). It is apparent that most people care about all of the ecosystem services in question, with 50-90% of attitudes expressed "care a good deal" or "care the most." The notable exception to this is formal education, on which Tempe Town Lake participants were more neutral than Phoenix Rio Salado visitors (Figure 12f). While nearly all components of ecosystem services had some portion of survey takers admit that they "do not care" or "care only slightly". Interestingly, these sentiments were most common in regards to stormwater regulation and educational opportunities (Figure 12c and 12f). These two components also received the most responses of "don't know." A Kruskal-Wallis test found habitat, formal and informal education were significantly different between the parks and the mean ranks for these components were higher at Phoenix Rio Salado (Table 12).

Table 7: Kruskal-Wallis results comparing affective measures for ecosystem services between parks.

Ecosystem Service	ES Component	N	Kruskal-Wallis Results χ^2 (df) | ρ	
Refugia	Biodiversity	104	0.392 (1)	0.531
	Habitat	**104**	**8.885 (1)**	**0.003**
Microclimate Control	Climate Refuge	102	2.047 (1)	0.153
	Shade	104	0.030 (1)	0.862
Stormwater Regulation	Slow & Control	103	2.040 (1)	0.153
	Store	101	2.816 (1)	0.093
Recreation	Active	104	3.335 (1)	0.068
	Passive	104	2.459 (1)	0.117
Aesthetics	Landscaping	103	0.036 (1)	0.850
	Views of Water	104	0.474 (1)	0.491
Educational Opportunities	**Formal**	**101**	**6.012 (1)**	**0.014**
	Experiential	**102**	**9.437 (1)**	**0.002**

Figure 7: Distribution of scores for affect across both sub-categories for (a) refugia (b) microclimate regulation, (c) stormwater regulation, (d) recreational opportunities, (e) aesthetics, and (f) educational opportunities.



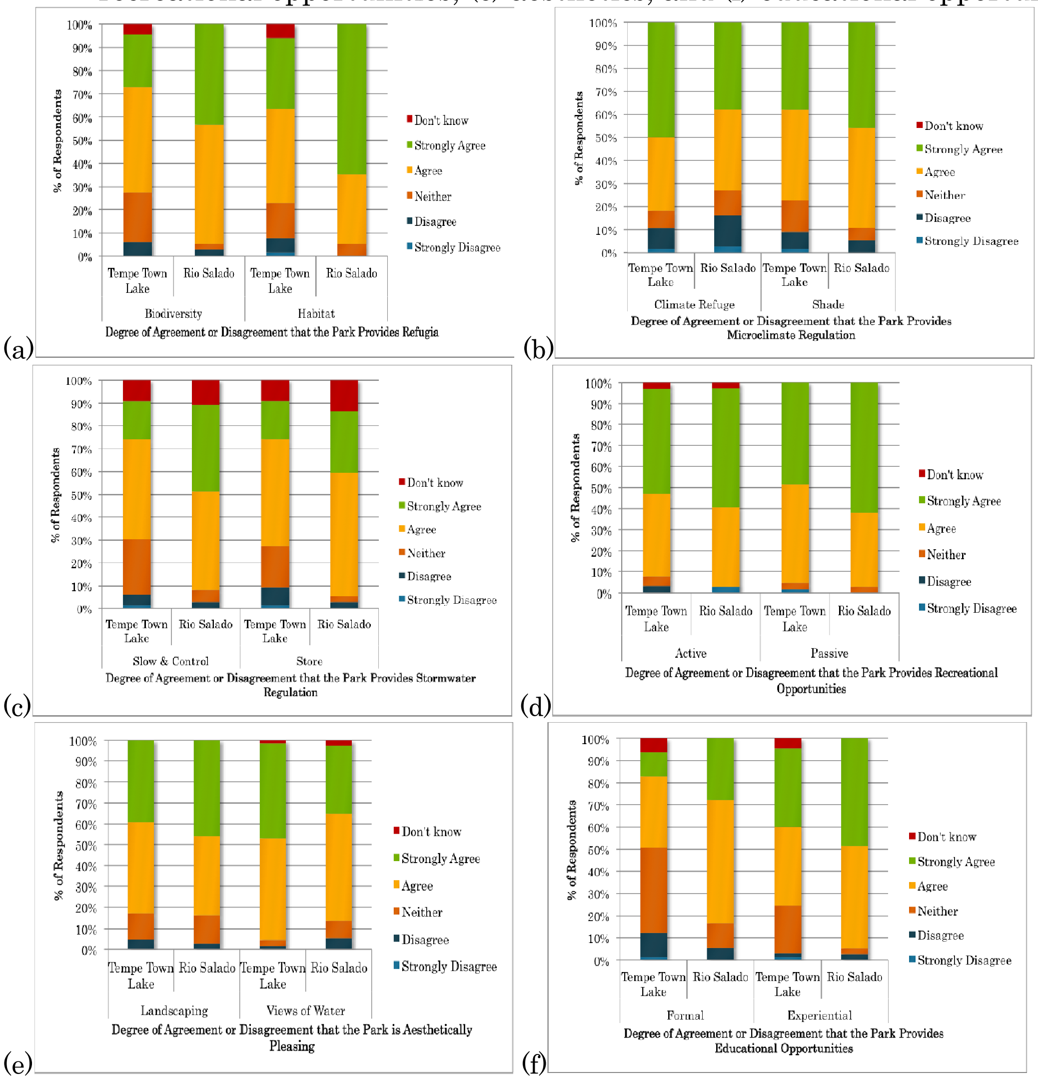
Cognitive Perceptions of Ecosystem Services.

Twelve questions on the survey rated the degree to which participants agreed or disagreed that an urban riparian park provided a particular service. Again, each construct for ecosystem services was described in two ways (see methods) and Cronbach's Alpha suggested that these scales were reliable. However, the distribution of answers did vary slightly between them. Again, scores are overwhelmingly positive with most participants "agreeing" or "strongly agreeing" that sites provided each ecosystem service (Figure 13). The most notable variances are in microclimate regulation where 5-14% of the population surveyed disagreed that adequate microclimate regulation was provided, depending on the phrasing (Figure 13b). Also of note is the 9-14% of the population at both parks who admitted they did not now how well the site offered stormwater regulation (Figure 12c). The distribution of scores for biodiversity, habitat, slowing and controlling water, storing flood water, and formal education are significantly different between the two parks ($\rho<0.05$) (Table 13). The mean ranks are higher at Phoenix Rio Salado for these five components.

Table 8: Kruskal-Wallis results comparing cognitive components of ecosystem services between parks.

Ecosystem Service	ES Component	N	Kruskal-Wallis Results χ^2 (df) | ρ	
Refugia	**Biodiversity**	**100**	**7.888 (1)**	**0.005**
	Habitat	**99**	**11.565 (1)**	**0.001**
Microclimate Control	Climate Refuge	103	1.707 (1)	0.191
	Shade	103	1.482 (1)	0.224
Stormwater Regulation	**Slow & Control**	**93**	**9.262 (1)**	**0.002**
	Store	**92**	**6.035 (1)**	**0.014**
Recreation	Active	100	0.630 (1)	0.427
	Passive	103	1.805 (1)	0.179
Aesthetics	Landscaping	101	0.354 (1)	0.552
	Views of Water	101	2.567 (1)	0.109
Educational Opportunities	**Formal**	**97**	**11.997 (1)**	**0.001**
	Experiential	99	3.505 (1)	0.061

Figure 8: Distribution of scores for cognition across both sub-categories for (a) refugia (b) microclimate regulation, (c) stormwater regulation, (d) recreational opportunities, (e) aesthetics, and (f) educational opportunities.



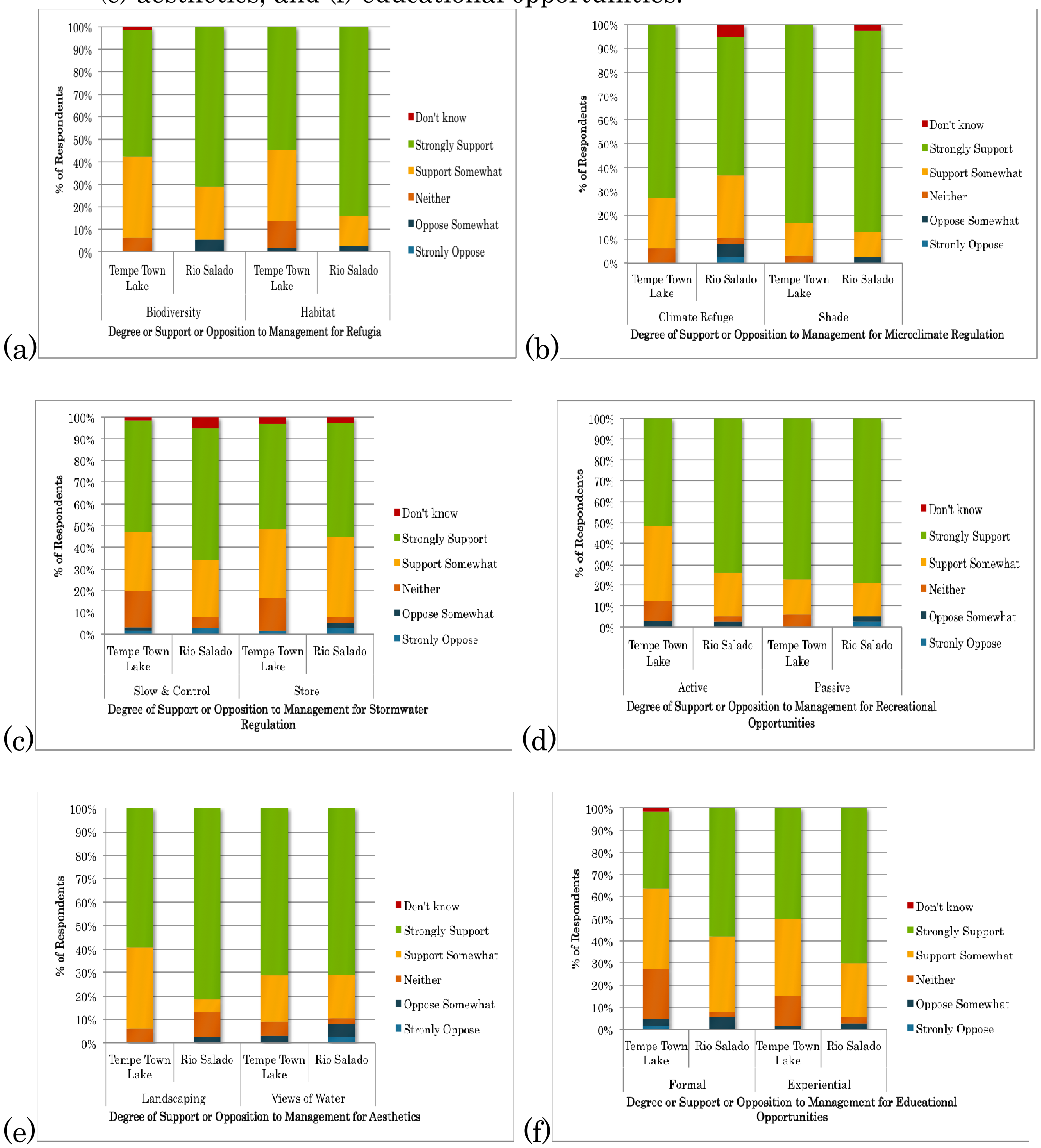
Behavioral Support for Ecosystem Services.

Twelve questions on the survey rated the degree to which participants supported or opposed management for ecosystem services at the two urban riparian parks. Again, each construct for ecosystem services was described in two ways (see methods) and Cronbach's Alpha suggested that these scales were reliable; however, the distribution of answers did vary slightly between them. Visitors to the park overwhelmingly supported all management practices for ecosystem services (Figure 14), but the distribution of scores for habitat, active recreation, and both formal and informal education were significantly different between the two parks ($\rho<0.05$) (Table 14). The mean rank for all five of these components was higher at Phoenix Rio Salado. There was very little opposition to management – a frequent comment was, "It all sounds good" – however, the little opposition that existed tended to be stronger at Phoenix Rio Salado (Figure 15, "Concerns and Interests about Park Management", below). This might be because the ethic of restoration is conscious of the negative consequences of humans managing ecosystems. Stormwater regulation again garnered the most uncertainty (Table 14c).

Table 9: Kruskal-Wallis results comparing behavioral components of ecosystem services between parks.

Ecosystem Service	**ES Component**	**N**	**Kruskal-Wallis Results χ^2 (df)**	**ρ**
Refugia	Biodiversity	103	1.738 (1)	0.187
	Habitat	**104**	**9.341 (1)**	**0.002**
Microclimate Control	Climate Refuge	102	1.707 (1)	0.191
	Shade	103	0.164 (1)	0.686
Stormwater Regulation	Slow & Control	101	1.813 (1)	0.178
	Store	101	0.432 (1)	0.511
Recreation	**Active**	**104**	**4.844 (1)**	**0.028**
	Passive	104	0.028 (1)	0.867
Aesthetics	Landscaping	104	3.434 (1)	0.064
	Views of Water	104	0.012 (1)	0.912
Educational Opportunities	**Formal**	**103**	**6.473 (1)**	**0.011**
	Experiential	**103**	**4.263 (1)**	**0.039**

Figure 9: Distribution of scores for behavior across both sub-categories for (a) refugia (b) microclimate regulation, (c) stormwater regulation, (d) recreational opportunities, (e) aesthetics, and (f) educational opportunities.



Q3. Attitudes and Management

This final section presents the qualitative, open-ended answers from surveys. Synthesis of these comments with management practice is presented in the discussion.

Reasons for coming to the park.

Answers to the question, "Why did you come to [the park] today?" were coded into nine sets of ecosystem services and an "other" category. The ecosystem services represented include: Aesthetics, Cultural Identity, Human Development, Inspiration, Interpersonal Relationships, Recreation, Refugia, and Societal Relationships (Table 8). Response phrases were further broken down into specific activities or characteristics of the site that were identified as having drawn the user (Table 8). The "other" category included built infrastructure that was, strictly speaking, not an ecosystem service, but rather a constructed amenity that could theoretically be enjoyed whether the park was present or not. For example, splash pads (play areas featuring shooting water) for children are a common feature in Arizona's public space and are also found at venues such as open-air malls.

Responses with multiple characteristics or activities mentioned were separated into fragments. For example, participant #39 reported coming to Tempe Town Lake to "enjoy [the] outdoors and views of water." "To enjoy the outdoors" was a common theme among respondents and coded as the ecosystem service *recreation* and the activity *passive recreation – general*. In this example, the individual also mentioned water as a specific draw, so #39 was split into two fragments and the second half of the statement coded as *aesthetics* with the specific characteristic *views – water*.

Table 10: Ecosystem service codes for open-ended answers as to why participants came to the parks

Ecosystem Service	Response Frequency		Description	Code	Response Frequency	
	Tempe Town Lake	Phoenix Rio Salado			Tempe Town Lake	Phoenix Rio Salado
Other (000)	6	2	built infrastructure - play equipment	1	5	0
			built infrastructure - other	2	1	2
Aesthetics (100)	4	6	beauty	101	1	2
			cleanliness	102	0	1
			natural characteristics	103	1	2
			views - general	104	0	1
			views - water	105	2	0
Cultural Identity (200)	5	1	sightseeing	201	5	1
Education (300)	1	1	show my child nature	301	1	1
Inspiration (400)	1	0	play an instrument	401	1	0
Interpersonal Relationships (500)	10	0	spend time with family	501	5	0
			spend time with friends	502	5	0
Recreation (600)	46	23	active recreation - biking	601	1	3
			active recreation - running	602	3	0
			active recreation - water sport	603	5	0
			active recreation - other	604	0	5
			active recreation - walk the dog	605	1	2
			passive recreation - general	606	6	1
			passive recreation - observation	607	3	1
			passive recreation - reading	608	1	1
			passive recreation - fishing	609	11	0
			passive recreation - walk	610	3	3
			psychological restoration - relax/find silence	611	6	5

			psychological restoration - breaks/time out	612	6	2
Refugia (700)	0	6	view wildlife	701	0	5
			interact with wildlife	702	0	1
Communit y Relationshi ps (800)	4	3	community engagement	801	2	0
			nature volunteering	802	0	2
			socialization	803	2	1

In total, 101 participants explained why they came to the urban riparian parks, yielding 119 activity fragments. *Recreation* was, not surprisingly, the most commonly identified reason for coming to the park, comprising 55-60% of all visits (Figure 5). No users identified Tempe Town Lake as a place to visit for its habitat characteristics (Figure 6), whereas this service comprised 14% of reasons to visit Phoenix Rio Salado. Aesthetics and refugia were the second most common reasons to visit Phoenix Rio Salado, comprising 14% each of responses. Thirteen percent of visitors to Tempe Town Lake reported using the site as a location to engage in family activities or be with friends (coded as Interpersonal Relationships) a service not specifically identified as Phoenix Rio Salado. Pearson's Chi-squared for parks versus motivations for coming suggests that the difference between parks are significant (χ^2 (8, n=119) = 21.436, ρ=0.006). However, 72% of cells did not contain at least 5 cases; this is because some services were dominantly documented at only one park. Cramer's V = 0.494, suggesting the effect size is moderate.

Figure 10: Recreation is the most commonly identified service motivating visits to these two urban riparian parks.

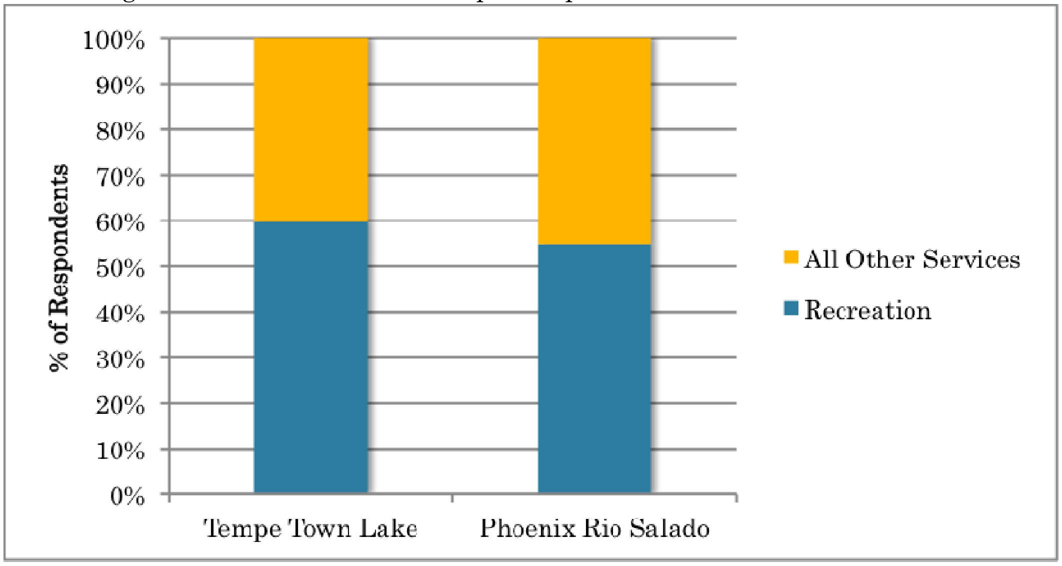
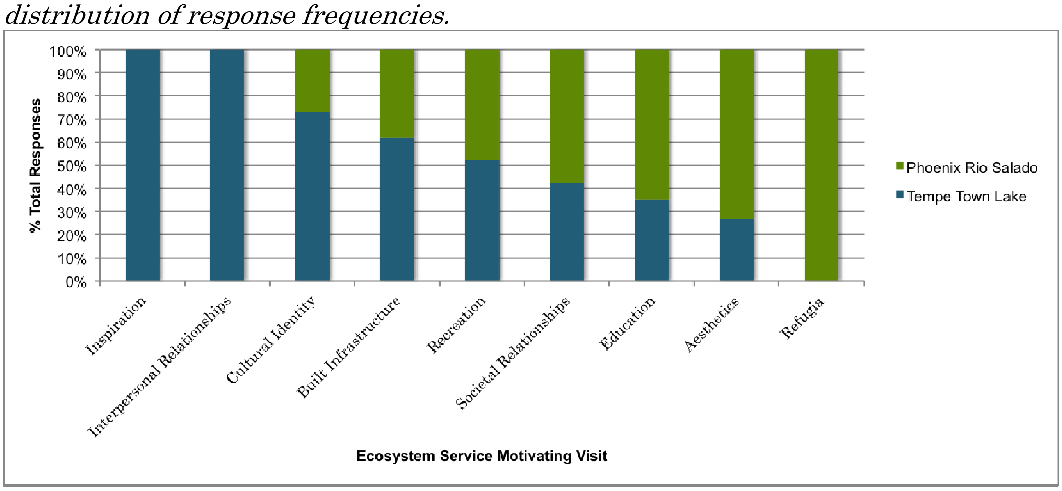


Figure 11: Distribution of all motives for visiting between the two parks (constituting the "all other" in Figure 6 above) as a percentage of total responses for each service. *Note: all bars do not represent the same number of responses (see Table 8), only the distribution of response frequencies.*



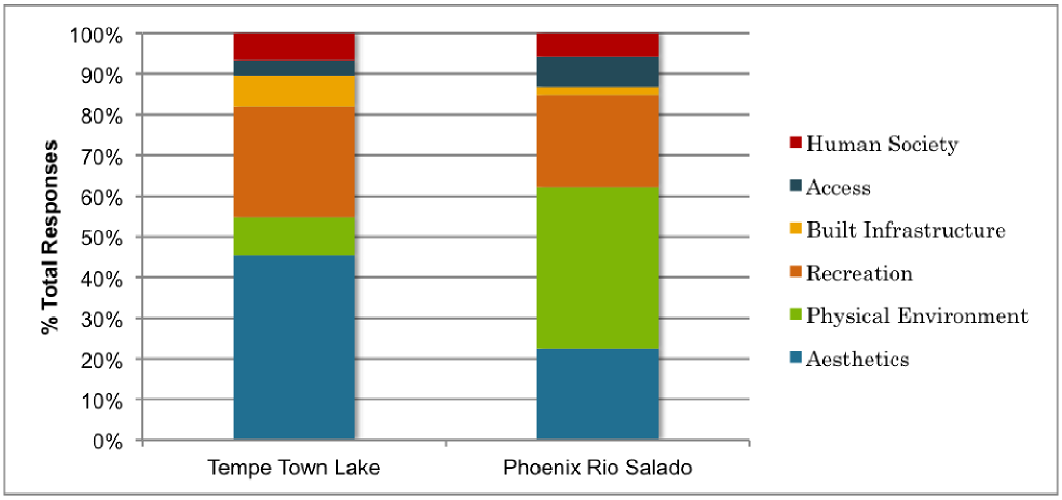
Favorite and Least Favorite Aspects of Tempe Town Lake and Phoenix Rio Salado Parks.

Visitors were asked to comment on their favorite and least favorite aspects of the parks, the goal of which was to take a qualitative look at both the services and disservices provided by nature in the city. However, responses had more to do with design and culture than nature, per se. These responses were coded into positive and negative attributes and given broader social-ecological codes including access, aesthetics, built infrastructure, human society, environment, and recreation (Table 9). In total 100 participants offered their favorite aspects of the parks, yielding 159 fragments, coded into 21 positive aspects in 6 aspect sets. Only 73 participants offered their least favorite aspects of the parks, yielding 89 fragments coded into 18 negative aspects within the same 6 aspect sets.

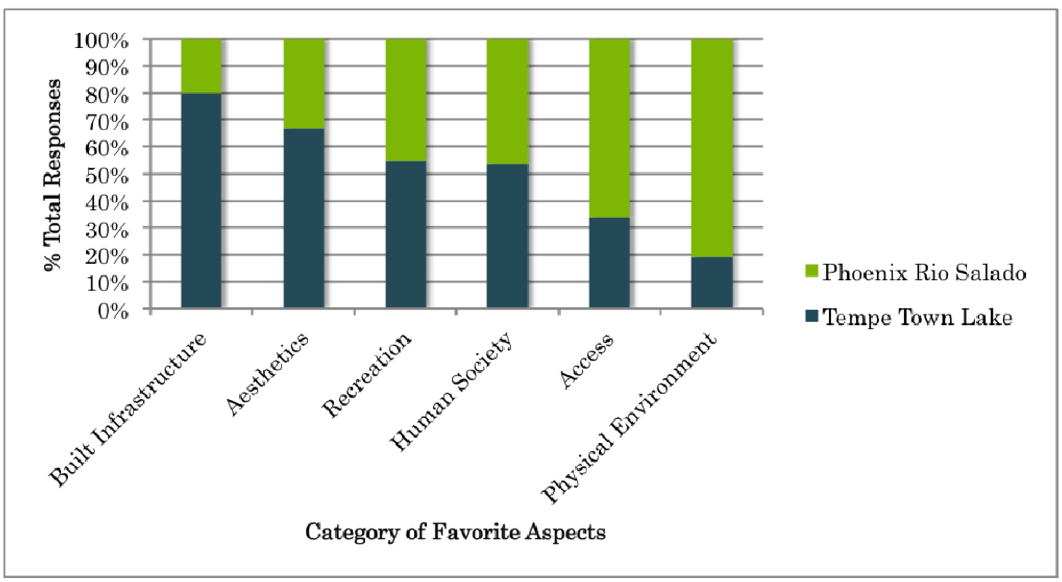
The most popular aspect of Tempe Town Lake was by far the aesthetics (Figure 7a). The single most frequently made comment was to look at and be near water; however, people also commented frequently that Tempe Town Lake was "clean" and they enjoyed the general look of it and the views of bridges. The most popular aspect of Phoenix Rio Salado was the environment. People recognized it as "urban nature" and appreciated that it had been recovered from trash, neglect, and habitat loss. Recreational opportunities were popular aspects of both parks (Figure 7b). Pearson's Chi-squared for parks versus favorite aspects suggests that the differences between parks are significant (χ^2 (5, n=159)= 24.671, ρ<0.001). However, 25% of cells did not contain at least 5 cases. Cramer's V = 0.394 suggesting the effect size was moderate (Pallant, 2010).

Figure 12: Distribution of responses for positive aspects (a) between total responses for all social-ecologically coded sets of response and (b) between the total responses for both urban riparian parks. *Note: all bars do not represent the same number of responses (see Table 9), only the distribution of response frequencies.*

(a)



(b)

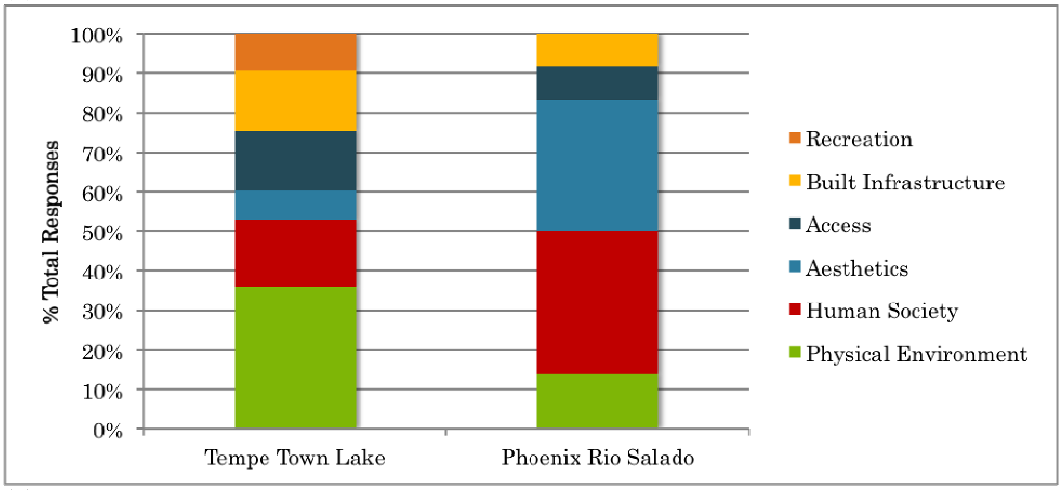


The least favorite aspects of Tempe Town Lake had to do with the environment (Figure 8a), specifically a desire for more shade/microclimate regulation and the perception of birds and insects as nuisances. At Phoenix

Rio Salado aspects of aesthetics and human society were equally recognized as troublesome. Many of the aesthetic concerns were general, but some had to do specifically with the perception of a lack of maintenance and the prevalence of trash. Concerns about safety and presence of the homeless or suspicions of drug use dominated this set of comments. Aesthetics and human society were less commonly cited at Tempe Town Lake (Figure Xb) where the major comments had to do with negative user interactions, specifically individuals not picking up after their dogs. Individuals at Tempe Town Lake also tended to expect more built infrastructure, such as restrooms and food vendors. Pearson's Chi-squared for parks versus least-favorite aspects suggests that the difference between parks are significant (χ^2 (5, n=89)= 19.919, ρ=0.001). However, 25% of cells did not contain at least 5 cases. Cramer's V = 0.473, which suggested that the effect size was moderate (Pallant, 2010).

Figure 13: Distribution of responses for negative aspects (a) across total responses for all social-ecologically coded sets of responses and (b) between total responses for both urban riparian parks. *Note: all bars do not represent the same number of responses (see Table 9), only the distribution of response frequencies.*

(a)



(b)

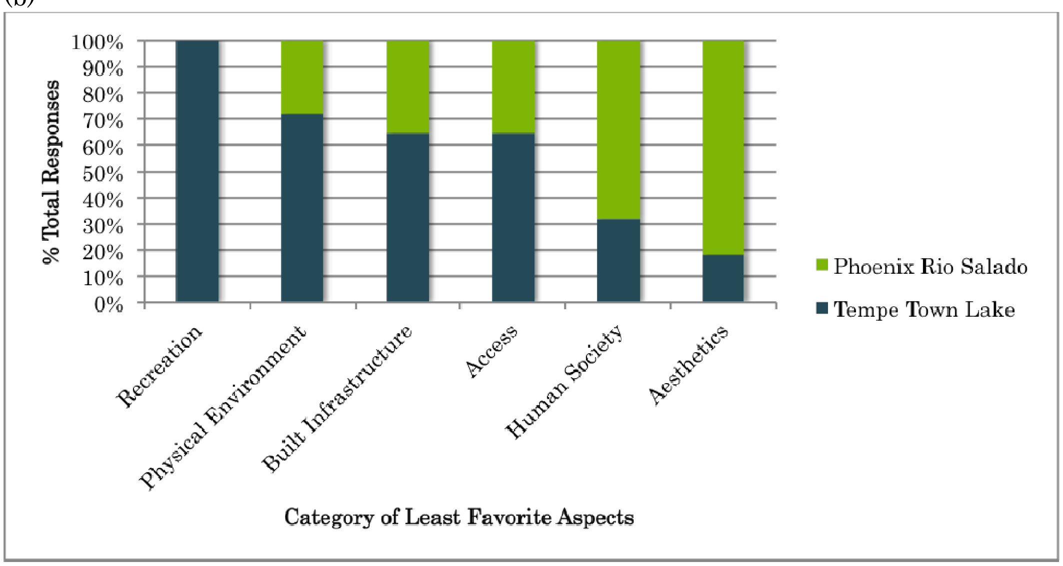


Table 11: Positive and negative attributes identified by survey participants at each urban riparian park and their frequency (both parks combined).

Attribute Set	Positive Attribute	Code	Response Frequency	Negative Attribute	Code	Response Frequency
Access (100)	access/location	101	8	inconvenient access/design	151	11
Aesthetics (200)	aesthetics - general	201	6	aesthetics - general	251	6
	aesthetics - bridges	202	6			
	aesthetics - planes	203	3			
	aesthetics - views	204	8			
	aesthetics - water	205	30			
	aesthetics - clean	206	7	aesthetics - inadequate maintenance	256	4
				aesthetics - trash	257	6
Built Infrastructure (300)	built infrastructure - general	301	4	built infrastructure - general	351	2
	built infrastructure - splash pad	302	5			
				built infrastructure - bathrooms	353	3
				built infrastructure - water fountains	354	3
				lack of food vendors	355	3
Human Society (400)	positive human interaction	401	4	user interaction problems	451	6
	uncrowded	402	2	presence of undesirable people/activities	452	7
	safe	403	4	safety concerns	453	4
				signs of civilization	454	4
				governance	455	1
Physical Environment (500)	microclimate regulation	501	7	inadequate microclimate regulation	551	10
	urban nature/natural state	502	21	urban nature interaction problems	552	9
				concerns about pollution	553	5
	restoration/urban renewal	504	3			
Recreational (600)	recreational opportunities - general	601	4	recreational opportunities - needs more	651	1

64

	recreational opportunities - fishing	602	4			
	recreational opportunities – trails for walking and biking	603	14			
	recreational opportunities - water sport	604	5	recreational opportunities - no swimming	654	4
	psychological restoration - relaxing/quiet	605	10			
	child-friendly	606	4			
n			**159**			**89**

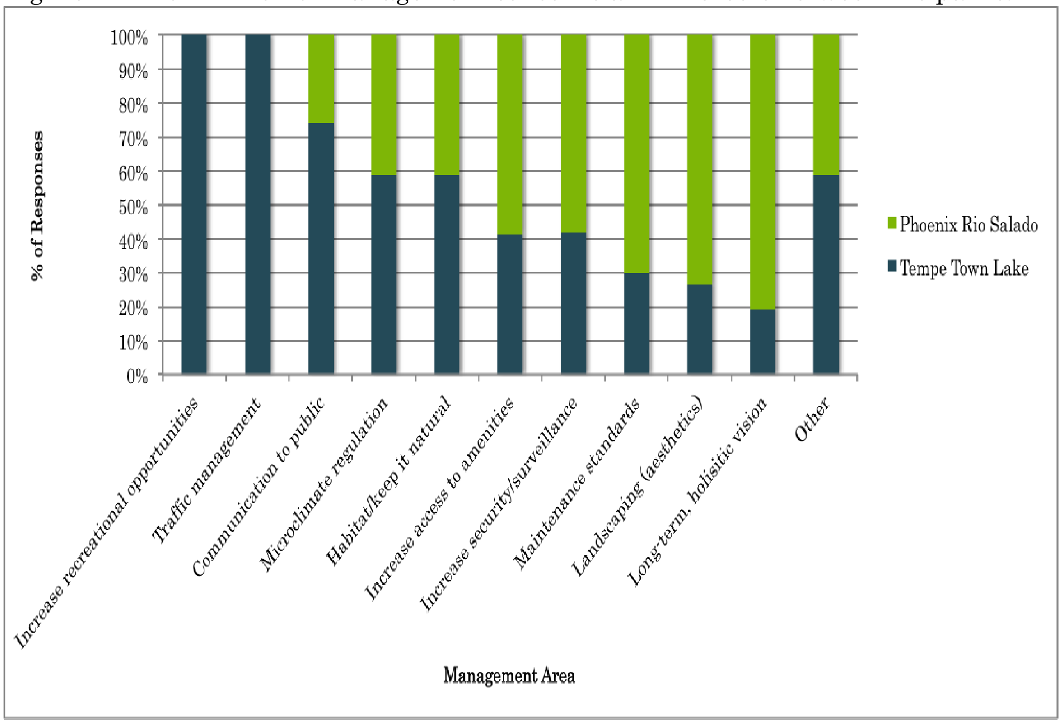
Concerns and Interests about Park Management.

The final open-ended question asked survey participants to comment on any concerns or interests about site management. Only 44 participants offered comments on this section of the survey, yielding 47 fragments in 10 management areas (Table 10). The other 57% of participants either left this question blank or indicated they had no concerns or interests. Security and surveillance were the most commonly expressed concerns, 60% of these concerns coming from visitors to Phoenix Rio Salado (Figure 9). The standard of maintenance was also a concern expressed primarily at Phoenix Rio Salado, where visitors either felt that maintenance had fallen or that the park was overgrown. Communication to the public was an interest of visitors at Tempe Town Lake who wanted to know more about water quality and rules concerning fishing. Of relevance to sustainability specifically, four park visitors expressed an interest in the city maintaining a commitment to its green space and a long-term vision for its role in the community. For three individuals this was a hope that the commitment they perceived in the development of park space continued, for one the feeling the commitment had not been made.

Table 12: Areas of concern or interest in management of the parks.

Management Area	Frequency
Increase security/surveillance	10
Maintenance standards	8
Communication to public	4
Increase access to amenities	4
Increase recreational opportunities	4
Long-term, holistic vision	4
Habitat/keep it natural	3
Microclimate regulation	3
Landscaping improvements	2
Traffic management	2
Other	3

Figure 14: Distribution of management concerns and interests between the parks.



DISCUSSION

Attitudes are evaluative in nature: They are complex and they have direction. This study shows that all three components of attitude are positively associated with the ecosystem services provided by urban riparian parks. These are not blanket attitudes towards nature, but rather nuanced and significantly different evaluations of different representations of nature along urban waterways. It is clear that park users value urban nature highly and support management for ecosystem services; their attitudes add an important dimension to the feasibility and success of sustainable cities that use green infrastructure to meet a suite of needs, from the function of the city as an integrated grey-green ecosystem to the health and education of its citizens.

Q1. Efficacy of the tripartite approach: Can the tripartite theory of attitudes be used to describe the subjective evaluation of ecosystem services and disservices from urban riparian public spaces?

The use of attitude theory to measure the subjective evaluations of ecosystem services was successful, wherein the framing of affect, cognition, and behavior tapped into similar dimensions. Results show that park users' subjective evaluations of the ecosystem services provided by urban riparian parks were overwhelmingly positive, matching findings of Jim and Chen (2006). The survey revealed that people cared about and supported ecosystem services, and mostly perceived the six services as provided by urban riparian parks. It is possible that the presentation of the questions concerning the three components of attitude in three distinct tables biased the responses, resulting in an artificial reliability (Groves et al., 2009). Ecosystem services, however, which are composites of the three attitudes, were also reliable, indicating differentiation between service types and upholding reliability. There are two seeming-anomalies in the data, however. The first is that quantitative values for behavior (support) were higher than affect (or cognition). The other is that exploratory factor analysis did not reduce all 36 statements into three dimensions, indicating that a tripartite model for attitudes might not be the full story.

One potential interpretation of these results is that the wording of the attitude questions was not suitable for all services and should be revisited. While the components for affect and cognition were straightforward, management is a somewhat specialized profession and the behavior question was left non-specific as to *how* an individual might support actions being taken by management to provide a service. Such an open-ended approach may be better suited for services where it is clearer what a management action looks like. The presented approach was taken so as to phrase questions consistently using a 5-item Likert scale, capturing *degrees* of each component of attitude, which limited the ability to get at some forms of behavior. In a study by Bright et al. (2002) behavior was ascertained by asking a series of "yes/no" questions about activities one had engaged in at the public space in question. While their goal was not to measure ecosystem services, assessing the personal interaction with the park may be a more definitive way to understand support for perceived services and opposition to perceived disserves. Such a lack of specificity may explain why quantitative support by user groups was greater even than affect or cognition and poorly nuanced, as it is unclear why an individual would oppose a service. The open-ended answers on this survey provide a suitable pilot study for the outline for a more specific approach using individual actions.

Another potential interpretation is that the wording was adequate, but the tripartite model does not perfectly capture the dimensions necessary to characterize the subjective value the public holds for services provided by urban riparian park space. Recreation and stormwater regulation are examples of this. Recreation was the most highly valued service provided by urban riparian parks while stormwater regulation was the least valued. Recreation is well understood by the individual while regulation of stormwater in cities is a design problem with engineered solutions, which are successful when they control the problem and ultimately hide it from the public. Since the regulation of stormwater is not something the average citizen has to actively think about, it follows that there are fewer positive associations between a parks providing stormwater regulation than recreation. The 4-component factor analysis results hint that cognition could play a major role in the value of ecosystem services, and may offer an interesting why to categorize services for discussions about subjective values. In this 4-component solution, aesthetics, recreation, and microclimate regulation loaded on a different factor than refugia, stormwater regulation, and educational opportunities, which reflect more of a community-level awareness of the site. The fracture in cognition seems to indicate that thoughts or beliefs that a space provides services depend on the quality of the service – on the one hand individual-level services indicating preference for and enjoyment of a site for personal use (aesthetics, recreational activities, suitability of the microclimate), and on the other, community-level or altruistic services whose benefits are beyond the expertise of the individual (the suitability of habitat, educational opportunities, or stormwater regulation). Interestingly, mean scores for these first three variables were also more highly rated than the mean scores for the latter three. The exception to this is refugia, which is valued significantly more at Phoenix Rio Salado than at Tempe Town Lake.

Q2. Attitudes: What are the attitudes towards ecosystem services and do they differ between the two urban riparian parks?

Attitudes of urban park users towards ecosystem services do appear sensitive to design. Affect, cognition, and behavior were all significantly more positive at Phoenix Rio Salado than at Tempe Town Lake and the composite scores for community-level services (refugia, education, stormwater regulation) plus recreation were significantly different between the parks. As the average age of Phoenix Rio Salado park users surveyed was older, some of the variance between the parks may be attributable to siginificant differences between age groups. The significant relationship between age and refugia and age and stormwater regulation, however, becomes insignificant when the data are separated by park and does not hold for any of the other indices. It is reasonable to conclude, therefore, that it is the structure and function of

Phoenix Rio Salado itself that lends to these differences in attitudes towards ecosystem services.

Phoenix Rio Salado is managed first and foremost as habitat, an urban refuge for native flora and fauna, as well as for migrating species. The fact that all scores for ecosystem services are higher in Phoenix Rio Salado speaks strongly to positive associations of urban dwellers with this kind of designed nature. The positive attitudes towards environmental education – not just a recognition that more educational opportunities exist at Phoenix Rio Salado, but also a greater *care* and *support* for education among its users – is especially interesting and suggest a cultural association being made between nature education and a less manicured but clearly designed urban habitat. Sarah Porter, Executive Director of the Arizona Audubon notes that the ultimate goal of Audubon programs is to get people involved with hands-on stewardship and "turning those experiences into political action or political decision-making" (personal communication, May 18, 2012). This research shows that exposure to different designs of urban green space – whether formal or informal – could be affecting people's attitudes towards ecosystem services, which would in turn affect related political actions. The correlation between design for refugia and more positive attitudes towards refugia and environmental education imply the powerful consequences of design on shaping a citizen-supported sustainable city.

The distinction in attitudes between Tempe Town Lake and Phoenix Rio Salado is in some ways troubling. Both sites constitute highly managed public space, maintained through constant inputs of water, energy, and tax dollars, and form a basis for interactions between people, plants, and wildlife. While Tempe Town Lake may not be seen as good habitat by park users, the lake supports more fish than were ever planned for, and a variety of birds frequent the location, forcing the park managers to keep constant tabs on species and populations that may endanger the flight path of Phoenix International Airport (N. Ryan, personal communication, May 4, 2012). Habitat rehabilitation was conducted at the inflow from Indian Bend Wash, is accessible to park users by multi-use path, and provides seating, shade structures, and educational signage (McGann & Associates, 2002). Wetland vegetation and wildlife in the Salt River channel mostly upstream but also downstream of the lake are immensely successful and largely unplanned, responding to increased releases from the Mesa water treatment facility (excess water bypasses the lake through a pump system and is released again below the dam) (D. Kaminski, personal communication, May 18, 2012). The success and adaptability of "wild" urban nature in this case is an obvious reason to be cognizant of urban riparian areas and the compounding benefits, both serendipitous and planned, that they provide. For example, Tempe installed a bypass system, pumping effluent water around the lake and releasing it at the base of the dam, out of concern the nutrient-rich effluent would disturb the careful balance of the lake (D. Kaminski, City of Tempe, May 18, 2012). Though not yet studied, it is possible these spontaneous wetlands are providing secondary treatment to the nutrient-rich effluent the city is concerned about. There is an obvious potential here to use and expand on the services provided by riparian vegetation to save money for the city.

While the problem of birds in the PHX flight path remains a challenge, implementing design to support urban nature could help the city meet the restoration goals required by the Army Corp and provide the potential for improved attitudes towards ecosystem services by citizens.

I believe the effluent scenario highlights how Tempe Town Lake is an amazing feat of engineering, a grey infrastructure project, with engineered solutions. Engineering with ecosystem services in mind could increase the value of the project to the city in more ways than one. While it is not in the scope of this study to say why more people visit one park than the other, the higher valuation of the ecosystem services at Phoenix Rio Salado where native vegetation and wildlife may flourish, but usership is much lower, reaffirms a narrow interpretation of nature in an urban context and points to the lost potential of a vibrant urban park like Tempe Town Lake. If we do not think of areas such as Tempe Town Lake as urban nature then we may fail to manage them in a way that promotes ecosystem services and urban sustainability.

Ultimately, sustainable urbanity must be valued and supported by its citizens. Both of these parks are venues for making the personal associations with nature that are critical for a sustainable future (Kumar & Kumar, 2007; Miller 2005) however qualitative answers on the survey indicate that Tempe Town Lake is much more about people and interaction, whereas Phoenix Rio Salado is more about individual pursuits and nature. Both these aspects of urban public space are necessary and users at both sites had positive attitudes towards ecosystem services. The point, then, is not to imply one design is better than the other. Rather it is to observe that the qualitative uses of the sight, the design, and strength of attitudes do seem to be related and it is apparent that design could potentially benefit from the inclusion of ecosystem services in its planning. Thus a diversity and integration of designs is necessary to provide a (bio)diversity of services.

Q3. Attitudes and management: What is the relationship between management practices, the attitudinal assessment of their value, and the socio-ecological context of both? Do the subjective assessments match efforts to provide services and avoid disservices?

"Please don't 'manage' it too much….it's nice to hear the birds." – Survey #49, Tempe Town Lake

The goal of asking users to comment on their favorite and least favorite aspects of the parks was to identify services and disservices of urban nature that may not have been captured by the quantitative questions, which were limited to six services. In practice, participants commented on human interaction and built infrastructure in addition to the physical environment. Of note, even *following* the rating of ecosystem services, few participants were inspired to comment on the structure and function of the ecosystem, but instead returned to themes of human use and interaction. Notably, 57% of had no concerns over park management, indicating satisfaction with the presentation and management of their park.

For those who did comment, what Nassauer (1996) calls cues to care were frequently observed – users enjoyed that Tempe Town Lake is “clean” and worry that Phoenix Rio Salado suffers from trash and vandalism. These observations are important as such cues indicate to a park user the level of human care a site garners, and that an area is meant to look the way it does. The issue of dense growth is an obvious case in point, where trash in combination with the enclosed understory inevitable of a habitat project, may be perceived as a lack of care. Dense habitat may also be a safety concern and participants at Rio Salado were more likely to report negative human interactions. This point suggests a disservice of habitat restoration projects if they cannot be adequately patrolled. Overall, comments suggested that experiences at the two parks were very different and that park users were as conscious of other people–if not more so–as they were of nature. These comments also indicated, unsurprisingly, that the quality of human interactions both drew and deterred park users in urban riparian areas.

Ten percent of park users admitted to uncertainty about stormwater regulation. This response is interesting because it can be interpreted in two ways. One possibility is , as F. Terry at the Flood Control District surmised, people simply do not realize that flooding is an issue (personal communication, May 22, 2012). The last major floods happened in the early ‘90s and dams have been controlling water flow through the valley in some way since the Roosevelt Dam was built. The other possible interpretation is park users are aware that the area is channelized and flooding controlled, as opposed to stormwater mitigation being a service provided by the park. This understanding would justify the lower scores and the uncertainty demonstrated by park users. In their current designs, neither Tempe Town Lake nor Rio Salado are considered hindrances to through-flow of flood water, but neither are the parks themselves considered as part of floodwater control; rather it is the channelization and levees themselves that serve this function (FCD, 2009; F. Terry, Flood Control District, personal communication, May 22, 2012). Though both spaces may be marginally sacrificial, the service would not be rendered until flows topped 100-year levels. Neither park maintained to purposefully slow and control floodwater, though no doubt the additional vegetation in Phoenix Rio Salado does in a small way. In this light, stormwater *regulation* (as opposed to *control*) is an underutilized ecosystem service of these two urban riparian parks and uncertainty or less optimistic attitudes towards stormwater regulation from park users can be justified, either through green or grey infrastructure, flood control remains "the single most important" consideration managers face at Tempe Town Lake. For example, though managers are aware of the desire for more shade trees, their planting is limited as a tree ripped out in a flood may endanger the integrity and function of the levees. All decisions based on meeting goals for economic development, recreation, and environmental improvement must not interfere with the engineered solutions for flood control (N. Ryan, personal communication, May 4, 2012). This is a good example of a trade-off that must be made in designing and managing for ecosystem services and the limits of subjective valuation in decision-making. Design and management at both sites is locked-in to a channelized, reinforced vision of the river, and surrounding urban land use at least depends on some security and predictability. To some extent the public's opinion reflects a reality of the climate and may be based on incomplete information concerning flood control; however, it may also reflect a more flexible approach to land use in future designs, leaving park spaces as sacrificial flood spaces that can provide more vegetation for more ecosystem services.

The Flood Control District of Maricopa County is beginning to move towards leaving riparian areas as flexible, sacrificial flood spaces, such as green belts and revegetation areas, and there are examples of this, such as the linear green space known as Indian Bend Wash leading into Tempe Town Lake. "It makes more sense to leave it natural than try to make it concrete," says Ms. Terry, but ultimately it's up to the landowners (personal communication, May 22, 2012). In the case of Tempe Town Lake, for example, a fortified levee allows development right up to the edges without flood plain insurance. As the second most important goal for Tempe Town Lake is economic development, the value of waterfront property is an important benefit to the city.

In general, management efforts seem to support recreation at both parks, though it is a much more central concern at Tempe Town Lake, and both parks offer an improved aesthetic to their previous conditions. Management at Phoenix Rio Salado supports refugia and educational opportunities directly and as part of their mission, where neither of these concerns are central at Tempe Town Lake, though habitat has been embraced where possible (and habitat prevention remains a management concern).

The overall positive attitudes towards ecosystem services, the distribution of these attitudes, and few management comments all indicate that subjective evaluations are mostly in line with park maintenance efforts.

CONCLUSION

"I hope that [they] always maintain this for our city. Every great city in the world has a green area." -Survey #1, Phoenix Rio Salado

The goal of this research was to use attitude theory to capture people's subjective assessment of the value of ecosystem services. Urban riparian parks were used as the setting because of their unique character, provision of many ecosystem services, and importance to urban sustainability. Both Tempe Town Lake and Phoenix Rio Salado are assets to their communities and provide myriad services to the public in their expressed design. When it comes to sustainability and the multiple functions of ecosystems, optimization in the traditional sense is not the answer (Holling, 1995; Spangenberg & Settele, 2010). Ironically, opposing optimization opposes the goals and assumptions of rational utility upheld by economics, from which ecosystem services derives its metaphorical language (Spangenberg & Settele, 2010). At the same time, all things cannot be achieved at the scale of a park, which is merely a unit in the urban landscape, and mutual exclusivity for some goals remains a reality (for example levees for stormwater control and shade trees).

Not everyone was keen on the design for Phoenix Rio Salado. Some locals saw the plans for a "scraggly" desert habitat project while other areas of the city got lush green parks as yet another injustice leveled against South Phoenicians (S. Porter, personal communication, May 18, 2012). Others saw and still see Phoenix Rio Salado as an amazing amenity to the city and an unprecedented rehabilitation effort. Phoenix Rio Salado can and should be a "unique, living habitat, with people actively in it" (R. Smart, Phoenix Parks, personal communication, May 18, 2012), but "people want picnics," observes Ms. Porter. "We need a flatland park with barbeques, maybe a water feature… a place where people can come for a few hours, take a stroll in the habitat and then enjoy the other things that people like to do when they're out." Ultimately, people need fair access to *both* the unique opportunities of a rugged-but-designed urban nature and the recreational and community opportunities of more traditional park space.

Providing both in proximal, networked green infrastructure as Ms. Porter observes is one means for meeting aesthetic and recreational desires while still providing urban refugia for non-human life. Getting people out to enjoy, learn about, and value urban riparian spaces will involve incorporating various visions of nature into their everyday lives such that both Tempe Town Lake and Phoenix Rio Salado have a role to play. Planning and design for multiple kinds of open space reinforces calls for ecosystem service through landscape-scale planning (Benedict & McMahon, 2002; Lovell & Johnston, 2009; Selman, 2009) and integration in designs speaks to Nassauer's "cues to care" with familiar aesthetic features in less manicured urban settings (1996; 2011b). My research suggests that a concerted effort to integrate and connect designs for urban riparian park space may be important to overcoming the gap between human values and healthy ecosystems. Such an effort could break down a cultural barrier between "restoration" like Phoenix Rio Salado and "parks" like Tempe Town Lake.

Planning for ecosystem services through integrated green infrastructure will not only help to enhance an array of benefits provided by these spaces, it will contribute to overall urban sustainability through quality of life, equity in access, and efficient resource use. The economy drives many decisions at both Tempe Town Lake and Phoenix Rio Salado, changing the visions and realities of park maintenance, and will no doubt continue to do so. Phoenix Rio Salado has the largest maintenance crew of any park in the Phoenix Parks system (R. Smart, personal communication, May 21, 2012) and property owners around Tempe Town Lake pay a not-small Community Facilities District fee to keep the park maintained. These urban riparian parks are highly managed amenities and as with any other infrastructure, they require upkeep, resources, and constant reassessment of the value communicated by design. It's an important part of the discussion, notes N. Ryan at the City of Tempe, to really understand how to pay for these services (personal communication, May 4, 2012). However, the economy cannot be the only factor driving decision-making and understanding the subjective values of ecosystem services – which are high across parks – helps shape the context in which economic decisions are made, such that a dollar is not always a dollar. For example, it may allow for future discussions in which a more flexible green infrastructure approach to flood control than levees and channelization saves millions of dollars, and which some former decisions, such as dams, that would eliminate habitat are no longer considered because the loss to biodiversity would be too great. This is not farfetched; some of these decisions are already beginning to be made in Arizona and elsewhere.

Assessing subjective values for ecosystem services helps to keep the pulse of the social-ecological decision-making.

In both parks, the returns on investments accrue over the long term, effecting opportunities for recreation and education, the image of place, and the ways in which people interact with their environment. This research shows that park users value the ecosystem services provided by urban riparian parks, even those that are not immediately related to their individual use and comfort (such as refugia or educational opportunities), reinforcing the trouble with trying to give an ecosystem service a value for individual utility. Equity and ecosystem services are central to sustainability (Ehrlich et al., 2012) and subjective valuation of these services are an important component of designing our relationship with ecosystems, and an important measure of a deep sustainability and social-ecological integrity, which cannot be perpetuated by rational utility and the invisible hand of the market alone. This research suggests that if design affects attitudes, periodic assessments of subjective values may be one way to measure changes in a social-ecological ethic and guide planning for community-level services.

We cannot protect the environment if we do not see ourselves as part of it (Cronon, 1995), and while the environment may have proven resilient to humans thus far its biophysical limits are our own (Eherlich et al., 2012). When it comes to sustainability, it is interesting to speculate which pillar is in fact the least flexible, though it seems most optimistic to assume culture and nature will meet in the middle. The ecosystem services literature has so far focused on an ecologic and economic understanding of the benefits provided to humans by nature, but less on the evaluative perceptions, judgments, or attitudes people place on these services. From this research it is apparent that a consideration of the subjective value should at least set the context for goal setting and economic decision-making. The aesthetics literature has focused on people's preferences, without context for the ecosystem services provided by the different forms nature takes. This research indicates aesthetics are flexible and different visions of nature support different strengths of attitude towards ecosystem services, leaving room for functional landscapes that are also aesthetically pleasing. This exploration of attitudes provides a more robust understanding of ecosystem services and, in turn, informs a deeper understanding of the social-ecological integrity of urban riparian areas.

Recommendations

This research offered a case study approach with a small sample size, paving the way for broader studies. One potential track to strengthen and expand upon the results here would be an objective measure of the ecosystem services here explored to compare with cognitive measures of participants.

A different conceptualization of behavior would be an especially interesting way to further conceptualize subjective values and perhaps better understand ecosystem disserves (what do people avoid doing in these spaces because of structure and function?).

Finally, exploratory factor analysis seemed to suggest that the difference in attitudes, specifically cognition, towards different services could be characterized as individual- or community-level attitudes. The difficulty in interpreting factor analysis results may be attributable to the small sample size and running a second round of the study to obtain a larger sample could help better determine whether this is an appropriate characterization of attitudes towards ecosystem services.

REFERENCES

Alberti, M. and Marzluff, J.M. (2004). Ecological resilience in urban ecosystems: linking urban patterns to human and ecological functions. *Urban Ecosystems*, 7:241-265.

Alfsen, C., Duval, A., Elmqvist, T. (2011). The Urban Landscape as a Social-Ecological System for Governance of Ecosystem Services. In J. Niemelä (Ed.), *Urban Ecology: Patterns, Processes, and Applications*, pp. 213-218. Oxford University Press: New York.

American Planning Association. (2003). How cities use parks for green infrastructure. Retrieved from http://www.planning.org/cityparks/briefingpapers/greeninfrastructure.htm

Bagozzi, R.P., Tybout, A.M., Craig, C.S., Sternthal, B. (1979) The construct validity of the tripartite classification of attitude. *Journal of Marketing Research*, 16(1):88-95.

Balmford, A., Burner, A., Cooper, P., Costanza, R., Farber, S. Geen, R.E., Jenkins, M., Jefferiss, P., Jessamy, V., Madden, J., Munro, K., Myers, N, Naeem, S., Paavola, J., Raymen, M., Rosenado, S., Roughgarden, J., Trumper, K., Tuner, K.R. (2002). Economic reasons for conserving wild nature. *Science*, 297:950-953.

Benedict, M.A. and McMahon E.T. (2002). Green infrastructure: smart conservation for the 21st century. *Renewable Resources Journal*, 20(3):12-17.

Bjerke, T., Østdahl, T., Thrane, C., Strumse, E. (2006). Vegetation density of urban parks and perceived appropriateness for recreation. *Urban Forestry & Urban Greening*, 5:35-44.

Bolin, B., Grineski, S., Collins, T. (2005). The geography of despair: environmental racism and themaking of South Phoenix, Arizona, USA. *Research in Human Ecology*, 12(2):156-168.

Bolund, P. and Hunhammar, S. (1999). Ecosystem services in urban areas. *Ecological Economics*, 29:293-301.

Bormann, F.H., Balmori, D., Geballe, G.T. (2001). *Redsigning the American Lawn: A Search for Environmental Harmony*. New Haven, CT: Yale University Press

Boyd, J., and Banzhaf, S. (2007). What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics*, 63: 616-626.

Brandt, J. and Vejre, H. (2004). Multifunctional Landscapes: Theory, Values, and History, Vol. 1. WIT Press: Gateshead, United Kingdom.

Brazel, A., Gobert, P., Lee, S., Clarke-Grossman, S., Zehnder, J., Hedquist, B., Comparri, E. (2007). Determinants of changes in the regional urban heat island in metropolitan Phoenix (Arizona, USA) between 1990 and 2004. *Climate Research*, 33:171-182.

Buchholz, T. and Younos T. 2007, July. Urban Stream Daylighting Case study evaluations. Virginia Water Resources Research Center, Virginia Tech. Blacksburg, Virginia.

Chiesura, A. (2004). The role of urban parks for the sustainable city. *Landscape and Urban Planning, 68*, 129-138.

City of Phoenix Planning Department. (2003). "Rio Salado Beyond the Banks." Retrieved from phoenix.gov/planning/btbplan.pdf

City of Phoenix. (2011). "Rio Salado Habitat Restoration Area." Retrieved from http://phoenix.gov/recreation/rec/parks/preserves/locations/riosalado/index.html

City of Phoenix. (2012). History and Restoration. Retrieved from http://phoenix.gov/parks/trails/locations/riosalado/history/index.html

City of Portland and Multnomah County. (2009). Climate Action Plan 2009. Retrieved from http://www.portlandonline.com/bps/index.cfm?c=49989&a=268612

City of Tempe. (2012a) Tempe Town Lake on the Rio Salado. Retrieved from http://www.tempe.gov/lake/

City of Tempe. (2012b) Historic Timeline. Retrieved from http://www.tempe.gov/index.aspx?page=1245

Costanza, R. (1992). Toward an Operational Definition of Ecosystem Health. In R. Costanza, B.G. Norton, & B.D. Haskell (Ed.), *Ecosystem Health: New Goals for Environmental Management*. Island Press: Washington, D.C.

Costanza, R. (2008). Ecosystem services: multiple classifications are needed. *Biological Conservation*, 141:350-352.

Costanza, R. (2000). Social goals and the valuation of ecosystem services. *Ecosystems*, 3:4-10.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K.E., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., van den Belt, M. (1997). The value of the world's ecosystem services and capital. *Science*, 387:253-260.

Cronon, W. (1996). The Trouble with Wilderness. In W. Cronon (Ed.), *Uncommon Ground: Rethinking the Human Place in Nature* (pp. 69-90). W.W. Norton & Company: New York.

Daily, G. (1997). What are ecosystem services? In Daily, G. (Ed.), *Nature's Services: Societal Dependence on Natural Ecosystems* (pp. 1-10). Island Press: Washington, D.C.

Daily, G., Plasky, S., Golstein, J., Kareiva, P., Mooney, H., Pejchar, L., Rickets, T., James, S., Shallenberger, R. (2009). Ecosystem services in decision making: time to deliver. *Frontiers in Ecology and the Environment*, 7(1):21-28.

de Groot, R. (2006). Functional-analysis and valuation as a tool to assess land use conflicts in planning for sustainable, multi-functional landscapes. *Landscape and Urban Planning*, 75: 175-186.

de Groot, R., Alkemade, R., Bratt, L., Hein, L., Willeman, L. (2010). Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity*, 7:260-272.

de Groot, R., Wilson, M.A., Boumans, R.M.J. (2002). A typology for the classification, description and value of ecosystem functions, goods and services. *Ecological Economics*, 41:393-408.

Dillman, D.A. (2000). *Mail and Internet Surveys: The Tailored Design Method.* John Wiley & Sons: New York.

Dockside Green. (2011). Onsite stormwater and sewage treatment. Retrieved from http://www.docksidegreen.com/Sustainability/Ecology.aspx

Dufour, S., Piégay, H. (2009). From the myth of lost paradise to targeted river restoration: forget natural references and focus on human benefits. *River Research and Applications*, 25: 568-581.

Dunlap, R.E. and Jones, R.E. (2002). Environmental Concern: Conceptual and Measurement Issues. In R.E. Dunlap & W. Michelson, *Handbook of Environmental Sociology* (pp482-524). W. Greenwood Press: Westport, CT.

Dunlap, R.E. and Michelson, W. (2002). Environmental Concern: Conceptual and Measurement Issues. In R.E. Dunlap & W. Michelson, *Handbook of Environmental Sociology* (pp482-524). W. Greenwood Press: Westport, CT.

Dunlap, R.E., Van Liere, K.D., Mertig, Angela G., Jones, R.E. (2000). Measuring endorsement of the New Ecological Paradigm: a revised NEP scale. *Journal of Social Issues*, 56(3):425-442.

Eagly, A.H. and Chaiken, S. (1993). The Psychology of Attitudes. Harcourt Brace Jovanovich: Orlando, FL.

Ehrlich, P., Kareiva, P. Dailey, G. (2012). Securing natural capital and expanding equity to rescale civilization. *Nature*, 486:68-73.

Environment Agency (2009). Using science to create a better place: ecosystem service case studies. Retrieved from http://publications.environment-agency.gov.uk/PDF/SCHO0508BOCS-E-E.pdf

Firehock, K, and Hefner, A. (2008, Oct 15) Madison County asset mapping project: a report to the Madison county planning commission. Retrieved from http://www.gicinc.org/projects.htm

Flood Control District (FCD) of Maricopa County. (2009). Phoenix Rio Salado II. Retrieved from http://www.fcd.maricopa.gov/Projects/PPM/projStructDetails.aspx?ProjectID=37.

Gibson, R.B. (2006). Sustainability assessment: basic components of a practical approach. *Impact Assessment and Project Appraisal*, 24(3), 170-182.

Gobster, P. (2001). Visions of nature: conflict and compatibility in urban park restoration. *Landscape and Urban Planning*, 56(1-2):35-51.

Gobster, P.H. and Hull, R.B. (2000). *Restoring Nature: Perspectives from the Social Sciences and Humanities*. Washigton, D.C.: Island Press.

Gobster, P.H., Nassauer, J.I., Daniel, T.C., Fry, G. (2007). The shared landscape: what does aesthetics have to do with ecology? *Landscape Ecology*, 22:959-972.

Gray, D.B. (1985). Ecological Attitudes. In *Ecological Beliefs and Behaviors* (pp. 21-56). Westport, CT: Greenwood Press.

Gregoire, T.G., Buyoff, G.J. (1999). Sampling and estimating recreational use. [Report] United States Department of Agriculture, Forest

Service, Pacific Northwest Research Station. Portland, Oregon. PNW-GTR-456.

Grimm, N., Faeth, S.H., Golubiewski, N.E., Redman, C.L., Wu, J., Bai, X., Briggs, J.M. (2008). Global change and theh ecology of cities. *Science*, 319: 756-760.

Groves, R.M.; Fowler, F.J., Couper, M.P., Lekowski, J.M., Singer, E., Tourangeau,R. (2009). *Survey Methodology*. 2nd Ed. Wiley: Hoboken, New Jersey.

Holling, C.S. 1995. What barriers? What bridges? In L. Gunderson, C.S. Holling & S.S. Light (Eds.) *Barriers and Bridges to the Renewal of Ecosystems and Institutions*. NY: Columbia Unversity Press.

Home, R., Bauer, N., Hunziker, M. (2010). Cultural and biological determinants in the evaluation of urban green spaces. *Environment and Behavior*, 42(4):494-523.

Ignatieva, M., Stewart, G.H., Meurk, C. (2011). Planning and design of ecological networks in urban areas. *Landscape and Ecological Engineering*, 7:17-25.

Jamieson, S. (2004). Likert scales: how to (ab)use them. *Medical Education*, 38:1212-1218.

Jim, C.Y., and Chen, W.Y. (2006). Perception and attitude of residents toward urban green spaces in Guangzhou (China). *Environmental Management*, 38(3):338-349.

Jorgensen, B. and Stedman, R.C. (2001). Sense of place as an attitude: lakeshore owners attitudes towards their properties. *Journal of Environmental Psychology*, 21:233-248.

Kahneman, D., Ritov, Ilana, Schkade, D. (1999). Economic preferences or attitude expressions? An analysis of dollar responses to public issues. *Journal of Risk and Uncertainty*, 19(1):203-235.

Kaplan, R., and Kaplan, S. (1989) *The Experience of Nature: A Psychological Perspective*. Cambridge University Press: New York.

Kaplan, S. (1995). The restorative benefits of nature: toward an integrative framework. *Journal of Environmental Psychology*, 15:169-182.

Kim, J. and Mueller, C.W. (1978). *Factor Analysis: Statistical Methods and Practical Issues*. Sage: Beverly Hills, CA.

Kumar, M. and Kumar, P. (2007). Valuation of the ecosystem services: a psycho-cultural perspective. *Ecological Economics*, 64:808-819.

Larson, E., Grimm, N., Gober, P., Redman, C.L. (2005). The paradoxical ecology and management of water in the Phoenix, USA metropolitan area. *Ecohydrology and Hydrobiology,* 5(4): 287-296.

Larson, K.L., Ibes, D.C., and White, D.D. (2011). Gendered perspectives about water risks and policy strategies: a tripartite conceptual approach. *Environment and Behavior*, 43(3):415-438.

Larson, K.L., White, D.D., Gober, P., Harlan, S.L., Wutich, A. (2009). Divergent perspectives on water resource sustainability in a public-policy-science context. *Environmental Science & Policy*, 12:1012-1023.

Loomis, J., Kent, P., Strange, L., Fausch, K., Covich, A. (2000). Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent valuation survey. *Ecological Economics*, 33:103-117.

Louv, R. (2006). *Last Child in the Woods: Saving our Children from Nature-Deficit Disorder*. Algonquin: Chapel Hill, North Carolina.

Lovell, S.T., and Johnston, D.M. (2009). Designing landscapes for performances based on emerging principles in landscape ecology. *Ecology and Society*, 14(1):44

Lundy, L. and Wade, R. (2011). Integrating sciences to sustain urban ecosystem services. Progress in Physical Geography, 35(5):653-669.

Luttik, J. (2000). The value of trees, water, and open space as reflected by house prices in the Netherlands. *Landscape and Urban Planning*, 48:161-167.

Lyytimäki, J., Petersen, L.K., Normander, B., Bezák, P. (2008). Nature as nuisance? Ecosystem services and disservices to urban lifestyle. *Environmental Sciences*, 5(3): 161-172.

Maio, G.R., Haddock, G. (2004). Theories of Attitude: Creating a Witches' Brew. In G.R. Maio & G. Haddock, *Contemporary Perspectives on the Psychology of Attitudes* (pp. 425-453). New York: Psychology Press.

Martin, L. (2010). Reclamation and reconciliation: land-use history, ecosystem services, and the Providence River. *Urban Ecosystems,* 13(2): 243-253.

McGann & Associates. (2002). Design Documentation Report Final Design Submittal. Rio Salado Environmental Restoration Project Tempe Reach: Indian Bend Wash Tempe Arizona. US Army Corps of Engineers Los Angeles District in cooperation with The City of Tempe

Meyers, J.L., Paul, M.J., and Taulbee, W.K. (2005). Stream ecosystem function in urbanizing landscapes. *Journal of the North American Benthological Society*, 24(3):602-612.

Millennium Ecosystem Assessment. (2005). Ecosystems and Human Well-being: Synthesis. Island Press: Washington, DC.

Miller, J.R. (2005). Biodiversity conservation and the extinction of experience. *Trends in Ecology and Evolution*, 20(8):430-434.

Min, B.W. (2011). Ecological aesthetic in restructuring urban landscapes. (Doctoral Dissertation). Retrieved from Arizona State University, Environmental Design and Planning.

Mooney, H. and Erhlich, P. (1997). Ecosystem Services: A Fragmentary History. In G. Daily (Ed.), *Nature's Services: Societal Dependence on Natural Ecosystems* (pp. 11-22). Washington, D.C.: Island Press.

Nassauer, J.I. (2011a). Designing for the Cultural Sustainability of Ecosystem Services. *IFLA World Congress: Scales of Nature: From Urban Landscapes to Alpine Gardens* [streaming video]. Retrieved from http://thearchitecturereport.com/designing-for-cultural-sustainability-of-ecosystem-services-joan-nassauer

Nassauer, J.I. (2011b). Care and stewardship: from home to planet. *Landscape and Urban Planning*, 100:321-323.

Nassauer, J.I. 1997. Cultural sustainability: aligning aesthetics with ecology. In J.I. Nassauer (Ed.), *Placing Nature: Culture and Landscape Ecology* (pp.65-83). Covelo, CA: Island Press.

Nassauer, J.I., Kosek, S.E., Corry, R.C. (2001). Meeting public expectations with ecological innovation in riparian landscapes. *Journal of the American Water Resources Association*, 37(6): 1439-1443.

Nelson County, University of Virginia, Skeo Solutions, and the Green Infrastructure Institute. (2011, Aug). Healthy Watersheds, Healthy Communities: The Nelson County Stewardship Guide for Residents, Businesses, Communities and Governments. Retrieved from http://www.gicinc.org/projectsnelson.htm

New York City Green Infrastructure Plan. 2010. City of New York. Retrieved from http://www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_plan.shtml

Newman, A. (2008). Inclusive planning of urban nature. *Ecological Restoration*, 26(3):229-234.

Niemelä, J., Saarela, S., Söderman, T., Kopperoinen, L., Yli-Pelkonen, V., Väre, S., Kotze, D. (2010). Using the ecosystem services approach for better planning and conservation of urban green spaces: a Finland case study. *Biodiversity and Conservation*, 19(11):3225-3243.

NOAA. (n.d.) Heat in the Southwest. Retrieved from http://www.wrh.noaa.gov/psr/general/safety/heat/

Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in Health Science Education*, 15:625-632.

Pallant, J. (2010). *SPSS Survival Manual: a step-by-step guide to data analysis using SPSS*. 4th ed. McGraw-Hill: New York.

Palmer, M., Bernhardt, E., Chornesky, E., Collins, S., Dobson, A., Duke, C., Gold, B., Jacobson, R., Kingsland, S., Kranz, R., Mappin, M., Martinez, M.L. Micheli, F., Morse, J., Pace, M., Pascual, M., Palumbi, S., Reichman, O.J., Simons, A., Townsend, A., Turner, M. (2004). Ecology for a crowded planet. *Science*, 304(5675):1251-1252.

Pickett, S.T.A., Cadenasso, M.L., Grove, J.M., Nilton, C.H., Poyat, R.V., Zipperer, W.C., Costanza, R. (2001). Urban ecological systems: linking terrestrial, ecological, physical and socio-economic components of metropolitan areas. *Annual Review of Ecology, Evolution and Systematics*, 32:127-157.

Pilgrim, S., Smith, D., Pretty, J. (2007). A cross-regional assessment of the factors affecting ecoliteracy: implications for policy and practice. *Ecological Applications*, 17(6):1742-1751)

Rio +20. (2012). 7 critical issues at Rio +20. United Nations Conference on Sustainable Development. Retrieved from http://www.uncsd2012.org/7issues.html

Rio Salado Audubon. (2012). About Us. Retrieved from http://riosalado.audubon.org/AboutUs.html

Rio Salado Restoration. (n.d.) Fact sheet. Retrieved from http://phoenix.gov/recreation/rec/parks/preserves/locations/riosalado/index.html

Selman, P. (2008). What do we mean by sustainable landscape? *Sustainability: Science, Practice, & Policy*, 4(2):23-28.

Selman, P. (2009). Planning for landscape multifunctionality. *Sustainability: Science, Practice, & Policy*, 5(2):45-52.

Spangenberg, J. and Settele, J. (2010). Precisely incorrect? Monetising the value of ecosystem services. *Ecological Complexity*, 7:327-337.

Spash, C., Urama, K., Burton, R., Kenyon, W., Shannon, P., Hill, G. (2005). Motives behind willingness to pay for improving biodiversity in a water ecosystem: economics, ethics and social psychology. *Ecological Economics,* 68:955-964.

Tempe Town Lake. (n.d.) Tempe Town Lake Fact Sheet. Retrieved from http://www.tempe.gov/lake/

Thompson, C.W. (2002). Urban open space in the 21st century. *Landscape and Urban Planning*, 60:59-72.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kazmierczak, A.E., Niemelä, J., James, P. (2007). Promoting ecosystem and human health in urban areas using green infrastructure: a literature review. *Landscape and Urban Planning*, 81:167-178.

Ulrich, R.S. (1986). Human responses to vegetation and landscapes. *Landscape and Urban Planning*, 13:29-44.

Ulrich, R.S., Simons, R.F., Losito, B.D., Fiorito, E., Miles, M.A., Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology*, 11:201-230.

United States Army Corp of Engineers (US ACE). (1997). Draft Feasibility Report Rio Salado, Salt River, Arizona. Los Angeles District South Pacific Division.

United States Census Bureau. (2012). State and County QuickFacts. Retrieved from http://quickfacts.census.gov/qfd/states/04/04013.html

Wallace, K. (2007). Classification of ecosystem services: problems and solutions. *Biological Conservation*, 139:235-246.

Wallace, K. (2007). Classification of ecosystem services: problems and solutions. *Biological Conservation,* 139:235-246.

Wallace, K. (2012). Values: drivers for planning biodiversity managemetn. *Environmental Science and Policy,* 17:1-11.

Walsh, C.J., Roy, A.H., Feminella, J.W., Cottingham, P.D., Groffman, P.M., Morgan, R.P. II. (2005). The urban stream syndrome: current knowledge and the search for a cure. *Journal of the North American Benthological Society*. 24(3):706-723.

White, D.D., Virden, R.J., Cahill, K.L. (2005). Visitor experiences in National Park Service cultural sites in Arizona: implications for interpretive planning and management. *Journal of Park and Recreation Administration*, 23(3):53-81.

White, M., Smith, A., Humphryes, K., Pahl, S., Snelling, D., Depledge, M. (2010). Blue space: the importance of water for preference, affect, and restorativeness of natural and built scenes. *Journal of Environmental Psychology*, 30:482-493.

White, R. (1996). Work and Nature. In W. Cronon (Ed.), *Uncommon Ground: Rethinking the Human Place in Nature* (pp. 171-185). W.W. Norton & Company: New York.

Winterboer, D. (2003). Wildlife Hazard Assessment for Rio Salado Restoration Project - Tempe Reach. US Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. Phoenix, AZ.

APPENDIX A

SURVEY MATERIALS

Cover Letter
Attitudes Towards Ecosystem Services

May 2012

Dear Participant,

I am a graduate student under the direction of Dr. Kelli Larson in the School of Sustainability at Arizona State University.

I am conducting a research study to better understand the attitudes of the public towards the services provided by urban riverside parks. I am inviting your participation, which will involve a brief, self-administered questionnaire. The survey should take approximately 5-10 minutes.

Your participation in this study is voluntary. You can skip questions if you wish. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. You must be 18 or older to participate in the study.

There are no direct benefits of your participation in this study, however the results of this study will be shared with park managers and other professionals and researchers seeking to better understand the services provided by urban riverside parks. There are no foreseeable risks or discomforts to your participation.

Your responses to this survey will be kept anonymous. Each survey will be assigned a number and at no point will your name be collected. The results of this research study may be used in reports, presentations, and publications, but your name will never be associated with your survey answers.

If you have any questions concerning the research study, please contact the research team at: Dr. Kelli Larson (or) Lea Wilson,
800 S. Cady Mall, Tempe, AZ 875502.
Phone: (480) 727-3603.
Email: lea.wilson@asu.edu.

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

Return of the questionnaire will be considered your consent to participate. Thank you!

Sincerely,
Lea Wilson

Ecosystem Service Attitude Survey: Phoenix Rio Salado

Date: May ______ Time________:_________ Group Size________ Survey #_________

This survey focuses on the Tempe Town Lake area. For the purposes of this survey, please consider “Tempe Town Lake” as the entire area between Priest and McClintock, including the lake and the river channel, surrounding trees, other plants, trails and other features on both the north and south sides of the lake.

1. Why did you come to Tempe Town Lake today?

2. Overall, what are your favorite aspects of Tempe Town Lake?

3. Over all, what are your least favorite aspects of Tempe Town Lake?

For the following questions, please circle the number that best describes your feelings, thoughts, or opinions on the statement.

4. To what extent do you *care* or *not care* that the Tempe Town Lake area currently provides the following things?

	Do Not Care	**Care Only Slightly**	**Care Somewhat**	**Care a Good Deal**	**Care the Most**	**Don't know**
a. A variety of trees and other plants	1	2	3	4	5	0
b. A place to hang out and enjoy being outdoors	1	2	3	4	5	0
c. Educational signs, classes, or other opportunities to learn about the environment	1	2	3	4	5	0
d. An area for exercising or physical activities	1	2	3	4	5	0
e. A place for people to explore and experience the local environment	1	2	3	4	5	0
f. A place where birds and other wildlife can find food and shelter	1	2	3	4	5	0
g. An area that stores flood water to protect streets and buildings from flood damage	1	2	3	4	5	0
h. Trees and shade that provide relief from the sun	1	2	3	4	5	0
i. Nice views of water	1	2	3	4	5	0
j. Trees and plants to slow and control the flow of storm water when it rains	1	2	3	4	5	0
k. A place to get away from the city heat	1	2	3	4	5	0
l. Beautiful landscaping	1	2	3	4	5	0

5. How much do you *agree* or *disagree* that the Tempe Town Lake area currently provides the following things?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Don't Know
a. A place for birds and other wildlife to find food and shelter	1	2	3	4	5	0
b. Beautiful landscaping	1	2	3	4	5	0
c. An area that stores flood water to protect streets and buildings from flood damage	1	2	3	4	5	0
d. A place to hang out and enjoy being outdoors	1	2	3	4	5	0
e. Educational signs, classes, or other opportunities to learn about the environment	1	2	3	4	5	0
f. Nice views of water	1	2	3	4	5	0
g. A variety of trees and other plants.	1	2	3	4	5	0
h. A place to get away from the city heat	1	2	3	4	5	0
i. A place for people to explore and experience the local environment	1	2	3	4	5	0
j. Trees and shade that provide relief from the sun	1	2	3	4	5	0
k. Trees and plants to slow and control water when it rains	1	2	3	4	5	0
l. An area for exercising or physical activities	1	2	3	4	5	0

6. To what extent do you ***support*** or ***oppose*** the following management actions being taken in the Tempe Town Lake area at the present time?

	Strongly Oppose	Oppose Some-what	Neither Oppose nor Support	Support Some-what	Strongly Support	Don't Know
a. Establishing shade trees to provide relief from the sun.	1	2	3	4	5	0
b. Providing infrastructure and areas for exercise or physical activities	1	2	3	4	5	0
c. Providing good places for birds and other wildlife to find food and shelter	1	2	3	4	5	0
d. Creating and maintaining a beautiful landscape	1	2	3	4	5	0
e. Managing the area to store flood water to protect streets and buildings from flood	1	2	3	4	5	0
f. Offer places to explore and experience the local environment	1	2	3	4	5	0
g. Planting a variety of trees and other plants in the area.	1	2	3	4	5	0
h. Maintaining trees and plants to slow and control water when it rains	1	2	3	4	5	0
i. Creating and maintaining nice views of water	1	2	3	4	5	0
j. Providing educational signs, classes, or other opportunities to learn about the environment	1	2	3	4	5	0
k. Providing places for people to hang out and enjoy being outdoors	1	2	3	4	5	0
l. Maintaining places to get away from the city heat	1	2	3	4	5	0

7. Do you have any particular concerns or interests in the management of this site? If so, what?

8. How did you get here today? ***Circle all that apply***

1- Car
2- Bike
3- On Foot
4 - Light Rail
5- Other________________________

9. About how long did it take you to get here today?

______________________________(minutes)

10a. If you live in the U.S. (in the Phoenix area or elsewhere), please note your zip code.

_______________________________(zip code)

10b. If you do not live in the US, in what country do you live?

____

11. What time of day do you usually come here?

1- Morning (5am-12pm)
2- Afternoon (12pm-4pm)
3- Evenings (4pm-9pm)
4- Other→ Please list__________________________

The following demographic questions are common in surveys and are used to describe participants and identify groups with similar characteristics. Your answers are anonymous and confidential, and you can of course skip any questions if you prefer.

12. In what year were you born? 19____________

13. Please circle if you are…

1 - Male
2 - Female

14a. What was the highest education you completed?

1- Pre-high school
2- High school/high school equivalent
3 - Some college, trade school, or associates degree
4 – Baccalaureate (BA/BS)
5- Master's
6- PhD
7- Other→Please list________________________

14b. → If you have a college degree or are currently enrolled, what was/is your major(s)?

____

15. Which do you consider yourself to be? Circle all that apply.
1 – White/Anglo
2 – Hispanic/Latino/Spanish
3 – Black/African American
4 – Asian/Asian American
5 – Native American/ American Indian
6 – Other → Please list ____________________________

16. Please choose the category that best describes your total household income in 2011.
1 – Under $15,000
2 – $15,000-$29,999
3 – $30,000-$49,999
4 – $50,000-$74,999
5 – $75,000-$99,999
6 – $100,000-$149,999
7 – More than $150,000
8 – Don't know

Thank you so much!

APPENDIX B

SURVEY DEMOGRAPHICS

Demographics

Survey participants were predominantly locals, 98% representing zip codes from the greater Phoenix area (Table 1). No participants reported being international, however, three other states were represented: California, Colorado, and Illinois. Visitors to Tempe Town Lake were 20% from Tempe, 20% from Mesa, and 25% from Phoenix. They were predominantly Caucasian (Table 6). Visitors to Phoenix Rio Salado were 75% from Phoenix and were 41% Caucasian and 41% Latino (Table 2, Figure 1). Notably, there was a higher representation by African Americans at both parks (12% average) than in Maricopa County (5%) (US Census Bureau, 2012). Overall, Maricopa County is 59% Caucasian, 30% Hispanic (the US Census Bureau does not separate "white" and "Hispanic" directly) 5% African American, 4% Asian American, and 2.1% Native Peoples (US Census Bureau, 2012). In general, a greater percentage of minorities were represented at Phoenix Rio Salado Restoration than at Tempe Town Lake.

Overall, more men agreed to take the survey at Tempe Town Lake, representing 59% of the total sample (n=63). The median age at Tempe Town Lake was 34 (n=57). The most commonly reported income category was $50,000-$74,999 (n=58), and the most commonly reported education category was "some college, trade school, or associates degree" (n=61). At Phoenix Rio Salado participants were 50% male (n=36) and the median age was 56 (n=33). The most commonly reported income category was $30,000-$49,999 (n=32), and most commonly reported education category was "some college, trade school, or associates degree" (n=34) (Table 1). The full range of education and incomes were represented at both parks. Phoenix Rio Salado had a slightly higher range of ages, with participants' ages 18-75 years, where as participants at Tempe Town Lake ranged from 18-64 years.

Sixty-one percent of travel to Tempe Town Lake was by car, 20% on foot, and 7% by bike (n=65) compared to 78% by car to reach Phoenix Rio Salado, 8% on foot, and 14% by bike (n=37). Thirteen percent of visitors reached Tempe Town Lake using the light rail; the light rail does not serve Phoenix Rio Salado area, however, one respondent at both Phoenix Rio Salado and Tempe Town Lake reached their destinations using the bus.

Park usage was steady throughout the day at Tempe Town Lake, with 29% of users reporting the morning (5am-12pm) as their usual time, 39% reporting the afternoon (12pm-4pm), and 22% reporting the evenings (4pm-9pm) (n=59). On the other hand, 58% of Phoenix Rio Salado users visited during the morning hours, only 12% in the afternoons, and 24% in the evenings (n=35).

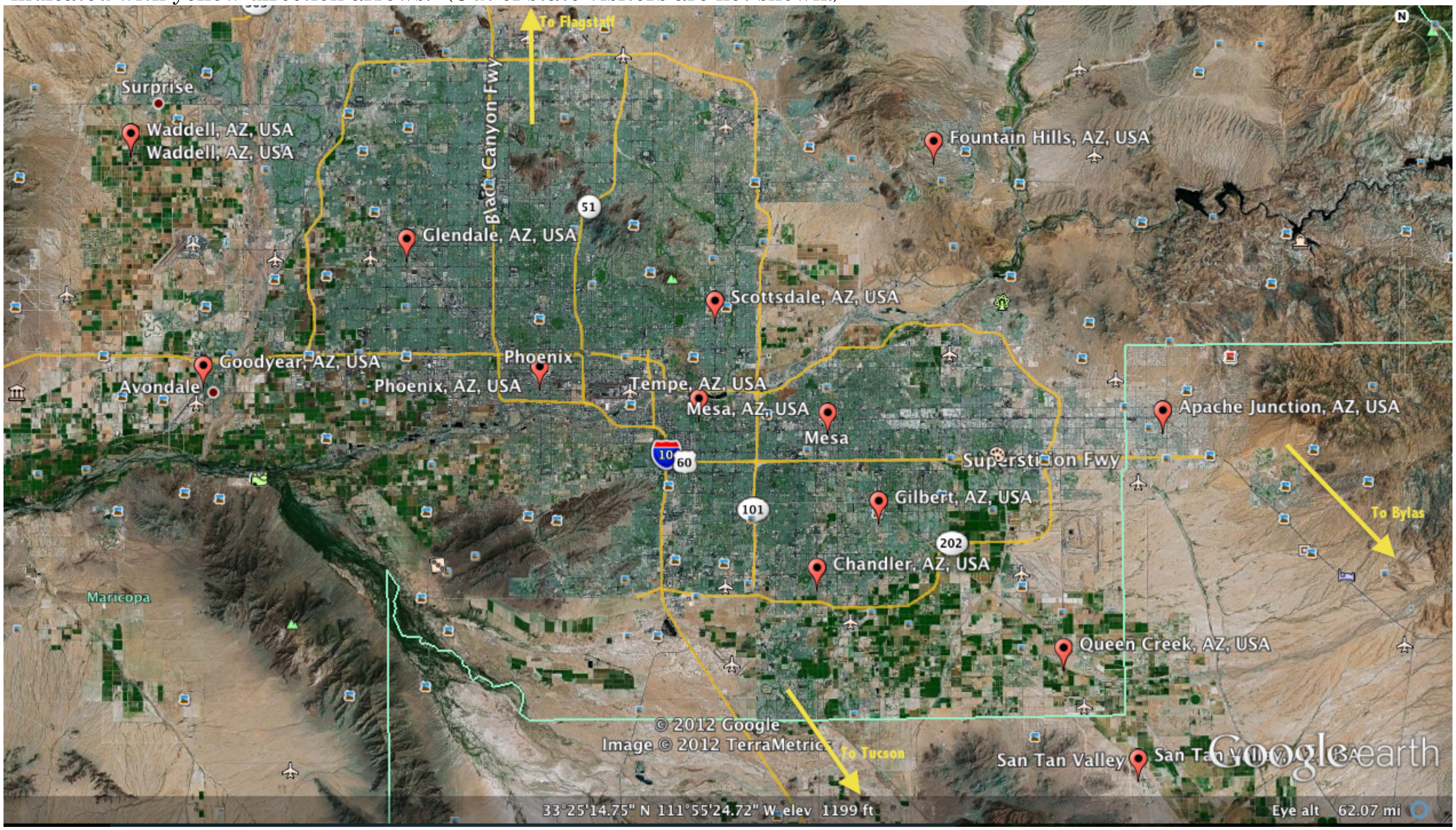
Table 1: Demographic characteristics the survey participants.

Demographic Characteristic	Overall	Tempe Town Lake	Phoenix Rio Salado Restoration
Total Response Weekdays Weekends	104 47 57	66 30 36	38 17 21
Gender Male Female	 56% 44%	 59% 41%	 50% 50%
Ethnicity Caucasian/white Latino/Hispanic African American Asian American Native	 56% 22% 12% 5% 5%	 64% 12% 10% 7% 8%	 41% 41% 15% 2% 0%
Median Age	40 years	34 years	56 years
Age Range	18-75 years	18-64 years	18-75 years
Age Quartiles 18-29 30-39 40-49 50-59 60+	 26% 20% 22% 18% 14%	 33% 25% 18% 12% 12%	 12% 12% 30% 28% 18%
Mode Education	Some college, trade school, or associates degree	Some college, trade school, or associates degree	Some college, trade school, or associates degree
Mode Income	$50,000-$74,999	$50,000-$74,999	$30,000-$49,999
Mode Travel Car Bike On Foot Light Rail	 67% 9% 16% 8%	 60% 7% 20% 12%	 76% 13% 8% 0%
Mode Preferred Visit Time Morning (5am-12pm) Afternoon (12pm-4pm) Evening (4pm-9pm)	 44% 31% 25%	 32% 44% 25%	 62% 13% 26%

Table 2: Geographic origins of survey participants at the time of visit.

Origin	% population at Tempe Town Lake	Distance from center of city to Tempe Town Lake (miles)	% population Phoenix Rio Salado Restoration	Distance from center of city to Phoenix Rio Salado Restoration (miles)
Out of State	5	n/a	3	n/a
Apache Junction	2	27	0	35
Bylas	3	124	0	131
Chandler	9	15	0	24
Flagstaff	2	155	0	148
Fountain Hills	0	23	6	35
Gilbert	5	14	0	21
Glendale	0	19	8	13
Goodyear	0	27	3	20
Mesa	**20**	**9**	0	19
Phoenix	**25**	**11**	**75**	**2**
Queen Creek	2	30	0	36
San Tan Valley	2	37	0	44
Scottsdale	5	5	3	14
Tempe	**20**	**1**	0	10
Tucson	2	112	0	115
Waddell	0	41	3	34

Figure 1: Cities in the valley from which survey participants came to visit the urban riparian parks. Cities outside of the map boundaries are indicated with yellow direction arrows. (Out of state visitors are not shown.)



APPENDIX C

FACTOR ANALYSIS

Exploratory Factor Analysis of Attitude Variables

Principal component analysis was used to explore whether there were any dimensions of the data that better explain relationships among variables than the three components of attitude the questions were designed to capture. Pallant (2010) suggested that a sample size of less than 150 or a ratio less than 5:1 participants to items is too small for factor analysis, however, the data met statistical suggestions for factor analysis with a Keiser-Meyer-Olkin (KMO) measure of sampling adequacy value of 0.766 and a significant value for Bartlett's Test of Sphericity (Pallant, 2010). Variables with correlation coefficients greater than 0.35 were retained.

There are multiple methods for deciding how many factors to accept and it is ultimately up to the researcher to settle on a number that is reasonable and can be defended by multiple measures (Kim & Mueller 1978). A summary of the multiple measures are presented in Table 1. Using Kaiser's criterion for eigenvalues greater than 1.0, SPSS found a 9-components solution for the 36-item analysis, together explaining 73% of the data (Table 2).

The scree test is another method for determining the appropriate number of components to keep. In this approach, the number of components to retain is determined by the number above an "elbow" in a plot of all the eiganvalues (a scree plot) (Catell, 1966 *in* Pallant, 2010). Here the scree plot (Figure 1) breaks after the first and fourth components suggesting that a 1- or 4- component solution might be more appropriate.

Parallel analysis, another test for determining the most appropriate number of factors to keep, compares actual eigenvalues to a series of randomly generated ones. Only the eigenvalues both greater than 1.0 *and* greater than the randomly generated eigenvalues are retained (Pallant, 2010) Using this test, a 5-component solution is suggested.

Table 1: Overview of exploratory factor analysis characteristics

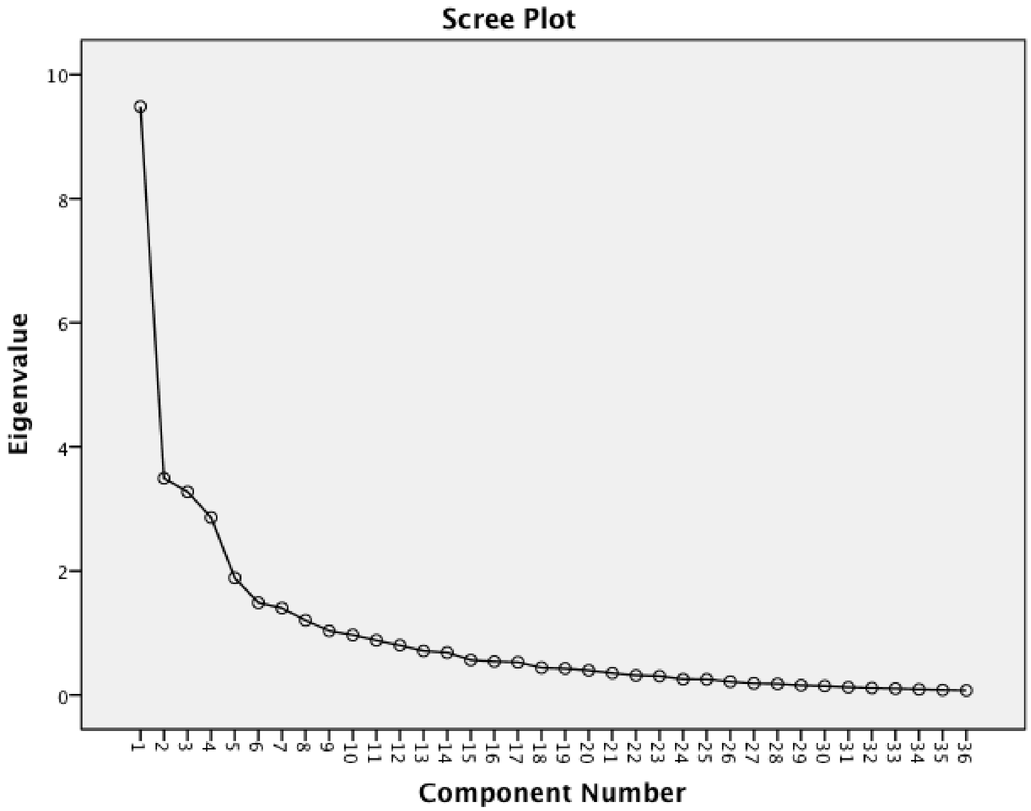
Ratio participants to items	104 : 36 = ~3
KMO	0.766
Bartlett's Test for Sphericity	x^2 = 2016 (df=630), p<0.001
Components extracted based on Eigenvalues (% variance explained)	9 (72.563%)
Components based on Scree Plot	1 or 4
Components based on parallel analysis	5

Table 2: A 9-component solution to the full 36-item analysis based on eigenvalues greater than 1.0

Component	Attitude Statement	Pattern	Structure	Communalities
1	Recreation Cognition: Active	0.586	0.685	0.698
	Refugia Behavior: Biodiversity	-0.413	0.525	0.724
2	Climate Cognition Climate Refuge	0.791	0.816	0.804
	Climate Behavior: Climate Refuge	0.785	0.85	0.821
	Climate Affect: Climate Refuge	0.674	0.71	0.84
3	Aesthetics Cognition: Landscaping	0.819	0.836	0.797
	Aesthetics Behavior: Views of Water	0.804	0.842	0.785
4	Stormwater Cognition: Store	-0.893	-0.861	0.801
	Stormwater Cognition: Slow & Control	-0.666	-0.733	0.634
	Stormwater Affect: Store	-0.623	-0.688	0.75
	Education Cognition: Formal	-0.539	-0.664	0.618

	Refugia Cognition: Habitat	-0.465	-0.6	0.684
5	Refugia Cognition: Biodiversity	0.719	0.822	0.816
	Aesthetics Cognition: Landscaping	0.714	0.768	0.739
	Climate Cognition: Shade	0.692	0.752	0.791
	Recreation Cognition: Passive	0.505	0.606	0.718
6	Recreation Affect: Active	-0.709	-0.751	0.733
	Stormwater Behavior: Store	0.438	-0.461	0.743
7	Climate Affect: Shade	-0.726	-0.73	0.623
	Aesthetics Affect: Landscaping	-0.715	-0.77	0.741
	Aesthetics Affect: Views of Water	-0.669	-0.695	0.685
	Storm Affect: Slow & Control	-0.611	-0.651	0.678
	Recreation Affect: Passive	-0.589	-0.636	0.608
	Refugia Affect: Biodiversity	-0.495	-0.57	0.585
	Refugia Affect: Habitat	-0.4	-0.528	0.608
8	Education Behav: Formal	0.764	0.768	0.732
	Education Affec: Informal	0.748	0.82	0.798
	Education Cognition: Informal	0.644	0.671	0.793
	Education Affect: Formal	0.623	0.705	0.733
	Education Behavior: Informal	0.559	0.667	0.737
9	Climate Behavior: Shade	0.749	0.751	0.608
	Refugia Behavior: Habitat	0.732	0.796	0.742
	Recreation Behavior: Active	0.695	0.725	0.749
	Aesthetics Behavior: Landscaping	0.638	0.705	0.734
	Recreation Behavior: Passive	0.512	0.585	0.808
	Storm Behavior: Slow & Control	0.463	0.61	0.666

Figure 1: Scree plot for 36-item exploratory factor analysis of ecosystem service variables



In reviewing the pattern matrices for the different components, one solution of particular interest is the 4-component solution explaining 53% of the variability in the data, based largely on the scree plot (Table 3). In this solution, behavior and affect are still mostly represented by their own components, but cognition is split between education, stormwater, and refugia on the one hand, and microclimate regulation, aesthetics, and recreation on the other. The division is not perfectly clean; one education and one stormwater affect variable loaded onto the Education, Stormwater Regulation & Refugia cognition component, and one climate behavior and refugia cognition variable loaded onto the Microclimate, Aesthetics &

Recreation component. Overlapping language could help to explain these cross-overs. The Cronbach's Alphas for all these scales are strong however, and would not be improved by removing any of the variables.

Table 2: A four-component Solution to the 36-item exploratory factor analysis. The components are based on the pattern matrix.

Component	Attitude Statement	Pattern	Structure	Communalities
1 **Cognition** Education, Stormwater Regulation & Refugia *Cronbach's Alpha = 0.842*	Education cog 1: Educational signs, classes, or other opportunities to learn about the environment	0.743	-0.664	0.581
	Storm Cog 1: Trees and plants to slow and control water when it rains	0.728	-0.733	0.547
	Storm Cog 2: An area that stores flood water to protect streets and buildings from flood damage	0.697	-0.861	0.544
	Refugia_Cog_2: A place for birds and other wildlife to find food and shelter	0.64	-0.6	0.472
	Education_Cog_2: A place for people to explore and experience the local environment	0.535	0.671	0.51
	*Education_Affect2: A place for people to explore and experience the local environment	0.513	0.82	0.622
	*Storm_Affect_2: An area that stores flood water to protect streets and buildings from flood damage	0.49	-0.688	0.514
2 **Cognition** Microclimate Regulation, Aesthetics & Recreation *Cronbach's Alpha = 0.847*	Climate_Cog_1: A place to get away from the city heat	0.698	0.816	0.518
	Aesthetics_Cog_2: Nice views of water	0.688	0.836	0.514
	Climate_Cog_2: Trees and shade that provide relief from the sun	0.656	0.752	0.589

	*Climate_Behav_1: Maintaining places to get away from the city heat	0.653	0.85	0.569
	Aesthetics_Cog_1: Beautiful landscaping	0.614	0.768	0.446
	Rec_Cog_1: An area for exercising or physical activities	0.539	0.685	0.448
	**Refugia_Cog_1: A variety of trees and other plants.	0.496	0.822	0.541
	Rec_Cog_2: A place to hang out and enjoy being outdoors	0.444	0.606	0.537
3 **Support** *Cronbach's Alpha = 0.876*	Refugia_Behav_2: Providing good places for birds and other wildlife to find food and shelter	0.718	0.585	0.67
	Climate_Behav_2: Establishing shade trees to provide relief from the sun.	0.705	0.751	0.507
	Aesthetics_Behav_1: Creating and maintaining a beautiful landscape	0.681	0.705	0.61
	Refugia_Behav_1: Planting a variety of trees and other plants in the area.	0.658	0.525	0.477
	Storm_Behav_1: Maintaining trees and plants to slow and control water when it rains	0.65	0.61	0.614
	Storm_Behav_2: Maintaining trees and plants to slow and control water when it rains	0.637	-0.461	0.485
	Rec_Behav_1: Providing infrastructure and areas for exercise or physical activities	0.623	0.725	0.485
	Aesthetics_Behav_2: Creating and maintaining nice views of water	0.586	0.842	0.549

	Education_Behav_1: Providing educational signs, classes, or other opportunities to learn about the environment	0.556	0.768	0.489
	Education_Behav_2: Offer places to explore and experience the local environment	0.554	0.667	0.554
	Rec_Behav_2: Providing places for people to hang out and enjoy being outdoors	0.543	0.585	0.58
4 **Affect** *Cronbach's Alpha = 0.835*	Aesthetics_Affect_1: Beautiful landscaping	0.741	-0.77	0.706
	Climate_Affect_2: Trees and shade that provide relief from the sun	0.709	-0.73	0.488
	Aesthetics_Affect_2: Nice views of water	0.693	-0.695	0.473
	Refugia_Affect_1: A variety of trees and other plants	0.628	-0.57	0.42
	Rec_Affect_2: A place to hang out and enjoy being outdoors	0.605	-0.528	0.577
	Climate_Affect_1: A place to get away from the city heat	0.6	0.71	0.544
	Storm_Affect_1: Trees and plants to slow and control the flow of storm water when it rains	0.57	-0.651	0.542
	Refugia_Affect_2: A place where birds and other wildlife can find food and shelter	0.555	-0.528	0.577
	Education_Affect_1: Educational signs, classes, or other opportunities to learn about the environment	0.457	0.705	0.539
	Rec_Affect_1: An area for exercising or physical activities	0.456	-0.751	0.407

*Not originally designed as a cognition variable
**Not originally designed as climate, recreation, or aesthetics variable

In addition to the 36-item analysis, principal component analysis with direct oblimin rotation was run on subsets of variables, the three components of attitudes and the 6 ecosystem services. All subsets were appropriate for factor analysis with KMO values > 0.6 and significant values for Bartlett's Test for Sphericity ($\rho<0.05$). Two of the three subsets of variables for the original components of attitude loaded onto three components, and one loaded on two (Table 4). The composition of these components, however, does not appear to be related (Appendix B). Cronbach's Alphas for the reliability of these scales as compared to the original are the same or lower. Only aesthetics was marginally higher.

Five of the six subsets of variables for the original construction of ecosystem services loaded onto two components (Table 4). Again, the pattern matrix for these components is not consistent between variables (Appendix B).

Table 4: Exploratory factor analysis summary for variable subsets based on the tripartite view of attitudes and ecosystem services. Number of components is based on Kaiser's Criterion for eigenvalues>1.0.

Variable Set	Number of Components	% Variance Explained
Affect	2	53
Cognition	3	63
Behavior	3	63
Variable Set	Number of Components	% Variance Explained
Refugia	2	60
Climate	2	66
Stormwater Regulation	2	66
Recreation	2	61
Aesthetics	2	64
Education	1	53

Figure 2: Solutions from exploratory factor analysis for subsets of variables based on the original categorization (components of attitude or ecosystem service) for eigenvalues greater than 1.0.

Variable Set	Number of Components	% Variance Explained	Grouping within Components
Affect	2	53	Aesthetics, Climate & Rec *Cronbach's Alpha = 0.799*
			Education, stormflow, & Refugia *Cronbach's Alpha = 0.827*
Cognition	3	63	Recreation, Education & Aesthetics 2 *Cronbach's Alpha = 0.723* *(0.733 if Aesthetics 2 removed)*
			Stormflow, education 1, Climate, refugia & aesthetics 1 *Cronbach's Alpha = 0.846*
Behavior	3	63	Climate 1, Rec & Aesthetics 2 *Cronbach's Alpha= 0.698*
			Climate 2, Rec & Aesthetics 1 *Cronbach's Alpha=0.744* *(0.756 if Climate 2 removed)*
			Storm & Education + Refugia 2 *Cronbach's Alpha=0.823*
Variable Set	Number of Components	% Variance Explained	Grouping
Refugia	2	60	Behavior, Affect, & Cog 1 *Cronbach's Alpha= 0.69*
			Cognition 2 *Cronbach's Alpha N/A*
Climate	2	66	Cognition & Behavior 1 & Affect 1 *Cronbach's Alpha = 0.809* *(0.810 if Affect1 removed)*
			Behavior 2 & Affect 2 *Cronbach's Alpha=0.431*
Stormwater	2	66	Cognition & Affect

Regulation			*Cronbach's Alpha=0.753*
			Behavior *Cronbach's Alpha = 0.725*
Recreation	2	61	Behavior & Affect 1 *Cronbach's Alpha=0.613*
			Cognition & Affect 2 *Cronbach's Alpha=0.617* *(0.693 if Affect2 removed)*
Aesthetics	2	64	Behavior & Cognition *Cronbach's Alpha= 0.739* *(0.748 if Cog1 removed)*
			Affect *Cronbach's Alpha=0.672*
Education	1	53	n/a

APPENDIX D
ATTITUDES AND AGE

Significant differences were found between some ecosystem services and age. Table 1 and 2 below show the Kruskal-Wallis test and mean ranks for each age categories and ecosystem services.

Table 1: Kurskal-Wallis test for the difference between different parks based on age.

Component	Chi-square (df)	ρ
Refugia	**9.632 (4)**	**0.047**
Microclimate	1.024 (4)	0.906
Stormwater	**11.437 (4)**	**0.022**
Recreation	4.323 (4)	0.364
Aesthetics	1.934 (4)	0.748
Education	7.012 (4)	0.135
Component	Chi-square (df)	ρ
Affect	8.826 (4)	0.066
Cognition	5.267 (4)	0.260
Behavior	6.543 (4)	0.162

Table 2: Mean ranks for significant indices from Figure 1.

Component Index	Age Category	N	Mean Rank
Refugia_Index	1994-1983	23	35.46
	1982-1973	18	41.06
	1972-1963	20	44.63
	1962-1953	**16**	**55.19**
	1953+	**13**	**58.85**
	Total	90	
Storm_Index	1994-1983	23	36.15
	1982-1973	18	34.67
	1972-1963	19	48.92
	1962-1953	**16**	**54.28**
	1953+	**13**	**57.81**
	Total	89	