The Pennsylvania State University

The Graduate School

College of Health and Human Development

LANDSCAPE, NICHE PERCEPTIONS, AND RECREATIONAL BEHAVIORAL INTENTION PATTERNS IN BALD EAGLE STATE PARK

A Dissertation in

Recreation, Park and Tourism Management

by

Po-Ching Wang

© 2009 Po-Ching Wang

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

May 2009

The Dissertation of Po-Ching Wang was reviewed and approved* by the following:

Alan R. Graefe
Associate Professor of Recreation, Park and Tourism Management
Dissertation Adviser
Chair of Committee

Deborah L. Kerstetter
Associate Professor of Recreation, Park and Tourism Management

Harry C. Zinn
Associate Professor of Recreation, Park and Tourism Management

James C. Finley
Professor of Forest Resources

Michael L. Rios
Assistant Professor of Architecture

John Dattilo
Department Head and Professor of Recreation, Park and Tourism Management

*Signatures are on file in the Graduate School

ABSTRACT

From a biological perspective, this research validates a theoretical model to explicate how the landscape compositions of natural recreational areas affect recreationists' behavioral intentions. One hundred and fifty landscape units, represented by 155 photo stimuli taken from the survey site, were the statistical units used in the model. A reference-group design was conducted to bridge 31 groups comprising 843 respondents in order to adjust and compare subjectively perceived ratings of the varied landscapes. Aerial photos and extensive field surveys using GPS, as well as compasses and laser rangefinders, were applied to measure the viewsheds of each photo stimulant. This research used GIS and related spatial statistic modules to analyze spatial patterns and to derive objective spatial information of the viewsheds, which were then combined with the adjusted subjective-rating scores to establish the data set for structural equation modeling (SEM) analysis. The results showed that the data fit the model well and all regression paths were statistically significant. Recreational behavioral intention was subject to situational environment settings, including landscape structure and landscape elements, through two mediator variables: perceptual constructs of landscape preference and place tenacity. When landscape structure was taken into account, shrub land and weedy fields contributed significantly to negative effects on place tenacity and landscape preference.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

Many people have supported and guided me through the course of this study. In particular, I am grateful to my advisor, Dr. Alan Graefe, for guiding this research and my academic endeavors at the Pennsylvania State University. His insights in regard to outdoor recreation management and methodology have greatly inspired my thinking and shaped my knowledge in the field. I would also like to express my deep gratitude to Dr. James Finley, whose door was always open to me and who was always ready to discuss my sometimes embryonic ideas. His generosity and kindness always touch me, an international student. I appreciate Dr. Harry Zinn's class about recreationists' perceptions and behaviors, which has indeed become the core of my research interests. I am grateful for Dr. Deborah Kerstetter's teaching regarding tourism's impacts, which has been invaluable in shaping this research. I also wish to acknowledge Dr. Michael Rios, whose knowledge of landscape planning and management has greatly enhanced my understanding that subject area. In addition, I would like to credit Dr. James Rosenberger as well for his help with research methodology and statistics.

I owe a huge debt of gratitude to the Bald Eagle State Park—park managers, rangers, and all the survey participants for their kind help with my research data collection. Without their help this research would not have been possible. I am also thankful to all my friends at Penn State and Taiwan for their consistent help and encouragement.

Last but not least, though I do not think I could ever thank them enough, I wish to express my deepest gratitude to my dear family in Taiwan for their consistent support throughout my academic studies.

Chapter 1

INTRODUCTION

The more habitats I have explored, the more I have felt that certain common features subliminally attract and hold my attention. Is it unreasonable to suppose that the human mind is primed to respond most strongly to some narrowly defined qualities that had the greatest impact on survival in the past? …What was the prevailing original habitat in which the brain evolved? Where would people go if given a completely free choice?

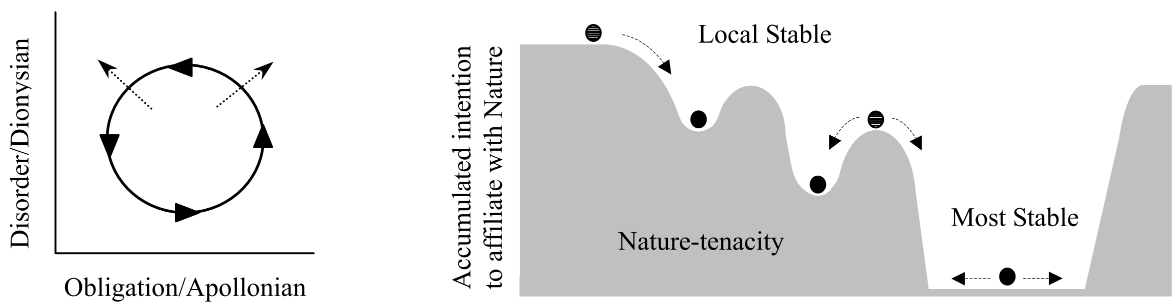
—E. O. Wilson (1984, p. 106)

Each autumn, hundreds of black-faced spoonbills (*Platalea minor*), large white wading birds, travel thousands of miles, passing through the Taiwan straits to return to the same coastal wetlands they had left in the spring, wetlands very near my home in Chi-Ku. Under the glittering sunset, these birds, members of an endangered species, play, chase each other, rest in the grass, and feed on the fish and shrimp in the shallow estuary. In the spring, they fly back to islands in northeastern Asia where they breed. Their offspring, who will be born on these islands, will in turn make their way to these same wetlands near my home.

Why are these birds and so many other animals so attached to a particular area and/or a particular cycle? Certainly, habitat tenacity and other genetically programmed biological behaviors have been observed in many organisms (cf. Wynne-Edwards, 1962). It may even be that humans share these traits. Might the patterns of birds such as the black-faced spoonbills, including their tenacious attachment to specific areas, suggest something about the relationships of human beings to the environment? Do human beings have an innate, biologically based attraction to particular natural recreational settings? These are questions that I have asked over and over as I have pursued my studies in outdoor recreation management.

The *nature* (genetic) versus *nurture* (environmental) issue in regard to human perception and behavior has been disputed for decades. On the one hand, genetically controlled variations in behavior have been demonstrated for some species based on laboratory experiments; likewise genetically controlled variations in behavior have also been found in the behavior of twins and in intelligence performance between races (Alland, 1973). On the other hand, some widely accepted social science theories stress that human instinct is simply an imprint from the individual's experience regardless of genetic background (cf. Ridley, 1997). Although the cognitive accompaniment for a given emotion may vary, human affections are thought of as being universal (Izard & Buechler, 1980; Ulrich, 1983). Ulrich (1993) further stressed that the initial response to an environmental setting may be affective or emotive, and not cognitively mediated. The survival requirements inherent in the evolutionary process have enabled and continue to enable mankind to respond sharply to surroundings—such as making an approach–avoidance decision—even when information from which to make a judgment is very limited. Such responses are termed "preferenda" (Zajonc, 1980). Culture seems to be the channeled expression of human instincts. This is why humans share many characteristics (such as love, hatred, friendship, enmity, loyalty, infidelity)—characteristics that may be universal across cultures regardless of superficial differences in language, social habits, and customs (Ridley, 1997). Although human nature may operate through nurture (cf. Ridley, 2003), its biological roots play a crucial role in effecting human perceptions and behavior patterns (cf. Badcock, 1991; Goldsmith, 1991; Reynolds, 1981). Biological instincts may help explain why native Balinese people and Western tourists make similar environmental evaluations (Hull & Revell, 1989), and why the modern human still appreciates savanna-like and water features that are similar to the habitat of the human primogenitor in Africa (cf. Balling & Falk, 1982; Campbell, 1998; Orians, 1980; Pfeiffer, 1985). Hence, although human experience may vary in terms of culture and learning, this research reasoned that certain natural settings are considerably more attractive and others considerably less so to modern humans for recreation purposes because they speak to the unconscious drive for human survival—an adaptive evolutionary trait. That is, certain kinds of natural places are more likely to trigger human biological instincts and thereby evoke their emotions and subsequent recreational intentions and behaviors.

This study assumes that the yearning for recreation in natural settings is a genetically predetermined response "released" from the retrogressive process of a structured modern life. Pursuing the experience of outdoor recreation in natural settings not only implies perceived freedom (cf. Kelley, 1972; Neulinger, 1974), it also suggests a self-sustained oscillatory process—a transition from forced rhythms to recuperate/retrieve natural biological rhythms. The origins of recreational behavior may be conceptualized as a by-product of the homeostatic process of the human organism, in which the system mechanism is driven by two interactive forces: the pursuit of structure (e.g., obligation and duty as proposed by Kant) and maximum disorder (e.g., the second law of thermodynamics). The system may ideally analogize as a non-chaotic periodic attractor with a limit cycle that explains oscillation between life with a high degree of organization and life with a high degree of freedom (Fig.1.1). Within this cyclical rhythm, the amount of obligation/pressure is tracked by the degree of freedom to motivate recreation behavior that elicits "pleasurable sensations." The civilizing of *Homo sapiens,* the arrival at a sense of duty and obligation and the subsequent structure of society is a relatively recent phenomenon; therefore, humans may not be biologically prepared for modern life (cf. James, 1962). The elasticity of the system itself drives human individuals retroactively back to the reference status of freedom and releases "pleasure" to encourage humans to persist in efforts to survive (cf. Bentham, 1789; Mill, 1871). This cyclical process may be regarded as a selfprotective mechanism that reveals the fostering of well-being as having profound evolutionary benefits.



A. Phase space diagram showing the cyclical rhythm between absolute obligation and disorder over time. Recreational behavior occurs during the process and releases pleasurable sensations.

B. The biological imprints of human instinct evoke the intention of “approaching” to nature, that is, nature-tenacity. The longer the duration in civilized environments, the greater the momentum to return to nature. The compulsion to demand nature may also relent through small-scale contact with natural elements, such as indoor plants.

Figure 1.1. Hypothetical concepts of the origins of outdoor recreation behavior.

Recreation behaviors have evolved in varied settings. It is assumed, however, that the biological rhythms of recreation-makers are more likely to be “reset” in the perceived relaxing setting of a natural landscape. Research has found that natural settings are more restorative than urban environments—that natural settings tend to reduce stress and anxiety (Ulrich, 1984). Further, evolutionary imprints or remnants may even drive human beings to approach the “right” resources (cf. Cartwright, 2000; Gibson, 1979; Pfeiffer, 1985), suggesting that human instincts, despite the passage of centuries in modern environments, might be resilient enough to draw humans back to some original niche in nature for comfort and relief, termed “nature-tenacity” or “nature-philia” (Fig. 1.1). Human beings have a tendency to affiliate with other living things

(Wilson, 1984). Although culture has nurtured human experiences and tastes, millions of years of evolution in natural settings might well be contrary to supporting human functioning in modern society. *Homo sapiens* might still be driven by resistance to civilization, and prefer the environment of the "wild." A return-to-nature is a " compensation process"; after a long duration in civilization, humans turn to the temptations of nature, which activate their recuperative skills and motivate enjoyment of natural biological rhythms.

Behavioral studies of outdoor recreation have paid relatively little attention to the scope of human biological instincts. Because the discipline of leisure studies, in general, is regarded as grounded in social science (cf. Godbey, 2000), behavioral research in outdoor recreation has generally been the domain of the liberal arts. Although mainstream behavioral studies present substantial theories and paradigms in regard to outdoor recreation research, they generally neglect the parameters of human biological interests. Yet an understanding of the underlying influences of human instincts is essential to understanding the relationship of human beings to the environment, and, therefore, such an understanding is necessary to apprehending the limits of traditional theories. The purpose of this study is not to argue about mainstream social variables, but rather to examine endeavors that emphasize the significance of human biological traits in regard to outdoor recreation behavior. The ideology of this study is expected to provide an alternative forum for debates, and its findings may add to contemporary theories of behavioral research in outdoor recreation management.

This study is grounded in an evolutionary concept of human instincts and intends to interpret human behavior in outdoor recreation settings from that viewpoint. Knowledge, such as that gathered from ethology and landscape ecology studies, has significantly influenced human behavioral research in recent times, thereby contributing solid background theories and quantitative measurement methods to this study. Ethological study, which ignited in the eighteenth century, focuses on animal behavior in natural habitats. Konrad Lorenz introduced the concept of “instincts” to represent the “fixed action patterns” of a species with a view toward natural selection, and so posited the notion of no-learning-required behavior. His experimental finding that a hatched goose “imprints” itself on the first moving object it sees has become a classic example of this concept (cf. Cartwright, 2000). Such knowledge may be fruitfully applied to the study of human behavior; certainly, a trend of doing so, such as social ethology, has prospered since the 1960s (cf. Lorenz, 1966; Wilson, 1975). The study of landscape ecology, however, began in the 1950s; it is, therefore, a relatively new phenomenon, focusing mainly on spatial patterns and related processes over time in communities and ecosystems. Some specific interests may cover the fields of landscape structure and function, species flow, energy flow, biotic diversity, landscape change, etc. (Forman & Godron, 1986). Research in landscape ecology indicates that landscape structure may influence the population and behavioral patterns of both animals and vegetation (cf. Henle, 1996; Poschlod et al., 1996).

Research Purpose, Questions, and Hypotheses

The purpose of this study is to empirically explore the relationship between natural landscape composition and recreationists’ perceptions and behavioral intentions. In detail, this research explores from the perspective of biological human heritage how nature-based recreational settings (objective environments) trigger recreationists’ perceptions and behavioral intentions (subjective feelings) (Fig. 1.2).

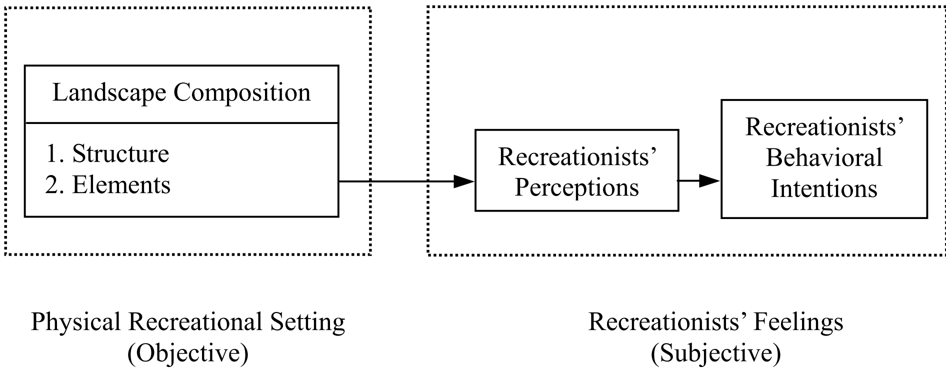


Figure 1.2. Behavioral intention arousal process in a recreational setting.

Based on the research purpose, an integrated model was developed as shown in Figure 1.3. The research questions and corresponding hypotheses are as follows:

Research Question: How do landscape compositions elicit recreationists' behavioral intentions?

> *Remark*: This research seeks to validate a theoretical model to explicate how landscape structures and elements of recreation areas affect visitors' behavioral intentions through other variables, including place tenacity and preference. Structural equation modeling (SEM) was conducted to validate the theoretical model.

Hypothesized model: The hypothesized model (Fig. 1.3) posits that landscape composition affects visitors' recreational behavioral intentions through perceptions of preference and place tenacity.

H_1: Landscape structure and landscape elements are correlated with each other.

H_2: Landscape structure is positively related to respondents' preferences.

H_3: Landscape structure is positively related to respondents' perceptions of place tenacity.

H_4: Landscape elements are positively related to respondents' preferences.

H_5: Landscape elements are positively related to respondents' place tenacity.

H_6: Recreationists' place tenacity is positively related to their landscape preference.

H_7: Recreationists' place tenacity is positively related to their intentions to visit.

H_8: Recreationists' landscape preferences are positively related to their intentions to visit.

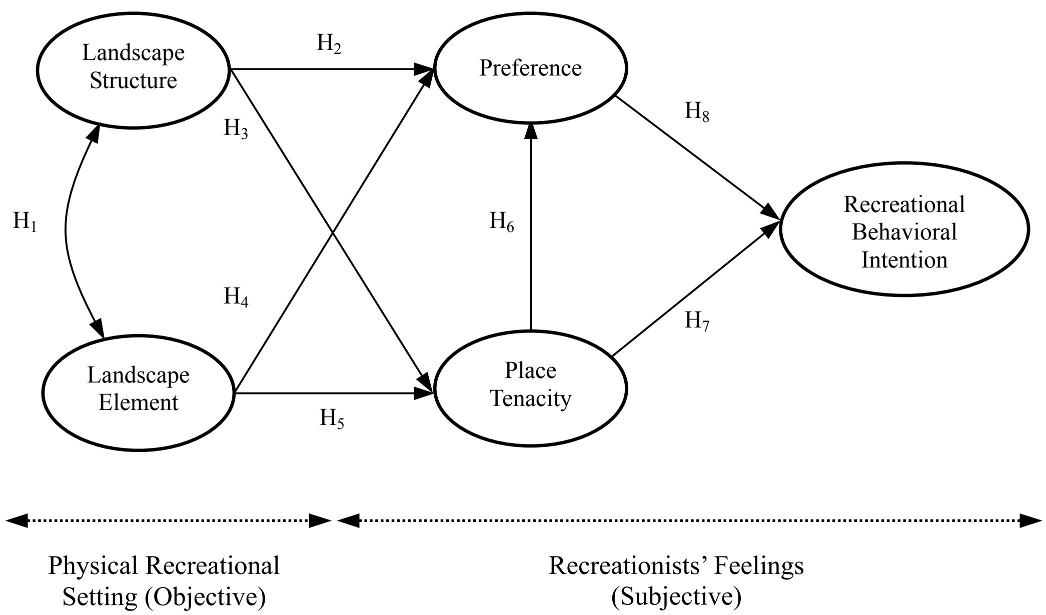


Figure 1.3. Hypothesized model.

Definitions

1. Niche: Niche in ecology may be thought to be a generalization of range (Kolasa & Waltho, 1998). Ecologists regard a niche as "a setting of environmental features that are suitable for an animal, into which it fits metaphorically" (Gibson, 1979, p. 129). The term niche has varied in meaning since the 1910s, but it may be formally defined as the "activity range of each species along every dimension of the environment" (Ricklefs, 1990, p. 729; also cf. Hutchinson, 1957). In the context of outdoor recreational management, this study defines niche as the particular physical settings within a natural environment preferred and exploited or relied upon by recreationists.

2. Landscape composition: This refers to the spatial representation of landscape structure and landscape elements. This research describes a landscape using two general categories: landscape structure and landscape elements.

a. Landscape structure is the distribution and configuration of landscape elements (cf. Forman & Godron, 1986). A suite of landscape metrics was applied to sketch the landscape structure characteristics, such as Edge Density (ED), Mean Patch Size (MPS), Area-Weighted Mean Shape Index (AWMSI), and Interspersion Juxtaposition Index (IJI) (cf. Elkie et al., 1999; McGarigal & Marks, 1995; O'Neill et al., 1988; Riitters et al., 1995).
b. A landscape element refers to a basic, relatively homogeneous, ecological unit in a landscape (cf. Forman & Godron, 1986; Forman, 1995). This research focused on five categories of natural elements: forest, shrub land, weedy field, lawn ground, and water body.

3. Preference: Preference is an expression of the recreationists' subjective selection of their favorite scenery in a given recreational area. From the perspective of human evolution, preference includes seven factors: coherence, complexity, mystery, legibility, prospect, and refuge, as well as hazard.

a. Coherence refers to the extent to which a scene is organized or unified through the repetition of landscape contents (Kaplan & Kaplan, 1978, 1995).
b. Complexity refers to the diversity of landscape elements in a scene (Kaplan & Kaplan, 1978, 1995).
c. Mystery refers to the idea that a recreational visitor could acquire new information upon coming to the scene (Kaplan & Kaplan, 1978, 1995).
d. Legibility refers to the extent to which recreationists could easily and thoroughly explore a landscape without becoming lost (Kaplan & Kaplan, 1978, 1995).
e. Prospect refers to the unimpeded opportunity to see in a natural landscape (Appleton, 1984, 1990, 1996; Greenbie, 1982; Lorenz, 1952).
f. Refuge reflects the opportunity to hide or be protected (Appleton, 1990, 1996; Greenbie, 1982).
g. Hazard refers to a sensation of being threatened and the desire to escape (Appleton, 1990, 1996; Greenbie, 1982).

4. Place tenacity: Place tenacity refers to an innate feeling of affinity with a place. This research categorizes place tenacity into two concepts: place identity and affordance.

a. Place identity refers to a sense of place belongingness (Kellert, 1993; Moore & Graefe, 1994; Proshansky et al., 1983; Williams & Patterson, 1996).

b. Affordance refers to a recreationist's sense of a place's resource richness (Gibson, 1979).

5. Recreational behavioral intention: Recreational behavioral intention refers to humans' motivations and behavioral tendencies in regard to seeking outdoor recreation (Bammel & Burrus-Bammel, 1996; Driver et al., 1987; Pigram & Jenkins, 1999). This research identifies four major behavioral intention prototypes (Kaplan, 1995; Kellert, 1997; Plutchik, 1991; Scott, 1958; Wilson, 1984):

a. Restoration refers to the human need to encounter nature for relaxing and rejuvenating experiences.
b. Exploration means the tendency to be in contact with and be informed by the environment.
c. Territoriality refers to the attempt to take over or stay in an area.
d. Affiliation refers to the inclination to approach and bond with preferred natural settings.

Significance of this Study

Understanding the mechanism by which the environment affects recreationists' perceptions and behavioral intentions may significantly benefit outdoor recreation management practice. Conventional studies, however, emphasize the importance of psychological reactions; few studies have been devoted to quantitatively understanding the functions of physical characteristics, such as landscape structure and its elements. Hence, park managers are unlikely to know how to create an appealing setting for park visitors. This study provides a quantitative way to measure the relationship between physical natural settings and recreationists' feelings. The findings may help professionals in park planning/design and management to provide an optimum experience for visitors.

This study’s findings also crucially strengthen and expand the theory of outdoor recreation management. The results not only provide a new branch of contemporary theory for outdoor recreation research, they also bridge the philosophy between liberal arts and natural science research. The mainstream in outdoor recreational behavior studies has been dominated by social science perspectives and has largely ignored human biological dimensions. Through a viewpoint informed by the notion of human biological instincts, this study establishes a new paradigm that can be used to interpret recreationists’ perceptions and behavior patterns.

Chapter 2

LITERATURE REVIEW

This chapter presents a review of the literature pertinent to the concept of the recreational niche, as well as literature that focuses on visitors' perceptions and behaviors. The review is divided into the following sections: 1) evolutionary perspectives of perceptions and behavioral intentions in regard to recreational niches in the natural environment; 2) place tenacity and landscape preference; 3) origin of outdoor recreation behavior; and 4) landscape composition in nature-based recreational areas.

Evolution of Perceptions and Behavioral Intentions in Recreational Niches

A niche represents a set of affordances in which a recreationist may utilize resources observed or latent in the natural environment for her/his enjoyment. Ecologists use the niche concept to present the relationship between a population or an individual to all dimensions of the environment, such as chemical and physical settings (cf. Hutchinson, 1957; Ricklefs, 1990). To better understand visual perception as a mechanism of reciprocity between the environment and the perceiver, Gibson (1979) further defined a niche as a set of affordances that species utilize or occupy in the environment. Affordances are interspecies- or intraspecies-specific, and an object may afford varied things to a species. A landscape may afford shelter for deer, but it might not fit human needs; a tree may provide food for birds, and it may simultaneously afford enjoyment to recreationists. The affordances of a given environment include, though are not limited to, its substances and surfaces. Through its perceptions of affordances, an organism can find its preferred niche in the environment, referred to as its *ecological niche*.

Studies on niche perceptions as a by-product of human evolution have been gaining in popularity for the last several decades. For example, Eibl-Eibesfeldt (1988) stressed that some environmental preferences might be the remnants of evolutionary adaptation, through which human forbears learned to detect and avert enemies and predators. Gibson (1979) stressed that a safe niche with dwellings, food, and/or recreation will satisfy humans and stimulate pleasure. The habitat theory (Appleton, 1996) proposes that an individual will find satisfaction in a biologically favorable niche, that is, one in which he/she is not exposed to any hazards. Furthermore, Kaplan (1975) indicated that humans quickly evaluate their surroundings based on the environmental information supply, concentrating on the most valuable information to decision-making, thus engaging a mechanism essential to survival. It is assumed that perceptions of settings as more or less favorable to survival might be at the evolutionary root of human beings' aesthetic preferences.

If for animal species habitat preferences are original and inherent instincts are evolutionary, it may logically be assumed that human beings also inherit particular preferences; those pristine affections, the subconscious desires, may pass from parents to offspring genetically (Wecker, 1964). Many animal species emerge from a significant genetic basis in regard to habitat selection (Brockmann, 1979; Drickamer & Vessey, 1982; Jackson, 1988; Partridge, 1974, 1978)—the offspring inherit the parents' preferences, even if they were born in different environments (Wecker, 1964). It is assumed that human beings may also have a similar biological reaction. Such a mechanism might explain why humans often become attached to certain environmental features, such as fresh water and vigorous vegetation (Greenbie, 1982). Consequently, these genetic preferences affect human behaviors in terms of natural recreation settings. If human beings evolved on the savanna of Africa, this would explain why savanna-like environments have a widespread appeal for recreationists and are characteristic of the gardens of many home owners (cf. Hiss, 1990), and thus might be used to support the imprinting theory (Alland, 1973).

The aforementioned concepts suggest that humans have underlying biological needs that drive what seem to be universal affections for certain natural settings. The concepts are, therefore, important for offering a rational basis for the present study's hypotheses. From an evolutionary viewpoint, the following subsections discuss recreationists' biological bond with the environment in terms of their perceptions and behavioral intentions.

Place Tenacity and Landscape Preference

The Role of Evolution in Determining Place Tenacity

Place tenacity refers to a tendency to affiliate with nature (Milton, 2002; Wilson, 1984), suggesting innate ties with particular natural settings. E. O. Wilson suggested that a deeper form of affective attachment beyond the particularities of habitat exists (Orr, 1993). Kellert (1997) indicated that some natural settings "possess attributes that seem to encourage strong emotional bonding and attachment" (p. 107). Moreover, having experienced modern artificial environments for a relatively short period compared with prehistory, humans may retain an innate urge to incline toward nature. Much research has stressed that some settings may be less crucial to survivorship than they once were, yet human emotional attachment to the amenities of such settings has been evolutionarily inherited and so has persisted (Gebhard et al., 2003; Heerwagen & Orians, 1993). This emotional dependence has been vital to human development. A person's affections may be established by emotional bonding with certain species and landscapes that provide evolutionary benefits such as emotional sustenance and security, sociability and affiliation, self-esteem and self-respect, and physical healing and mental restoration (Kellert, 1997; Myers & Russell, 2003). This research divided place tenacity into two concepts: *place identity* and *affordance*.

Place Identity

Place identity is the affective bond with the environment. Place is a center of meaning composed of experience and space. Norberg-Schultz (1965) posited that space where life occurs is place; Tuan (1977) further stressed that if a space is meaningful to the actor, it may become a place. Traditionally the related idea of identity tends to represent the self-concept by organizing information about the self and determining who we are or want to be in social respects, which, however, ignores the importance of non-human objects and contexts (Clayton, 2003). However, studies focusing on the relevance of identity to natural objects or environments have begun to emerge from varied disciplines over the past few decades (cf. Clayton & Opotow, 2003; Jackson, 1996; Sommer, 2003). In general, place and identity together create what is known as place belongingness, which can be usefully summarized as encompassing the "potpourri of memories, conceptions, interpretations, ideas, and related feelings about specific physical settings as well as types of settings" (Proshansky et al., 1983, p. 60). Place identity can be identified in recreationists' perceptions, and it is manifested toward some particular nature-based outdoor settings, functioning as an essential recreational experience (cf. Bricker & Kerstetter, 2000; Moore & Graefe, 1994; Williams et al., 1992).

Place identity may be generated through a process of empathizing with a natural setting

(Milton, 2002). It implies that a place's meaning inheres in more than the place's physical characteristics—there may be an affective bond between the actor and the setting, sometimes known as "topophilia" (Tuan, 1974), "or sense of place" (Tuan, 1980). Some other theories, such as those of "dwelling" (Heidegger, 1977), "existential foothold" (Norberg-Schultz, 1979), "appropriation of space" (Proshansky, 1976), and "territory" (Brown, 1987) have also been adopted to interpret the process of the creation of emotional ties, in which basic relationships between humans and the environment may generally be divided into two complementary concepts: space and character (Norberg-Schultz, 1979).

On the basis of person–environment compatibility (cf. Kaplan & Talbot, 1983), Korpela (1989) argued that place identity is a product of an active self-regulation mechanism that relates to nature. Tuan (1976) also coined the term "geopiety" to represent humans' emotional reverence for and attachment to nature. Indeed, in addition to exploiting resources, human beings, based on the biophilia theory (Wilson, 1984), have a genetic aptitude for affiliating with nature. This process also contributes distinct evolutionary advantages in terms of human ability to adapt, persist, and thrive by way of connections between personal identity and nature (Kellert, 1993, 1997).

Affordance

Affordance, a term introduced by Gibson (1979), indicates a real-world and direct perception of the practical opportunities or action possibilities for animal species' utilization. Affordance is "what the environment offers the animals, what it provides or furnishes, either for good or ill" (Gibson, 1979, p. 127). This theory of affordance emphasizes the environment–actor–task interaction as a whole to better explain the perceptual experience, which is categorized as an ecological approach that contradicts traditional cognitive theories. Gibson further hypothesized that the composition and layout of surfaces in an environment constitute what they afford.

Derived from an evolutionary perspective, Gibson's ecological theory of perception is more in line with functionalism, as it emphasizes the adaptation and functioning of organisms in their environment (Gibson, 1979). Humans tend to take advantage of objects' useful functions in the environment, such as the provision of food, safety, comfort, or recreation (McAndrew, 1993). Based on evolutionary biological needs, hominids chose a suitable environment as their niche by way of seeking, evaluating, or transforming natural settings, and this capability contributes to survival fitness. Gibson stressed that some environmental facts, such as successful locomotion, prevention of injury and death, and location of vital resources, are most relevant to species' biological adaptation (Lombardo, 1987). These innate evolutionary effects also influence recreationists' environmental preference (cf. Appleton, 1990; Kaplan & Kaplan, 1982).

During a recreational experience, a visitor explores environments and objects, and in so doing does not perceive the physical world per se but the environment's "affordance." Such a perceptual focus in regard to the natural stimuli may encourage appropriate behavior (e.g., Gibson, 1979). Based on Gibson's ecological theory of perception, organisms actively explore the environment and encounter objects in varied ways—the invariant functional properties of objects are termed affordance (Bell et al., 2001). Natural settings afford recreational opportunities that are not subjective or contingent on the moods or needs of recreationists. Recreational opportunities exist whether or not a visitor wishes to use them (e.g., Gibson, 1979; Lombardo, 1987)—this denotes invariant functional properties. The affordances that a recreationist perceives are "in a sense objective, real, and physical, unlike values and meanings, which are often supposed to be subjective, phenomenal, and mental" (Gibson, 1979, p. 129). In respect to contemporary recreational theories, "affordance" in this research is defined as being closely related to "place dependence" (cf. Bricker & Kerstetter, 2000; Moore & Graefe, 1994; Williams et al., 1992); however, it is also more open to evolution-oriented theories, in which affordance emphasizes the direct arousal of biological imprints in regard to natural settings.

In the present research, *affordance* and *place identity* are both important for interpreting recreationists' physical and psychological bonds with natural settings.

Landscape Aesthetics and Preferences

Ulrich (1977) stressed that "evolution has left humans with strong perceptual and informational biases that affect aesthetic preferences for landscapes" (p. 279). Affective experiences, or emotional experiences, are the most significant benefits for many recreationists in nature-based environments (Rossman & Ulehla, 1977; Shafer & Mietz, 1969; Ulrich 1983). Affections are regarded as innate, cross-cultural phenomena (Izard, 1977). In terms of evolution, it would be highly adaptive for a species to develop a strong affective preference that motivates the individual to actively find a well-functioning environment in which to survive and mate (cf. Charlesworth, 1976). Initial affections might boost human recognition and improve the efficiency of "information processing" (Zajonc, 1980), in which the quick-onset process to promptly execute human approach–avoidance behaviors improves survivorship and fitness, based on the standpoint of adaptation in evolution (Ulrich, 1983).

The quality of scenery is a vital factor to recreation and tourism (Real et al., 2000), in light of the likelihood that humans generate varied associations with and ideas about particular natural elements and landscapes. A closed forest in Western literature oftentimes elicits a sense of depression, or it evokes fear. In contrast, open treeless plains are often regarded as desolate (Orians, 1980). Furthermore, most people prefer even-cut grassland around their housing areas (Hiss, 1990). We generally appraise a natural environment as beautiful if it offers to fulfill biological needs (Dewey, 1958). Research even states that some existing animal species have similar aesthetic standards (Eibl-Elbefeldt, 1988).

Aesthetic affection, an emotion that governs environmental preference, is inherent in human beings (Langer, 1953). Although aesthetic value may involve both innateness and learned experience (Bourassa, 1990), research has indicated some common scenic preferences across cultures in which evolutionary mechanisms may be subconsciously evoked (Hull & Revell, 1989). That is, some biological roots might still function in human judgment. Research indicates that hominids might have originated from a savanna-like habitat in East Africa near riparian or lacustrine locations (Boaz, 1979; Geist, 1978), in which the niche acted as a well-functioning provider of various resources for large terrestrial and omnivorous primates. Interestingly, empirical research has consistently proven that after millions of years, humans are still attracted to savanna-like and water-featuring landscapes—this is especially so for children, who generally have less cultural experience (e.g., Balling & Falk, 1982; Orians, 1986). While there still is no direct evidence that the aesthetic preference of present humans is an evolutionary remnant, research based on lab experiments has suggested that genetic preference is inherited by offspring in some animal species (e.g., Wecker, 1964).

Combining evolutionary theory with information-processing theory, the preference frame was established to interpret recreationists' preferences for a given landscape (cf. Kaplan & Kaplan, 1982). "The environment is not in the head" (Wohlwill, 1973, p. 166). Humans derive external information from the natural environment and mentally restructure the informational pattern. A natural image (as) perceived by humans stems from interactions between the observer and the environment (Lynch, 1997). People unconsciously organize perceptions and knowledge of a surrounding environment to construct mental representations of a setting—an intricately entwined process (Gartner, 1993; Kaplan, 1983). During this processing, humans evaluate the environment based on the information available, with greater amounts of information improving chances of survivorship. The mechanism is critical to an organism in evolution (Kaplan, 1975).

Information handling became more essential to the tree-dwelling hominid as it evolved in the extensive African savanna and sought to evade predators, compete for food, or even travel far from the home range to follow wounded prey (Campbell, 1998; Kaplan & Kaplan, 1978; Pfeiffer, 1985). In this terra incognita, higher chances of fitness and survivorship may have depended on the accurate and efficient processing of environmental information. Based on information-processing theory, Kaplan and Kaplan (1978, 1995) categorized spatial context into four features in order to evaluate human environmental preference: coherence, complexity, mystery, and legibility. Coherence refers to the extent to which a scene is organized or unified through the repetition of landscape contents; complexity refers to the diversity of landscape elements in a scene; mystery suggests that one could acquire new information if traveling into the scene; and legibility is the extent to which one could extensively explore a landscape without becoming lost.

Somewhat similarly, following an adaptive problem-solving perspective, Heerwagen and Orians (1993) argued that human brains are evolutionarily designed to wisely gather and respond to the opportunities and constraints embedded in ancestral environmental information in order to improve their chances for survival. Natural components such as resource availability, shelter and predator protection, hazard cues, and way finding and movement are the critical factors that define suitable habitability, which, in turn, improved our ancestors' health, survival, and reproductive success. Such components then, with their attendant positive effects on survival chances, would have evoked the hominid's instinctively positive emotional responses and led to exploration of the environment.

Inspired by English painting and based on the concept of evolutionary biological needs (e.g., Gibson, 1979), the prospect–refuge theory proposes to interpret human preferences for certain landscapes (Appleton, 1984, 1990, 1996). An optimal habitat capable of the functions/symbolisms of prospect and refuge stirs human sensations of preference. A safe and comforting environment is a suitable niche for human beings due to the species' biological limitations. *Homo sapiens* are not physically strong in relation to possible predators; nor are they fast enough to flee. Thus their intelligence dictates a preference for a safe vantage point that allows them to retreat from immediate environmental threats (Greenbie, 1982). Prospect refers to an unimpeded view of a natural setting from a vantage point. Refuge reflects a niche that functions as a shelter and allows humans to hide from perils or threats. These natural constructs evidently support human decision-making processes in terms of habitat selection. Although no direct empirical research proves that humans retrieve the aforementioned congenital heritage when placed again in natural settings, Lorenz (1952) painted a vivid picture of human instincts as they may operate in this regard as follows:

> We are taking a walk in the forest.… We do what all wild animals and all good naturalists, wild boars, leopards, hunters and zoologists would do under similar

> circumstances: we reconnoiter, seeking, before we leave our cover, to gain from it the advantage which it can offer alike to hunter and hunted—namely to see without being seen. (1952, p. 181)

Those who seek to directly and comprehensively depict the mechanisms that may inhere in environmental preference have encountered various obstacles in gathering scientific evidence. The afore-cited theories, however, contribute significantly to indirect interpretation of the vestiges of biological adaptation and human preference in modern society (cf. Kaplan, 1992; Heerwagen & Orians, 1993).

The Origin of Outdoor Recreation Behavior in Evolution

Over past decades, research has been trying to forge links between biological and cultural evolution to help explain human behavior, although little effort has focused on the field of outdoor recreation. Darwin's influential theories presented in *On the Origin of Species by Means of Natural Selection* (1859) and *The Expression of the Emotions in Man and Animals* (1872) have permeated the majority of work on ethology and human behavior (Cartwright, 2000). Darwin hypothesized that *Homo sapiens* share their roots with other creatures, and human and animal behaviors are closely connected even if they are structured differently. His conceits continue to be widely supported at the present time by evolutionists and anthropologists (Cohen, 1975). Outdoor recreation behavior in natural settings, though expressing complex and diversified extrinsic patterns, still originates from the evolutionary force of the common instincts that cross animal species—including human beings. These origins in general may be categorized as pursuit of natural experience, as well as play, and they possess the functions of biologically prepared learning.

The Pursuit of Natural Experience and Play

An encounter with a natural environment may be described as a green experience (Kaplan, 1978). The instinct to interact with nature is essential and intense. Research consistently indicates that humans appreciate natural scenes more than man-made landscapes (Wohlwill, 1976). Historically, nature, in its grandest form, has functioned as a prominent object for human society to commune with (McAndrew, 1993; Tuan, 1974, 1976). In addition, at the present time, people still regard nature as essential and even desire daily contact with it (Kaplan & Kaplan, 1995; Talbot & Kaplan, 1984).

The pursuit of experiences with nature is an instinctual human need, making an encounter with nature an end in itself (Hendee & Stankey, 1973; Kaplan & Kaplan, 1978). According to the biophilia theory proposed by Wilson (1984), affiliating with nature is a genetically based tendency that also contributes to environmental fitness and adaptive benefits for human beings (Kellert, 1993). Although humans in modern society do not need to overcome prey or escape predators in the wilderness, the inherited yearning for certain kinds of natural environments remains. It also seems that evolutionary remnants still incite humans to challenge nature. Some outdoor recreational activities such as hunting, fishing, camping, mountain climbing use nature as an arena (Kellert, 1993).

Play fulfills the pursuit of natural experience in outdoor recreation, and it involves voluntary and emotional pleasure (Bammel & Burrus-Bammel, 1996; Beach, 1945; Ellis, 1973), which is the origin of human beings' leisure and recreation (Goodale & Godbey, 1988). Play, in a biological heritage, is a general property of animal species that man has also retained (Alland, 1973). The nonverbal forms of play (such as activity play, object play, and social play) that overlap between nonhuman primates and humans seem to follow similar developmental courses (Fairbanks, 2000); nevertheless, the amount, diversity, and duration of play are associated with a species' phylogenetic position (Beach, 1945). Primates benefit from play because through it they learn how to fight, hunt, and communicate (cf. Nissen, 1951b). Play also promotes group cohesion (Burghardt, 1984; Chalmers, 1984; Fairbanks, 2000; Power, 2000). Therefore, play is functional and has a role in the ability of an individual and species to adapt in terms of physical and social development, social communication and integration, and establishment of a dominance hierarchy (Smith, 1978). For mankind, play significantly favors the cultural evolution of human society (Greenfield et al., 2000; McDougall, 1908). It has not only evolved and flourished in extremely varied recreational activities in natural settings, such as fishing, hunting, and other field sports, play also has developed into a significant cultural form and presentations (Huizinga, 1955; von Schiller, 1905).

The pursuit of natural experiences in outdoor recreation implies a revitalization process in the modern environment (cf. Pigram & Jenkins, 1999). The attention restoration theory (ART) can be applied to explain the attraction of human beings to natural environments (Hartig et al., 1997). Mental fatigue may occur when humans are forced or obligated to attend to something uninteresting, leading to so-called "voluntary attention" (James, 1962) or "directed attention" (Kaplan & Kaplan, 1995). Based on theories of the evolution of human perception, this obligation process, involving as it does the receipt of environmental information, could generate confusion, leading to a state of toleration that would cause physical and psychological pain and thus threaten the survival of the species. The process consequently motivates species to search for an alternative situation or an environment with advantages. Since many natural environments stimulate pleasure and inhibit pain—regarded as a restorative process—it attracts human beings.

During an encounter with nature, humans may have some experiences that restore or improve their health, such as being away, extent, fascination, and compatibility (Kaplan & Kaplan, 1995).

The Instinct Patterns of Behavioral Intentions

Research has documented variations in motivation and behavioral tendencies in outdoor recreation (cf. Bammel & Burrus-Bammel, 1996; Driver et al., 1987; Pigram & Jenkins, 1999). Piéron (1928, cited as Plutchik, 1991) stated that attraction–avoidance in regard to objects is the basic behavioral intention pattern in the least-differentiated organisms. Similarly, Mehrabian and Russell (1974) also categorized emotional behavior into two archetypes in man–environment interactions: approach and avoidance, which were further developed into four verbal measures: desire to stay, explore, work, and affiliate in the situation. Scott (1958), in his work entitled *Animal Behavior,* illustrated nine adaptive behaviors common to all animals: ingestive, shelter-seeking, agonistic, sexual, care-giving, care-soliciting, eliminative, allelomimetic, and investigative. Plutchik (1980, 1991), based on Scott's pattern framework, developed eight human emotional behavioral prototypes: incorporation, rejection, destruction, protection, reproduction, deprivation, orientation, and exploration. After reorganizing the aforementioned theories, this research adopted four prototypes of behavioral intentions: exploration, affiliation, territoriality, and restoration. Each is described below.

Territoriality

Territorial intention, in this research, is an archetype of emotional behavior in nature-based outdoor recreation, which might be driven by the instinct toward aggression. Konrad Lorenz (1966), in his *On Aggression,* maintained that aggressive tendencies are inborn in animals;

human beings also share in this general tendency (also cf. Wilson, 1978). Territorial intention refers to the attempt to control a geographic area and the objects in it (cf. Sack, 1983). It is considered to be an imprinted biological heritage (Brown, 1987) that has shaped and been shaped by the biological and cultural evolution of human beings over millions of years (McAndrew, 1993). This instinct to claim and defend territories has been a vital process in human development (Kellert, 1997). Although social and cultural elements are more characteristic of human territoriality than they are of animal territoriality, these territorial feelings or representations are similarly rooted in survival needs such as finding shelter, obtaining food, minimizing intraspecies aggression, and protecting health (Bell et al., 2001).

A natural setting is a hippodrome and slaughterhouse for the selection of competitive species. The expression of an urge to master nature has been smelted in the evolutionary course and demonstrates some adaptive benefits such as physical strength and mental prowess, self-reliance and independence, exploration and adventure, and courage and heroism (Kellert, 1997). These benefits set in motion human tendencies to challenge nature and hone aggressive skills. "Mastering nature" once implied gathering sustenance, establishing territory, or the searching for security, that is, the very means of survival; now, it remains encoded in various behavioral patterns in outdoor recreation (Kellert, 1997).

Today, many outdoor recreational activities—such as hunting, sport fishing, camping, rafting, mountain climbing, and SUV driving through wild fields—simulate or retrieve these aggressive instincts. Furthermore, crowd avoidance, solitude, and personal distance in outdoor recreation also reveal evolutionary vestiges of territoriality. Actually, almost all recreational games today, such as football, reflect territorial instincts. Recreationists make emotional exclamations, demonstrate considerable satisfaction, and tend to flaunt the challengeable targets they hunt, navigate, or even just photograph. That recreationists sometimes request that the grassland in a recreation park be mowed may be regarded as a striking instance of territoriality.

In sum, a territorial feeling, such as control arousal for an environment, is a powerful way to prevent a sense of helplessness, which also elicits affection in an individual (cf. Kaplan & Talbot, 1983). This inclination toward territory control often indicates an effort to make or look for an environmental setting that is more satisfactory and also meshes with other human instincts, such as exploration; it also motivates a variety of outdoor recreational behaviors.

Curiosity and Exploration

Curiosity and a need to explore drive recreationists away from their "home range" to pursue alternative experience and satisfaction (e.g., Anderson & Tindall, 1972; Schoggen & Schoggen, 1985). Curiosity is the tendency toward exploratory learning (Lorenz, 1956); it is in general regarded as the phenomenological counterpart of exploratory act sequences that impels organism to the novel objects (Bradbard & Endsley, 1980; Symons, 1978; Welker, 1978)—an instinct or propensity found across species (Plutchik, 1991).

Exploration refers to the more-or-less random set of activities by which organisms get to know an environment. Exploration intention, a basic prototypic pattern, is the constant desire to be in contact with and informed by the environment—it is the archetype of play (Plutchik, 1991). Exploration may keep individuals in contact with and informed about the environment and so decrease unfamiliarity and uncertainty (cf. Plutchik, 1991). In evolution, the quest for exploration or discovery has some adaptive benefits for human beings, such as improved physical fitness and vitality, aggrandized curiosity and imagination, improved self-confidence and self-esteem, and enriched calm and peace of mind (Kellert, 1997). Exploration is discovered at all levels of evolution in the interaction between organisms and environments. It has been observed universally throughout situations and animal species.

Although exploration behavior in evolution consumes an organism's energy and time and may expose the individual to the risk of predation (Orians, 1986), it seems that "the tendency to approach novel stimulus objects is universal" (Berlyne, 1960). Organisms are highly motivated to explore and will work hard in this regard even when the remuneration is simply an opportunity to experience a new environment (Harlow et al., 1950; Orians, 1986), in which the process might imply adaptive value for species survival (Welker, 1978).

Animals commonly indulge in locomotor exploration (Ellis, 1973; Nissen, 1951a), which might explain why off-road driving for leisure is so common in outdoor recreation (cf. Cordell & Super, 2000). Berlyne (1960) also introduced the term "homo ludens" and further stated that outdoor recreation, entertainment, and even idle curiosity are in part driven and processed by exploration. Actually, most outdoor recreation reveals exploration instincts such as novelty, variety, and change, which are important to maintaining an optimal level of arousal (cf. Driver et al., 1987; Mannell & Kleiber, 1997). The need for arousal or activation-seeking is an important mechanism in leisure behaviors (cf. Iso-Ahola, 1980).

Exploration and curiosity are interrelated and both have similar evolutionary and developmental significance (Schoggen & Schoggen, 1985). Exploring a new environment may not only be dangerous for a species due to the uncertainty of encountering predators or other environmental hazards, but is also a time- and energy-consuming process (Case, 2000). However, the current state of the habitat may not remain such as to support species' activities over substantial time periods; if this is so, exploration beyond the individual's home range may be important for species survival. When curiosity motivates a species to search for an optimal situation, such as pursuing another suitable niche to escape from psychological pain (cf. Orians, 1986; Welker, 1978), a high level of adaptation is indicated.

Affiliation

Affiliation, among these aforementioned prototypical patterns, is the innate desire for and tendency to approach natural settings. According to the biophilia theory (Wilson, 1984), humans possess a biologically based attraction to life and lifelike processes, which fosters a tendency to bond with nature (Kellert, 1997). In addition, the biologically prepared theory, presented by Seligman (1970), proposed that evolution has predisposed humans and many animal species to easily and quickly learn those associations or responses that foster survival when certain objects or situations are encountered—this suggests that positive responses to some objects may be biologically prepared (Ulrich, 1993). These instincts toward nature seem to have been retained in various human motivations and behavioral patterns in modern society, where they may even be continuing to evolve.

Both the biological rewards and the dangers associated with natural settings during human evolution have led individuals to learn various adaptive responses, such as approach–avoidance behavior, to certain natural stimuli and configurations. This instinct persists to this day (Ulrich, 1993). Approach behavior to a natural setting has been regarded as the prototype of human behavior toward a given environment (Mehrabian & Russell, 1974); it may also imply an affiliative behavior in regard to natural surroundings. If early humans inclined toward connecting with an affordable habitat, it follows that present research can logically assume that biological remnants might drive recreationists' intentions to affiliate with "suitable" natural settings.

Restoration

Restoration intention is regarded as another prototype of emotional behavior in outdoor recreation. Both the "expressed leisure needs" concept (Iso-Ahola, 1980) and hierarchical theory (Maslow, 1954) imply the importance of biological need in leisure behaviors. Actually, human behaviors, in evolution, aim to enhance individual or specific survivorship. Genetic instincts are also inherited and guide the tendency of human behaviors in modern society (Pfeiffer, 1985). Since human bodies and brains originated from, and have been selected by, natural settings for millions of years, mankind might encounter considerable obstacles to adaptation in the relatively short time period of modern civilization (Wilson, 1984). Humans tend to become fatigued due to "directed attention" in artificial settings, which instinctively evokes the individual sensation of survivorship pressure. Further, this mechanism inherently drives the individual to avoid an unhealthy situation and seek a sounder environment (cf. James, 1962; Kaplan, 1995; Kaplan & Kaplan, 1995). Similarly, Dewey (1958) pointed out that human instinct demands adequate adjustment to surroundings in order to restore equilibrium. The intention of approaching and experiencing nature is valuable to human health (cf. Knopf, 1987). It is also an active biological feedback process that plays a key role in processing functional evolutionary characteristics (Ulrich, 1993).

Although many natural scenes are effective in fostering restoration, some outdoor environments have been threatening to humans throughout evolution and are not relaxing (Ulrich, 1993). A natural setting associated with security or low risk (e.g., refuge), spatial openness, as well as other environmental affordances (e.g., food and water) may have benefited early humans. Consequently, it is logical to speculate that these environmental properties contribute to recreationists' physical and psychological restoration because they support lower levels of anxiety in regard to survival threats; for the purposes of this study, we speculate that the environmental stimuli evoke the approach behaviors of recreationists by way of the biological imprint (cf. Ulrich, 1993).

The Landscape Compositions of Nature-based Recreational Areas

The meaning of landscape may be simplified as "a collection of land" (Jackson, 1986, p. 67), which represents the assemblage of landscape mosaics in which community patches integrate and interact with each other (Godron & Forman, 1983; Turner et al., 2001). In a given outdoor recreational setting, for example, a landscape may be regarded as the entirety of the objectives perceived or detected by a visitor. Research tends to categorize a landscape according to two general compositions: landscape contents/elements and landscape spatial configuration/structure (Forman & Godron, 1986; Kaplan & Kaplan, 1995). The content-based category focuses on the common characteristics of specific objects or elements of a landscape, such as camping grounds, lakes, trails, forests, etc. Landscape configuration emphasizes the way elements are arranged in space, or it emphasizes their forms, such as the shape of a lake or the relative positioning of camping grounds and forests. Both the landscape elements and spatial structure are likely to play an essential role in influencing the recreationists' perceptions of outdoor recreation natural settings, described in detail as follows.

Landscape Elements

Landscape elements, those of both natural and human origin, refer to the basic and relatively homogeneous patches/units at any scale in a landscape (Forman, 1995; Forman & Godron, 1986). Research indicates that humans have aesthetic and affective responses to certain types of natural landscape elements, with these reactions quickly elicited and perhaps being biologically based (cf. Ulrich, 1983). Studies in forest recreation indicate a positive aesthetic preference for comparatively even-length grassland/lawn and a negative preference for rough ground cover (e.g., Arthur, 1977; Daniel & Boster, 1976). Open meadows encompassed by woods are also highly attractive (Zube, 1976), but weedy fields, scrubland, and agricultural landscape have negative attraction (Kaplan et al., 1989). Water, a dominant feature of scenic quality (Zube et al., 1975), generally arouses feelings of great pleasure (Ulrich, 1983). A natural water body, such as a mountain lake or waterfall, usually attracts humans (cf. Herzog, 1985; Palmer & Zube, 1976). Kaplan et al. (1989) studied environmental preference for varied land-cover types and concluded that weedy fields and scrubland were negative predictors. Furthermore, Hammit (1987) even found that most recreationists easily remembered waterfalls, uprooted trees, and some particular trails in natural recreational settings.

Pursuing or approaching the “right” resources, such as vigorous vegetation and fresh water, is innate to organisms because it improves the chances of individual survivorship and improves reproduction rates, both of which are important in terms of biological adaptation (Wynne-Edwards, 1962). For *Homo sapiens,* the preferences have also developed significantly because this capability has helped humans searching for suitable resources to ameliorate their environmental fitness (cf. Charlesworth, 1976). Innate biological preferences for certain landscape elements do not only define a human sense of beauty, they also trigger an emotional bond. Research has documented the evolution of human primogenitors in the extensive savanna of East Africa (cf. Campbell, 1998; Pfeiffer, 1985), and it may go some way to explaining why parks and gardens worldwide are not constructed as closed forests (Orians, 1986).

Various approaches are used to define and classify landscape elements, including, but not limited to, professional judgment and analytic classification (e.g., Meeus et al., 1990; Mora & Iverson, 2002), which depend on environmental facts and researchers' needs. For example, Kaplan et al. (1989) categorized land-cover types as agriculture, cut-grassland, weedy field, scrubland, forests, and woodlawn. The current research focused on selected natural elements in outdoor recreation settings (refer to Chapter 3).

Landscape Structures

Landscape may elicit empathic responses that demonstrate the profoundness of the inclination of attachment (cf. Kellert, 1997). The ancient Chinese Feng-Shui concept, for example, might disclose the human preference for a habitat (or a setting) in which the landscape structure and/or elements appear similar to the human female genital organ: this preference could be thought of as a profound connection to, even worship, of the female role in reproduction. Why might recreationists be attracted to particular natural settings? The relationship between habitat structure and animal preference has been addressed for decades in wildlife research, but it is rarely referred to in the human dimension; this is especially the case for outdoor recreation research. Landscape structure, the spatial distribution of elements in relation to size, shape, configuration, etc. (Forman & Godron, 1986), may influence and modify species' behaviors (Farina, 1998). For example, research has indicated that landscape structure may affect the habitat selection of animal species (cf. Aplet, 2000; Case, 2000; Farina, 2000; Harker et al., 1999; Paton, 1994; Schmiegelow & Mönkkönen, 2002; Stacey & Taper, 1992). On the other hand, to a certain extent, human perceptions may be similarly affected in regard to landscape structure: Orians (1986) maintained that human beings, like other animal species, display a strong emotional response to particular landscape configurations. Similar landscape structures may remind people of a similar sense of space (Tuan, 1977). Furthermore, Antrop and van Eetvelde (2000) suggested interpreting human visual images and their effects on landscape structure with reference to aspects of holistic bio-philosophy.

The instincts involved in human perception, cognition, and evaluation are directly influenced by landscape structure (Nassauer, 1995). For example, the degree of the recreationists' recognition and recall of surroundings is an important factor in determining how much they understand and enjoy the natural environment (Hammitt, 1987). A legible natural environment, a well-structured landscape with distinctive elements, allows humans to easily understand and remember their surroundings, and it affects their preferences (Kaplan & Kaplan, 1995). Human ability to understand a landscape also reveals how the species can avoid environmental danger and improve survivorship throughout evolution (Kaplan, 1975). Glass and Holyoak (1986) maintained that a clear landscape structure pattern is more likely to attract sightseeing activities; a vague landscape tends to degrade recreational pleasure. It seems that although humans have varied experiences, some particular types of landscape structures in natural settings are more likely than others to trigger instinctively affective reflections.

Some of these habitat-related theories may also apply to the interpretation of human preference for certain landscape patterns. Based on the prospect–refuge theory (Appleton, 1975, 1984, 1996), an environment in which one may "see without being seen" (prospect) and experience sheltered functions (refuge) will provide relaxation and pleasure, rather than anxiety. This is because the hominid in that place can clearly look into the distance to avoid potential hazards from the surroundings, such as encroaching predators. Interestingly, in modern society, an environment that offers a strong sense of prospect and refuge has even tended to be a popular play space for children (Hester, 1979), enabling games of hide and seek, or gatherings in a tube or tree house (e.g., Gibson, 1979). It is also very common for recreationists to prefer to place themselves at the edge of space, perhaps picking the table in the corner of a park.

The existence and size of any given landscape element affects the representation/layout of the landscape structure. Landscape structure may be sketched using landscape metrics or indices to quantitatively depict structural characteristics in consideration of the spatial arrangement of landscape elements at the class or landscape level (Cardille & Turner, 2002). Many landscape metrics represent landscape patterns, but some are inherently redundant and highly dependent, only substituting for information in certain cases. Research has attempted to collapse these metrics into fewer categories to provide for greater efficiency in practice. Turner et al. (1991) recommended several dimensions, such as contagion, evenness, and fractal, to succinctly represent the attributes of landscape metrics. Riitters et al. (1995) conducted factor analysis and suggested six categories of landscape metrics: average patch compaction, overall image texture, average patch shape, patch perimeter-area scaling, number of attribute classes, and large-patch density-area scaling.

Chapter 3

RESEARCH METHODS

This chapter explains the methods and procedures employed to achieve the research objectives. It discusses the profile of the study area, research design, instrument development, data-collection methods, and related matters.

Variable Development and Model Rationalization

The final hypothesized model was developed based on the literature review (see Fig. 3.1); it consisted of two exogenous latent constructs: *landscape structure* and *landscape elements,* as well as three endogenous constructs: *landscape preference, place tenacity,* and *recreational behavioral intention*.

The landscape structure was measured with landscape indices: Edge Density (ED), Mean Patch Size (MPS), Area-Weighted Mean Shape Index (AWMSI), and Interspersion Juxtaposition Index (IJI). Considering the logic of human perception and the practical applications for outdoor recreation management, this research identified four concise categories of landscape structure: patch density and size, edge, shape, and diversity and interspersion. One individual landscape index was chosen to represent each category, compressively and efficiently sketching the spatial information for each given landscape. The four indices (cf., Cardille & Turner, 2002; Elkie et al., 1999; O'Neill et al., 1988; Turner, 1989) were as follows:

Edge Density (ED). Edge Density (meters per hectare) refers to the amount of edge relative to the landscape area—the average edge length per hectare in a given landscape. Edge Density is calculated using the following equation (cf. Elkie et al., 1999; McGarigal & Marks, 1995):

$$\text{At the landscape level, } ED = \frac{E}{A}(10{,}000)$$

Where

E represents the total length (m) of all edge segments in a given landscape, and *A* denotes the total area (m^2). The values are multiplied by 10,000 to convert into hectares.

Mean Patch Size (MPS). Mean Patch Size represents the average patch size within a given landscape, which is calculated using the following equation:

$$\text{At the landscape level, } MPS = \frac{A}{N}\left(\frac{1}{10{,}000}\right)$$

Where

A is defined as the total area (m^2) of a given landscape observed by recreationists' "visibility surface," the *view shed* (refer to the Research Design and Procedures section of this chapter for details). *N* presents the total patch number within the observed landscape. The value of *A/N* is divided by 10, 000 to convert into hectares.

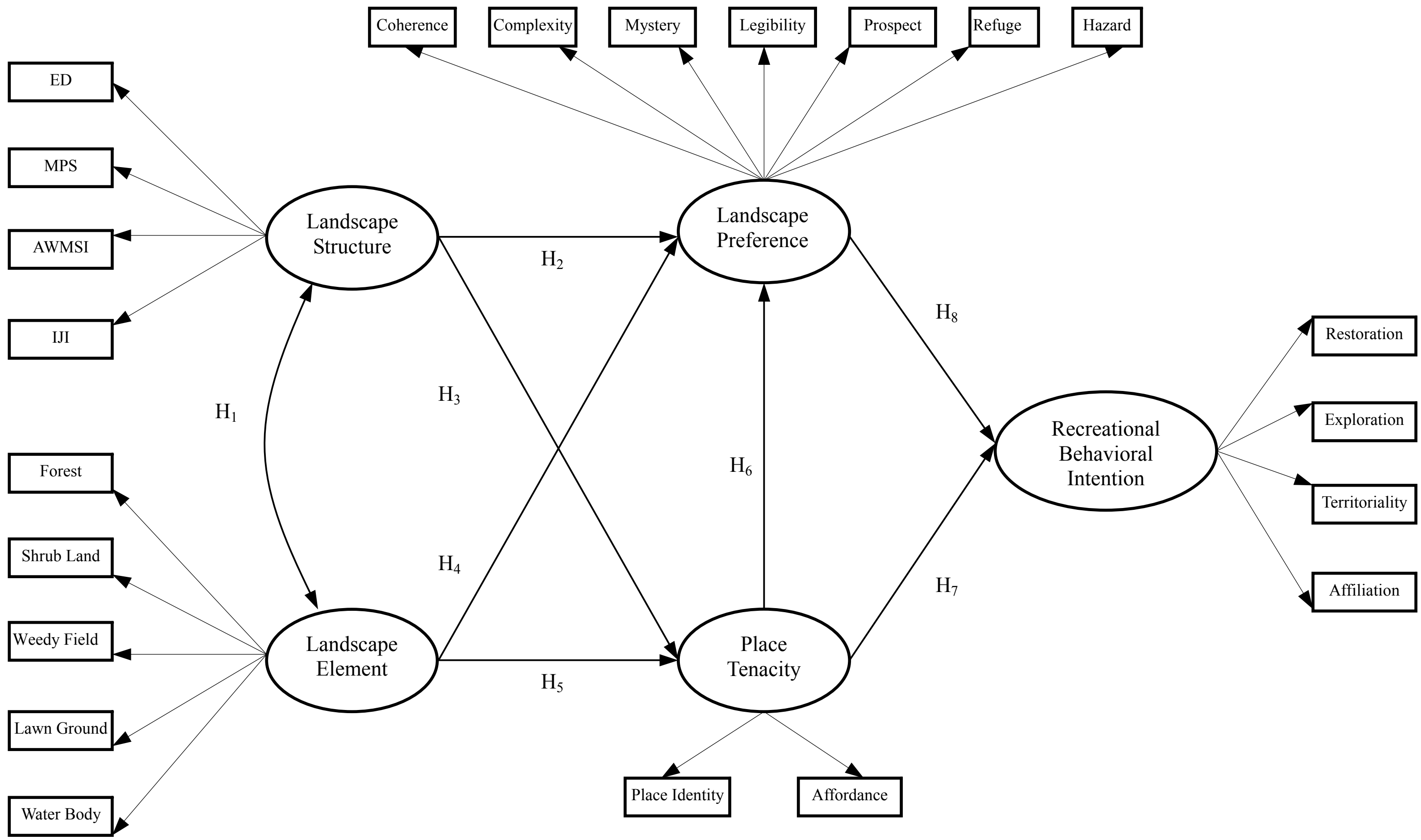


Figure 3.1. Final hypothesized structural model.

Area-Weighted Mean Shape Index (AWMSI). The Area-Weighted Mean Shape Index illustrates the degree of shape irregularity of patches within a given landscape. The index value equals 1 if all patches are square (raster format in GIS) in the observed landscape, and the values increase if the path shape becomes irregular. *AWMSI* is derived from the following equation (raster format) (Elkie et al., 1999; McGarigal & Marks, 1995):

$$\text{At the landscape level, } AWMSI = \sum_{i=1}^{m} \sum_{j=1}^{n} \left[\left(\frac{0.25 p_{ij}}{\sqrt{a_{ij}}} \right) \left(\frac{a_{ij}}{A} \right) \right]$$

Where

i denotes the patch types from one 1 to *m'* present in the landscape, and *j* indicates the path type from 1 to *n*. P_{ij} means the perimeter (meter) of patch *ij*, and a_{ij} represents the area (m^2) of patch *ij*. *A* is defined as the total area of the landscape.

Interspersion Juxtaposition Index (IJI). The Interspersion Juxtaposition Index measures the patch adjacency, which expresses the degree of the intermixture of patch types within a landscape (Elkie et al., 1999; McGarigal & Marks, 1995). *IJI* explicitly takes the spatial configuration of patch types into account. *IJI* approaches zero when patch adjacency becomes uneven, and equals 100 when all classes are equally adjacent to all other classes. At the landscape level, *IJI* measures the interspersion of each patch in the landscape. *IJI* is measured by the following equation:

$$\text{At the landscape level, } IJI = \frac{-\sum_{i=1}^{m'} \sum_{k=i+1}^{m'} \left[\left(\frac{e_{ik}}{E} \right) * \ln \left(\frac{e_{ik}}{E} \right) \right]}{\ln\left(0.5\left(m'\left(m'-1\right)\right)\right)} (100)$$

Where

i and *k* denote the patch types from 1 to *m'* present in the landscape, and *m* is the number of patch types (classes) present in the landscape, including the landscape border, if present. The e_{ik} is the total edge length (m) in the landscape between patch types (classes). *E* is the total length (m) of the edge in the landscape.

In regard to the landscape element, after the study took into account former research (e.g., Kaplan et al., 1989), the a priori environmental condition, and the information presented by aerial photos, the landscape elements were measured based on the selected criteria (Table 3.1) and categorized into five observed variables: *forest, shrub land, weedy field, lawn ground,* and *water body.* The pilot landscape survey was conducted in the late spring of 2004, and the final landscape investigations and selections were performed during the summer of 2004.

The measurement variables and data for the exogenous latent constructs (landscape structure and elements) were derived from spatial information as conveyed by the color aerial photo images within the boundaries of "visibility surface" via digitization and computation in the GIS (Geographic Information System) environment (consult the Research Design and Procedures section of this chapter for details). Summaries of the variables are presented in Table 3.2.

There were three endogenous constructs in this model: landscape preference, place tenacity, and *recreational behavioral intention*. The landscape preference construct was measured by seven variables: *coherence, complexity, mystery, legibility, prospect, refuge,* and *hazard* (Appleton, 1990, 1996; Greenbie, 1982; Kaplan & Kaplan, 1978). Place tenacity was measured by two variables: *place identity* and *affordance* (Bricker & Kerstetter, 2000; Gibson, 1979;

Moore & Graefe, 1994; Proshansky et al., 1983; Williams & Patterson, 1996). The recreational behavioral intention construct was measured using four variables: *restoration, exploration, territoriality,* and *affiliation* (Kaplan, 1995; Kellert, 1997; Plutchik, 1991; Scott, 1958; Wilson, 1984). The summaries of the variables are shown in Table 3.3. The data for the variables in the endogenous latent constructs were gathered from respondents' evaluation scores for the photos.

Table 3.1

Description of Landscape-cover Types

Landscape Cover	Description of Criteria
Forest	Tree open canopy higher than 30 feet
Shrub Land	Early succession of woody plants
Weedy Field	Longer, very uneven, with no evidence of mowing or grazing
Lawn Ground	Short, predominately green, even textures, maintained by mowing or grazing
Water Body	Wetlands, streams, or lakes

Table 3.2

Summary of Exogenous Latent Constructs

Exogenous Latent Construct *Variable*	Data Resource	Scale
Landscape Structure		
Mean Patch Size (MPS)	Deriving the needed information from aerial photos	Interval/Ratio
Edge Density (ED)	Deriving the needed information from aerial photos	Interval/Ratio
Area-Weighted Mean Shape Index (AWMSI)	Deriving the needed information from aerial photos	Interval/Ratio
Interspersion Juxtaposition Index (IJI)	Deriving the needed information from aerial photos	Interval/Ratio
Landscape Element		
Forest	Deriving the needed information from aerial photos	Interval/Ratio
Shrub Land	Deriving the needed information from aerial photos	Interval/Ratio
Weedy Field	Deriving the needed information from aerial photos	Interval/Ratio
Lawn Ground	Deriving the needed information from aerial photos	Interval/Ratio
Water Body	Deriving the needed information from aerial photos	Interval/Ratio

Table 3.3

Summary of Endogenous Latent Constructs

Endogenous Latent Construct *Variable*	Data Resource	Scale
Landscape Preference		
Coherence	Recreationists' responses	Interval/A 9-point Likert scale
Legibility	Recreationists' responses	Interval/A 9-point Likert scale
Complexity	Recreationists' responses	Interval/A 9-point Likert scale
Mystery	Recreationists' responses	Interval/A 9-point Likert scale
Prospect	Recreationists' responses	Interval/A 9-point Likert scale
Refuge	Recreationists' responses	Interval/A 9-point Likert scale
Hazard	Recreationists' responses	Interval/A 9-point Likert scale
Place Tenacity		
Place Identity	Recreationists' responses	Interval/A 9-point Likert scale
Affordance	Recreationists' responses	Interval/A 9-point Likert scale
Behavioral Intention		
Explore	Recreationists' responses	Interval/A 9-point Likert scale
Affiliate	Recreationists' responses	Interval/A 9-point Likert scale
Territorialize	Recreationists' responses	Interval/A 9-point Likert scale
Restore	Recreationists' responses	Interval/A 9-point Likert scale

Research Operation Process

The research methods and procedures are summarized with a flowchart (Fig. 3.2). Two attributes of on-site surveys were borrowed to derive data about subjective information from recreationists and objective information from recreational settings.

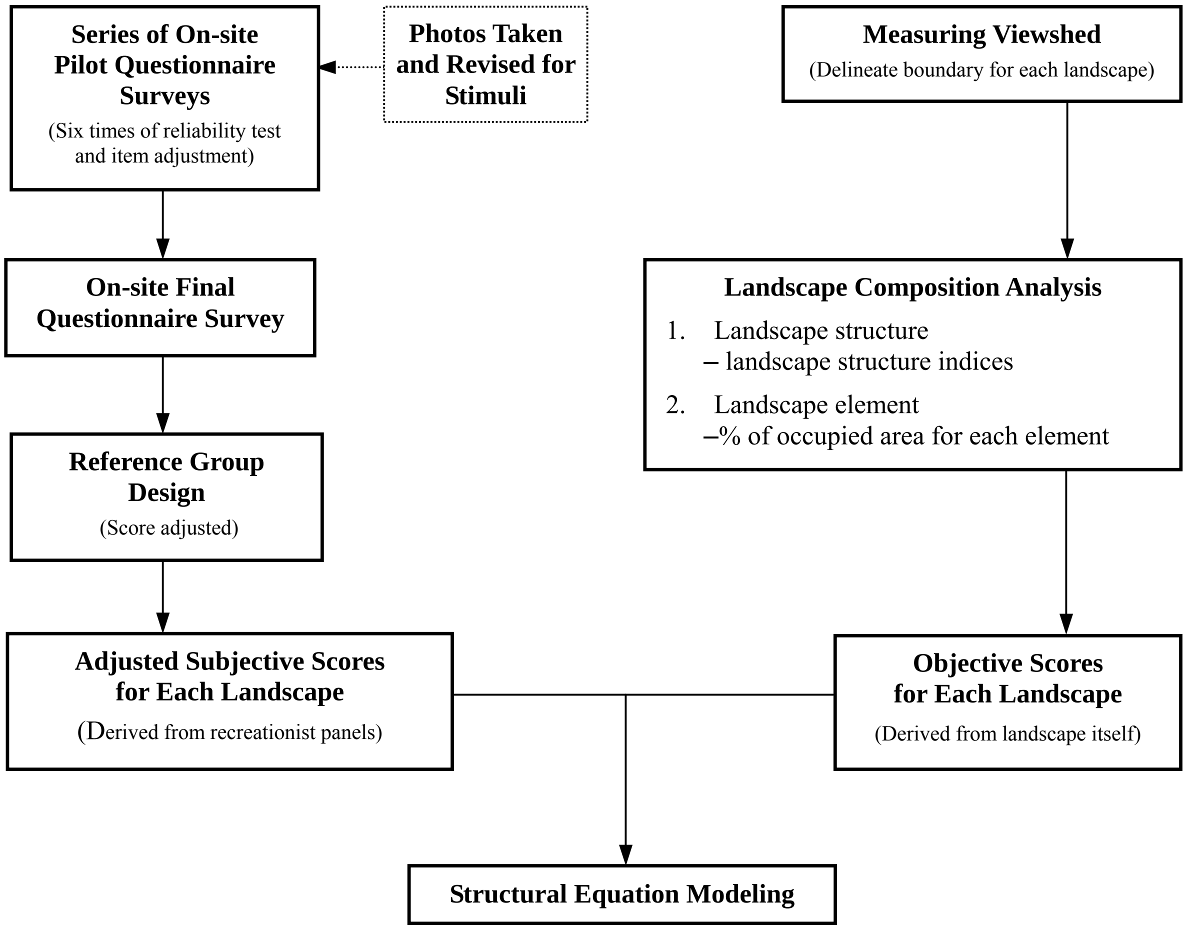


Figure 3.2. Flowchart of the research procedure.

Study Area and Setting

This study required an area with diverse natural settings that would provide sufficient episodes for an examination of the research questions and hypotheses. Furthermore, a more homogenous landscape covering a fine scale was preferred because this sort of cover facilitates the landscape-classification process; a highly diverse landscape at fine scale would be likely to generate more measurement errors should the resolution of the aerial photos or satellite images be low. A study area with fewer artificial facilities was favored because an architectural envelope might be prone to eliciting a wide-range variance of preference.

The chosen study area was within the Bald Eagle State Park, located in the broad Bald Eagle Valley, Howard, north central Pennsylvania (Fig. 3.3) (cf. DCNR, 2006). This 5,900-acre park possesses unique geologic features, such as smooth and undulating uplands, as well as numerous long and narrow mountain ridges separated by valleys. The park's geology provides a scenic backdrop for its lake and forests. The diverse vegetation is still undergoing natural succession in that the weedy fields are transforming into scrublands and forests—this process works with the landform to create various niches for butterflies, woodpeckers, bears, and bald eagles. The lake is created by the reservoir, which draws water through limestone from several intermittent streams. The alkaline warm-water lake contains varied habitats for aquatic species and creates opportunities for the fishery. These natural resources not only provide great settings for outdoor environmental education and interpretation, they also create a full range of opportunities for daytime and overnight recreation, such as boating, swimming, camping, picnicking, hiking, hunting, and wildlife watching. Winter recreation opportunities, such as cross-country skiing, ice-skating, sledding, and ice-fishing, are also available.

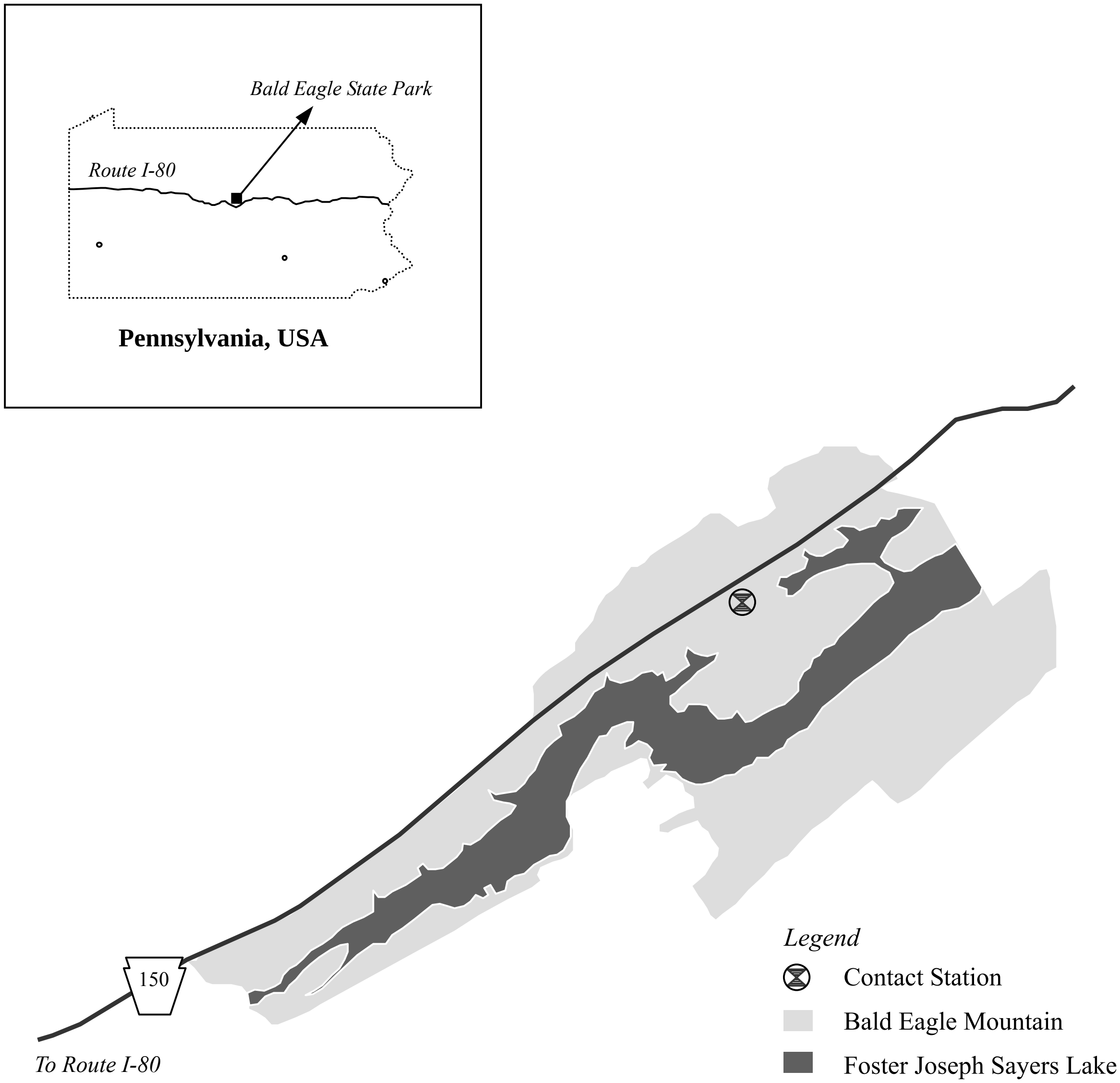


Figure 3.3. Bald Eagle State Park map.

Research Design and Procedures

Research Design

Statistical Unit

Since the hypothesis of this study involved testing how the landscape structure and elements (objective) may influence recreationists' perceptions and behavioral intentions (subjective) (refer to Fig. 1.3), "landscape unit," instead of "visitor," was adopted as the *statistical unit*. A set of scores (both objective and subjective) pertaining to a given "landscape unit" is given at the level at which the scores operated to validate the final hypothesized model (cf. Fig. 3.1).

Stimuli

Questionnaires consisting of color photos and question items were adopted to measure the recreationists' environmental perceptions and their recreational behavioral intentions. The color photographs served as a stimulus/reference resource for respondents, enabling them to evaluate the environment. Using photos to evaluate environmental perceptions has been validated in many empirical studies (Herzog et al., 2000; Kaplan et al., 1989; Shafer & Mietz, 1970).

As this study focused only on natural settings, the selection of landscape photos excluded all architectural elements and facilities. Each unique color photo, taken with a 35mm lens, covered a view that approximates what may be seen by the human eye in order to function as a surrogate for a landscape unit. Although some research has encouraged the use of 360° panorama photos, rather than a specific restricted view, as a perceptual stimuli to study landscape (e.g., Meitner, 2004), the pretest for this study in May 2004 found a disorientation effect that confounded observers' perceptions. Another measurement error in adapting panorama photos was also significant: with a given prairie patch in a closed forest, for example, a panoramic photo taken in the prairie at a stand close to the forest (edge) and pictured at the center of the prairie patch presented the same geographic information yet might elicit different perspectives.

Most photos were taken during the late summer and early fall of 2004 while the trees and bushes still displayed foliage. To reduce the shadow effects caused by the trees and/or architecture, photos were usually taken between 9:00 a.m. and 3:00 p.m. each day.

To choose the better stimuli set from the data pool, at each photo-point, a series of photographs were shot at each geographic point (X, Y), slightly adjusting the shooting angle to create a photo candidate (Fig. 3.4). As the weather changed constantly in the study area and the sunlight dramatically affected picture quality, photos were also shot on different days from the same angle (Fig. 3.5). The photo candidates were organized and coded (Fig. 3.6) for printing at a size of approximately 4 by 5 cm (refer to Appendix A). They were then cut and sorted onto self-made white boards and bound at the bottom with celluloid bands (similar to a stamp album) in order to facilitate review and selection by research committee members (refer to Appendix B).

		
FM27_6_289.JPG	FM27_8_310.JPG	FM27_9_315.JPG

Figure 3.4. Series of photographs shot with slight adjustments to the shooting angle.

M83_1_136.JPG	RM83_10_136.JPG	FM83_1_136.JPG

Figure 3.5. Pictures shot on different days from the same angle.

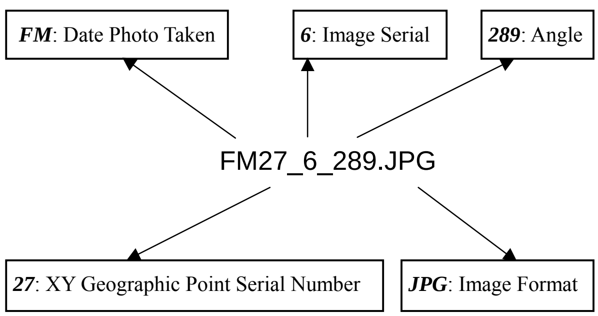


Figure 3.6. Decryption of photo coding.

To avoid the possibility of unwanted confounding noise, each photo was revised using the PhotoShop computer program to accomplish the following tasks: 1) remove images of visitors and trash (if any); 2) adjust the RGB and brightness; and 3) remove clouds and patch a clear blue sky as the new background.

Sample Size and Statistical Method

A sufficient sample size was suggested to fulfill the statistical requirement and generate a robust validity. Statistics offer a number of possible ways to examine the hypothesized model. This research validated the model using structural equation modeling (SEM) (cf. Bollen, 1989), which provides a technique for estimating, analyzing, and testing specified relationships among latent and observed variables. Although SEM is a powerful tool, it recommends a minimum sample size of 100 (Hair et al., 1998). Although a smaller sample may still be considered, it would reduce model validity. When cost, time restrictions, and prior investigations in this area had been taken into account, it was determined to adopt a sample size of 155.

Reference-group Research Design

Statement of problem. Each respondent (visitor/recreationist) was asked to evaluate the photos. Obstacles arose, however, when asking a recreationist to review all 155 photos in the field because the evaluation instrument for each photo consisted of 13 questions. Humans have a limited capacity to compare numbers of objects simultaneously. Previous research has suggested evaluating a maximum number of five to eight photos at a time in order to avoid higher measurement errors and so gain improved reliability (Brown & Daniel, 1990). It might become practically functional and much more efficient if the 155 stimuli were divided into groups containing fewer photos. However, even if this were done, the rating criterion scale among groups might be different when evaluating comparability among them (Fig. 3.7).

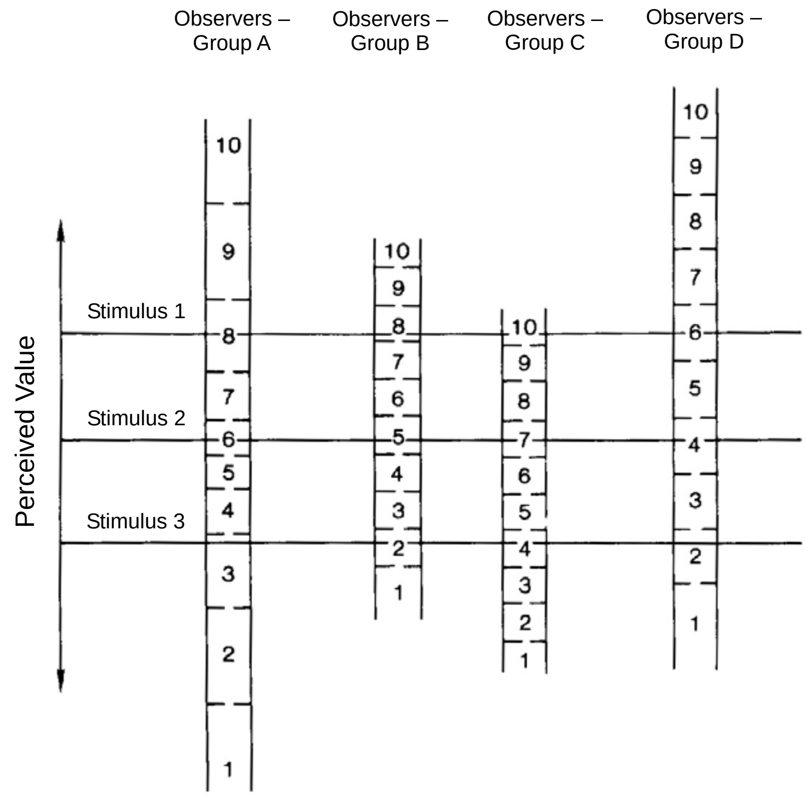


Figure 3.7. Difference of the rating criterion scales of four observer groups (adapted from Brown & Daniel, 1990).

Method. Experimental designs such as reference group or baseline design provided the inspiration to help adjust the scale difference in judgment (cf. Brown & Daniel, 1990). To rectify the rating scale into the same "standard," it was suggested that a subset of stimuli (*baseline*) common to the separate (experimental) groups be provided to act as the basis of comparison among the groups. A baseline functioned as a bridge connecting all other experimental groups.

To do so, this research broke all 155 stimuli into smaller groups/blocks; however, the research bridged those blocks with the reference group (baseline), which facilitated the field survey in practical terms. Five unique photos for each “experimental group” were selected based on empirical studies (cf. Daniel & Bolster, 1976) and considerations of the practical limitations of the physical and psychological status of subjects in the field survey; the sets of photos formed 31 experimental groups/blocks in total. In addition, there were also three baseline stimuli in the “reference group” for evaluation by each visitor/recreationist (Fig. 3.8). Hence, each respondent was responsible for eight photos, and there were 158 photo stimuli in total for evaluation.

It was suggested that each panel should contain at least 15 to 30 subjects, who would function as judges in evaluating the same set of photos. Thus, a more robust outcome would be generated. Subjects’ scores for each question/item were averaged (e.g., Brown & Daniel, 1990; Daniel & Bolster, 1976). Consequently, a minimum number of 465 to 930 respondents was required to operate on rationality.

The 158 unique color photos were selected from 468 possibles taken in the study area, including three baseline photos as the reference group, and 155 non-baseline photos that were sorted into 31 experimental groups (five for each group). The complete set of 155 photos represented the wide spectrum of the major a priori landscape structures and compositions in the Bald Eagle State Park; the three baseline photos expressed the allover landscape. The baseline and non-baseline photos placed in an alternating sequence in the questionnaire. The layout is conceptualized in Figure 3.9.

Panels/Group	Photo ID# for Review (experimental group/non-baseline photo)	Photo ID# for Review (reference group/baseline photo)
Group 1	*1, 2, 3, 4, 5*	*B1, B2, B3*
Group 2	*6, 7, 8, 9, 10*	*B1, B2, B3*
Group 3	*11, 12, 13, 14, 15*	*B1, B2, B3*
Group 4	*16, 17, 18, 19, 20*	*B1, B2, B3*
Group 5	*21, 22, 23, 24, 25*	*B1, B2, B3*
Group 6	*26, 27, 28, 29, 30*	*B1, B2, B3*
Group 7	*31, 32, 33, 34, 35*	*B1, B2, B3*
Group 8	*36, 37, 38, 39, 40*	*B1, B2, B3*
Group 9	*41, 42, 43, 44, 45*	*B1, B2, B3*
Group 10	*46, 47, 48, 49, 50*	*B1, B2, B3*
Group 11	*51, 52, 53, 54, 55*	*B1, B2, B3*
Group 12	*56, 57, 58, 59, 60*	*B1, B2, B3*
Group 13	*61, 62, 63, 64, 65*	*B1, B2, B3*
Group 14	*66, 67, 68, 69,70*	*B1, B2, B3*
Group 15	*71, 72, 73, 74, 75*	*B1, B2, B3*
Group 16	*76, 77, 78, 79, 80*	*B1, B2, B3*
Group 17	*81, 82, 83, 83, 85*	*B1, B2, B3*
Group 18	*86, 87, 88, 89, 90*	*B1, B2, B3*
Group 19	*91, 92, 93, 94, 95*	*B1, B2, B3*
Group 20	*96, 97, 98, 99, 100*	*B1, B2, B3*
Group 21	*101, 102, 103, 104, 105*	*B1, B2, B3*
Group 22	*106, 107, 108, 109, 110*	*B1, B2, B3*
Group 23	*111, 112, 113, 114, 115*	*B1, B2, B3*
Group 24	*116, 117, 118, 119, 120*	*B1, B2, B3*
Group 25	*121, 122, 123, 124, 125*	*B1, B2, B3*
Group 26	*126, 127, 128, 129, 130*	*B1, B2, B3*
Group 27	*131, 132, 133, 134, 135*	*B1, B2, B3*
Group 28	*136, 137, 138, 139, 140*	*B1, B2, B3*
Group 29	*141, 142, 143, 144, 145*	*B1, B2, B3*
Group 30	*146, 147, 148, 149, 150*	*B1, B2, B3*
Group 31	*151, 152, 153, 154, 155*	*B1, B2, B3*

Remarks:

1. Each panel group consisted of 20–30 participants who evaluated 8 photos, including 5 non-baseline photos and 3 baseline photos.

2. Photo IDs #1 to #155 were unique non-baseline photos, representing different landscape contents.

3. Photo IDs #B1, #B2, and #B3 also had different landscape contents, which functioned as a baseline to adjust the variance of perception scores among panels.

4. The perception scores for each question item were transformed.

Figure 3.8. Design for applying experimental and reference groups to facilitate the field study. To evaluate bulk photos and to avoid the possibility that participants might experience physical and psychological fatigue, a baseline-photo reference was designed to simplify the task.

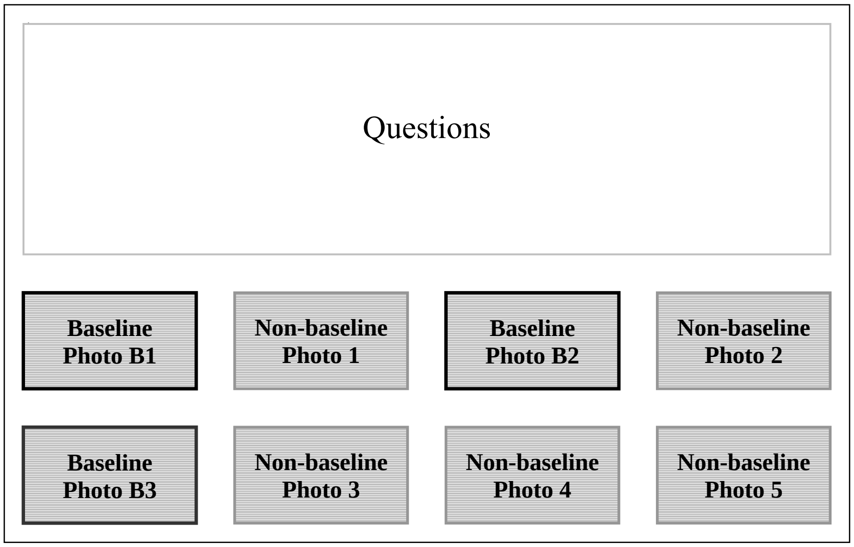


Figure 3.9. Layout example of the baseline and non-baseline photos in the questionnaire.

Score Adjustment

The study took ratings of the baseline stimuli as the common basis for standardization, and the baseline-adjusted Z-score procedure in this research computed standard scores using the following equation (cf. Brown & Daniel, 1990):

$$BZ_{ij} = \left(R_{ij} - BMR_j\right) / \, BSDR_j$$

Where

BZ_{ij} represents the baseline-adjusted standard scores of stimulus *i* for respondent *j*; R_{ij} denotes the rating of stimulus *i by* respondent *j*; BMR_j is the mean rating of the baseline stimuli by respondent *j*; $BSDR_j$ indicates the standard deviation of ratings of the baseline stimuli by respondent *j*.

Through the *Z* computation, each respondent's rating scores to a scale were transformed into a new scale that was comparable to the scale of other respondents. The computing process was assisted via the RMRATE computer program, which assigned a newly transformed value for each question answered by each individual respondent.

On-site Landscape Survey

Selecting Landscape and Recording Coordinates

Each landscape unit in this research was represented by a unique eye-level photo (refer to the afore-cited) taken at Bald Eagle State Park, presenting the visibility surface from a photo-taken geographic point that contained the information of latitude and longitude (X, Y) as measured with a GPS (Global Positioning System) device. The trigonometrical survey (Fig. 3.10) and aerial photos were applied to rectify the GPS measurement error, especially for points under the forest canopy and/or points affected by topographic obstructions. All data points were recorded using *ArcGIS* software.

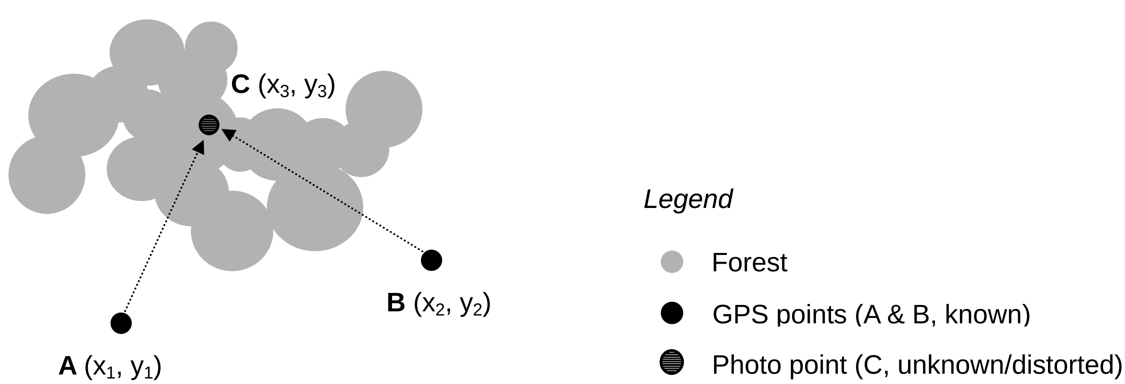


Figure 3.10. Application of the trigonometrical survey to rectify GPS measurement error. The geographic position of point C in the forest was corrected in reference to both points A and B.

Analyzing Viewsheds

A viewshed depicted the visibility surface from the observation point (photo-taken point), and it represented a landscape unit in this research. Aerial photos and extensive field surveys using GPS, as well as a compass and laser rangefinder, were used to measure/rectify the viewsheds. These tools were chosen because although conducting a spatial analysis with DEM (Digital Elevation Model) data in a GIS (Geographic Information System) environment is a convenient way to create the viewshed, the process ignores the a priori vegetation conditions. For instance, the disparities/offsets between terrain and vegetation may result in a significant measurement error in viewshed estimation. To adjust the boundary of the visibility surface, on-site rectification was applied.

A digital laser rangefinder and compass were adopted to rectify the visibility surface with a 2-degree resolution. The angle transformation between the coordinate settings of the compass and *ArcGIS* is detailed in Appendix C. The visibility surfaces were delineated with ArcGIS, which started from the first point in the (X, Y) coordinate where a photo was taken and linked together other points with the references of distance and direction to complete the whole polygon for further analysis. The computation of the landscape composition, including landscape structure and elements, via SEM was based on the information derived from the aerial photo image within the boundary of the "visibility surface." The collected data were depicted in the field using a paper format (Fig. 3.11) and digitized using the ArcGIS computer program in the lab thereafter. The results were confirmed with the color aerial photos and rechecked on site.

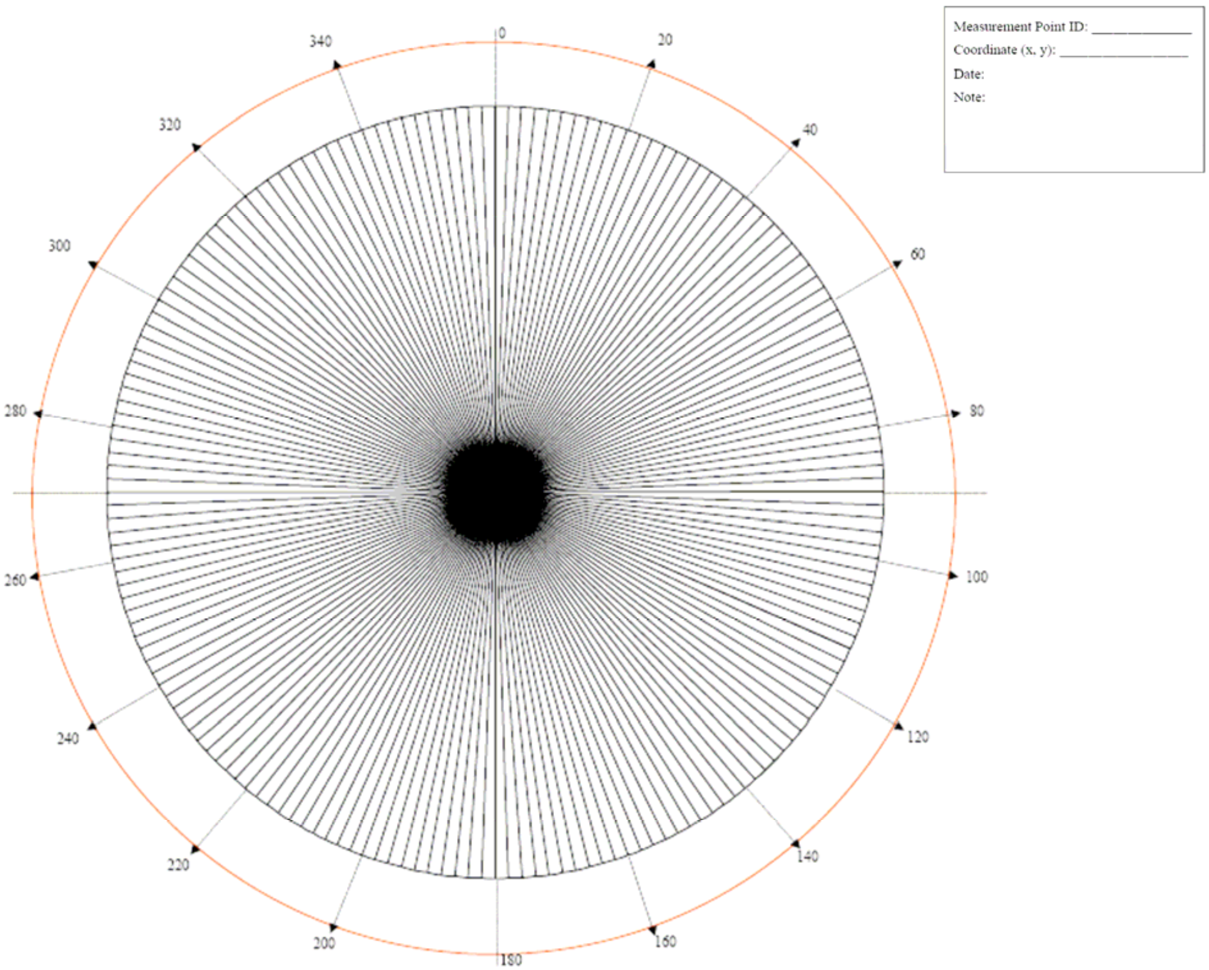


Figure 3.11. Paper-based visibility surface recorder.

Landscape Classification, Digitization, and Metrics Analysis

The color aerial photo interpretation and on-site investigation were conducted to establish land-cover classification data for further analysis of landscape structure and elements. Although a multi-spectral remote sensing image might have contained more valuable information, aerial color photos from USGS taken in August 2004 with a 1-meter resolution in the *DOQQ* (Digital Othophoto Quarter-Quadrangle) format that show trees, etc., with foliage were selected. The aerial photos and the selected landscape photos were taken within the same time period, thus reducing potential biases due to possible changes in vegetation shape and condition over time.

The initial landscape classification was assisted via the eCognition computer program based on the criteria for the five landscape categories (Table 3.1). The classification was re-identified and rectified on site thereafter to complete the land-cover information. The data were stored using the ArcGIS software in a vector data format.

The Patch Analyst computer program was adopted to derive the information on landscape metrics using the raster data format transformed from the vector format in the ArcView GIS environment.

On-site Pilot Questionnaire Survey for Item Development

Procedure for the Reliability Test

To approach a higher measurement consistency in the recreationists' evaluations of the 155 stimuli in 31 groups in the final survey, a series of pilot studies to examine reliability was conducted in June and July 2005 to gather suitable question items (Table 3.4). In consideration of the possibility of respondent fatigue during the survey process, 5 pilot studies were performed with the rationales of more questions, fewer photos; fewer questions, more photos. The initial use of more questions and fewer photos ensured a wider examination of the candidate questions. However, gradually non-qualified questions were filtered out of the question pool via reliability testing. As the number of question items was reduced in each pilot study, more photos were shown for evaluation.

The first questionnaire used 67 items to measure the 13 variables (cf. Table 3.3) using only one photo. After the reliability analysis via the SPSS program had been conducted, 40 items were recommended for the second pilot test, and 2 photographs were applied for stimuli. After another reliability analysis had been conducted, 20 remaining items, accompanied by 4 pictures, were considered for the third pilot survey. The fourth survey consisted of 19 questions and 6 photos. The fifth survey comprised 13 items and 8 photos. The results of the serial reliability tests are shown in Tables 3.5 through 3.9. The set of final question items is detailed in Table 3.10.

Table 3.4

Procedure to Determine Pilot Studies

Pilot Survey	Number of Items	Number of Photo	Sample size
1st pilot survey	67	1	34
2nd pilot survey	40	2	50
3rd pilot survey	20	4	40
4th pilot survey	19	6	37
5th pilot survey	13	8	30

Table 3.5

Reliability Pretest I for the Endogenous Latent Constructs: Using One Photo

Latent Construct *Variable*	Item	Alpha if item deleted	S*
Landscape Preference			
Coherence	The landscape is well organized.	.9036	.8731
	The landscape hangs together.	.8233	
	It is easy to find some overall pattern or structure in this landscape.	.8298	
	It is easy to organize or structure the scene.	.8201	
	The elements in this landscape belong together.	.8503	
Complexity	The complexity of the landscape looks just right.	.6158	.6848
	The diversity in the landscape patterns is just right.	.6335	
	The variety in this landscape looks just right.	.6462	
	The landscape has too much going on.	.7765	
	There is much going on in this scene.	.6090	
	There is much to look at here.	.5210	
Mystery	This landscape seems to invite me to enter it more deeply.	.9308	.9246
	This landscape seems to have some profound meaning.	.9036	
	This place seems to promise more if I could walk deeper into it.	.8914	
	This landscape seems to have wonderments inside.	.9066	
	There could be some interesting or fascinating things here.	.9033	
Legibility	It would be easy to get lost in this environment.**	.7668	.8011
	The landscape patterns are very clear here.	.8421	
	It could be easy to find my way in this place.	.7306	
	It is easy to figure out where I am in this place.	.7364	
	It is a confusing landscape.**	.7697	
	The landscape looks chaotic.**	.7605	
Prospect	I have an unobstructed view of the surroundings.	.8582	.8256
	There are unimpeded visual opportunities to observe surroundings.	.7936	
	It is not difficult to observe the environment.	.8016	
	It is easy to see through this place.	.7829	
	It is a wide-open place.	.7773	
	It is easy to see all parts of this place without having your view blocked or interfered with.	.7586	
Refuge	I feel sheltered in this place.	.6479	.7549
	I feel protected in this place.	.7464	
	It is easy for me to find a place to hide here.	.6286	
	It is easy to find a place where you can see what's going on without being seen.	.6827	
	It is easy for me to escape from any danger in this place.	.8199	
Hazard	It looks safe here.	.8703	.8873
	It looks dangerous in this place.**	.8672	
	I could be harmed in this place.**	.8500	
	I feel anxious about this place.**	.8968	
	I feel uneasy about this place.**	.8439	
	I feel fearful of this place.**	.8754	

Table 3.5

(Continued)

Latent Construct *Variable*	Item	Alpha if item deleted	S*
Place Tenacity			
Place Identity	I feel compatible with this place.	.9148	.9247
	I have a sense of oneness with this place.	.9122	
	I identify with this place.	.9050	
	I have a sense that I belong here.	.9081	
	Being here suits my personality.	.9169	
	This place means a lot to me.	.9089	
Affordance	This place has some functional properties.	.8338	.8581
	There are some attractive resources in this place.	.8427	
	This place offers opportunities for enjoyment.	.8342	
	I can do things I like here.	.8187	
	I would get more satisfaction out of visiting this place than any other places.	.8529	
	This place would provide benefits to me.	.8213	
Behavioral Intention			
Exploration	I would like to explore around here.	.8948	.9155
	I would like to check out something here.	.8829	
	I would like to have fun here.	.9059	
	I would like to visit this place.	.8918	
	I would avoid looking around this place.*	.9068	
Restoration	I would like to relax here.	.9497	.9694
	I would like to enjoy myself in this place.	.9313	
	I would like to rest in this place.	.9819	
Affiliation	I desire to interact with this landscape.	.7909	.8715
	I would like to get to know this place better.	.7846	
	I would like to attach myself with this place.	.8748	
	I would avoid visiting this place.*	.8765	
Territoriality	I would like to stay here.	.7217	.8135
	I would like to go around here.	.8297	
	I would like to spend more time here.	.6876	
	I don't want to leave this place.	.8015	

Note. Sample size = 34. *Cronbach's Alpha. **Reversed scores.

Table 3.6

Reliability Pretest II for the Endogenous Latent Constructs: Using Two Photos

Latent Construct *Variable*	Item	Test Photo #1 Alpha if item deleted	Test Photo #1 S*	Test Photo #2 Alpha if item deleted	Test Photo #2 S*
Landscape Preference					
Coherence	The landscape hangs together.	.659	.787	.649	.634
	It is easy to organize or structure the scene.	.755		.612	
	The elements in this landscape belong together.	.712		.313	
Complexity	The diversity in the landscape patterns is just right.	.553	.764	.584	.774
	The variety in this landscape looks just right.	.694		.516	
	There is much to look at here.	.791		.858	
Mystery	This landscape seems to invite me to enter it more deeply.	.950	.915	.817	.809
	This place seems to promise more if I could walk deeper into it.	.823		.566	
	There could be some interesting or fascinating things here.	.860		.794	
Legibility	It could be easy to find my way in this place.	.889	.705	.730	.316
	It is a confusing landscape.**	.428		-.224	
	The landscape looks chaotic.**	.348		-.321	
Prospect	It is not difficult to observe the environment.	.755	.710	.634	.401
	It is easy to see through this place.	.593		.220	
	It is a wide-open place.	.629		.284	
	It is easy to see all parts of this place without having your view blocked or interfered with.	.607		.206	
Refuge	I feel protected in this place.	.593	.713	.615	.733
	It is easy to find a place where you can see what's going on without being seen.	.674		.676	
	It is easy for me to escape from any danger in this place.	.597		.648	
Hazard	It looks safe here.	.853	.674	.808	.655
	I could be harmed in this place.**	.387		.316	
	I feel uneasy about this place.**	.372		.435	
Place Tenacity					
Place Identity	I identify with this place.	.845	.896	.815	.907
	Being here suits my personality.	.814		.856	
	This place means a lot to me.	.887		.924	
Affordance	This place offers opportunities for enjoyment.	.736	.813	.694	.763
	I can do things I like here.	.593		.582	
	This place would provide benefits to me.	.886		.761	
Behavioral Intention					
Exploration	I would like to explore around here.	.089	.319	.764	.851
	I would like to check out something here.	.900		.830	
	I would like to visit this place.	.246		.781	
Restoration	I would like to relax here.	.352	.560	.772	.879
	I would like to enjoy myself in this place.	.369		.799	
	I would like to rest in this place.	.934		.928	
Affiliation	I desire to interact with this landscape.	.905	.893	.782	.871
	I would like to get to know this place better.	.783		.782	
	I would like to attach myself with this place.	.850		.894	
Territoriality	I would like to stay here.	.985	.940	.859	.867
	I would like to go around here.	.867		.722	
	I would like to spend more time here.	.874		.851	

Note. Sample size = 50. *Cronbach's Alpha. **Reversed scores.

Table 3.7

Reliability Pretest III for the Endogenous Latent Constructs: Using Four Photos

Latent Construct *Variable*	Item	1 Alpha if item deleted	1 Cronbach's Alpha	2 Alpha if item deleted	2 Cronbach's Alpha	3 Alpha if item deleted	3 Cronbach's Alpha	4 Alpha if item deleted	4 Cronbach's Alpha
Landscape Preference									
Coherence	The elements in this landscape belong together.	.844	.861	.708	.710	.272	.342	.351	.371
Complexity	The variety in this landscape looks just right.	.835		.698		.268		.300	
Mystery	This landscape seems to invite me to enter it more deeply.	.835		.690		.276		.317	
Legibility	It could be easy to find my way in this place.	.829		.690		.306		.292	
Prospect	It is easy to see through this place.	.864		.549		.328		.378	
Refuge	It is easy to find a place where you can see what's going on without being seen.	.881		.633		.259		.281	
	It is easy for me to escape from any danger in this place.	.831		.694		.771		.806	
Hazard	It looks safe here.	.825		.696		.277		.311	
Place Tenacity									
Place Identity	I feel compatible with this place.	.903	.917	.525	.599	.915	.677	.885	.895
	I identify with this place.	.886		.553		.617		.854	
	Being here suits my personality.	.884		.512		.601		.853	
Affordance	This place offers opportunities for enjoyment.	.918		.525		.611		.896	
	I can do things I like here.	.895		.881		.605		.875	
	This place would provide benefits to me.	.921		.525		.613		.894	
Behavioral Intention									
Exploration	I would like to explore around here.	.925	.934	.543	.620	.959	.963	.909	.925
Restoration	I would like to relax here.	.926		.534		.950		.917	
	I would like to enjoy myself in this place.	.910		.908		.969		.908	
Affiliation	I desire to interact with this landscape.	.926		.572		.954		.903	
Territoriality	I would like to get to know this place better.	.923		.543		.952		.922	
	I would like to spend more time here.	.921		.540		.948		.911	

Note. Sample size = 40.

Table 3.8

Reliability Pretest IV for the Endogenous Latent Constructs: Using Six Photos

Latent Construct	Item	1	1	2	2	3	3	4	4	5	5	6	6
Variable		C_I*	C_A**	C_I	C_A	C_I	C_A	C_I	C_A	C_I	C_A	C_I	C_A
Landscape Preference													
Coherence	The elements in this landscape belong together.	.839	.856	.925	.915	.910	.916	.827	.833	.933	.934	.853	.855
Complexity	The variety in this landscape looks just right.	.846		.917		.908		.839		.932		.844	
Mystery	This landscape seems to invite me to enter it more deeply.	.834		.905		.915		.828		.923		.853	
	This landscape seems to have some profound meaning.	.839		.900		.909		.818		.928		.832	
Legibility	It would be easy to find my way in this place.	.849		.907		.915		.826		.929		.862	
	It is easy to figure out where I am here.	.848		.905		.903		.799		.927		.836	
	The landscape patterns of this place are very clear.	.858		.908		.905		.804		.930		.832	
Prospect	I have a clear view of the surroundings.	.844		.902		.908		.823		.925		.850	
	I can see all parts of this place without having my view blocked or interfered with.	.859		.913		.912		.808		.933		.848	
Refuge	I find this place comforting.	.829		.898		.900		.815		.921		.822	
Hazard	I feel safe here.	.837		.901		.902		.813		.921		.830	
Place Tenacity													
Place Identity	I identify with this place.	.797	.851	.912	.933	.867	.910	.806	.885	.846	.917	.798	.906
Affordance	This place offers opportunities for enjoyment.	.733		.925		.895		.933		.954		.905	
	I can do things I like here.	.840		.870		.852		.763		.819		.881	
Behavioral Intention													
Exploration	I would like to explore around here.	.921	.939	.952	.952	.950	.944	.913	.926	.969	.976	.889	.912
Restoration	I would like to relax here.	.918		.939		.934		.889		.966		.872	
Affiliation	I desire to interact with this place.	.924		.940		.925		.925		.979		.960	
	I would like to get to know this place better.	.946		.938		.926		.893		.967		.863	
Territoriality	I would like to spend more time here.	.917		.932		.924		.925		.968		.861	

Note. Sample size = 37. *Scores of Alpha if item deleted. **Scores of Cronbach's Alpha.

Table 3.9

Reliability Pretest V for the Endogenous Latent Constructs: Using Eight Photos

		1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
Latent Construct *Variable*	Item	S_i*	S_c**	S_i	S_c	S_i	S_c	S_i	S_c	S_i	S_c	S_i	S_c	S_i	S_c	S_i	S_c
Landscape Preference			.766		.873		.803		.751		.907		.796		.813		.874
Coherence	The elements in this landscape belong together.	.766		.880		.819		.763		.895		.805		.808		.882	
Complexity	The variety in this landscape looks just right.	.766		.874		.794		.727		.897		.807		.835		.870	
Mystery	This landscape seems to invite me to enter it more deeply.	.736		.852		.773		.717		.895		.773		.783		.856	
Legibility	It would be easy to find my way in this place.	.723		.836		.769		.694		.889		.742		.779		.842	
Prospect	I have a clear view of the surroundings.	.704		.843		.790		.720		.886		.757		.770		.833	
Refuge	I find this place comforting.	.713		.837		.779		.706		.888		.733		.765		.831	
Hazard	I feel safe here.	.738		.852		.751		.720		.901		.746		.766		.870	
Place Tenacity			.804		.038		.757		.757		.957		.820		.741		.934
Place Identity	I identify with this place.																
Affordance	I can do things I like here.																
Behavioral Intention			.903		.967		.929		.929		.943		.968		.971		.965
Exploration	I would like to explore around here.	.923		.960		.899		.899		.952		.972		.972		.969	
Restoration	I would like to relax here.	.865		.960		.924		.924		.913		.958		.959		.945	
Affiliation	I would like to get to know this place better.	.847		.951		.876		.876		.905		.945		.953		.950	
Territoriality	I would like to spend more time here.	.856		.956		.932		.932		.929		.959		.961		.951	

Note. Sample size = 30. *Scores of Alpha if item deleted. **Scores of Cronbach's Alpha.

Table 3.10

Summary of the Endogenous Latent Constructs, Items, and Corresponding Measurements

Endogenous Latent Construct *Variable*	Measurement Item	Scale*
Scenic Beauty		
Coherence	The elements in this landscape belong together.	Interval
Complexity	The variety in this landscape looks just right.	Interval
Mystery	This landscape seems to invite me to enter it more deeply.	Interval
Legibility	It would be easy to find my way in this place.	Interval
Natural Image		
Prospect	I have a clear view of the surroundings.	Interval
Refuge	I find this place comforting.	Interval
Hazard	I feel safe here.	Interval
Place Tenacity		
Place Identity	I identify with this place.	Interval
Affordance	I can do things I like here.	Interval
Behavioral Intention		
Exploration	I would like to explore around here.	Interval
Restoration	I would like to relax here.	Interval
Affiliation	I would like to get to know this place better.	Interval
Territoriality	I would like to spend more time here.	Interval

Note. *A 9-point Likert scale from 1 (strongly disagree) to 9 (strongly agree).

Data Collection and Instrument

Survey Instrument and Administration

The survey instrument used in this study is a questionnaire asking structural questions. An 11 by 17 inch questionnaire, one-sided, consisting of eight full-color photos and question items, was used to evaluate the recreationists' landscape perceptions and recreational behavioral intentions. The survey was self-administered, and questionnaires were fixed on a board (14 by 20 inches) to facilitate the survey process. The photos were laser-printed and were a comfortable resolution and size for viewing.

The questions addressed related to two major segments: The first section asked the respondents' socio-demographic questions, such as gender, age, level of education, occupation, income, and location of residence. This information was used to structure an overall subject profile. The second part comprised questions designed to gather respondents' opinions about recreational settings. A sample of the questionnaire format can be found in Appendix D.

The survey was conducted from August to November 2005. A systematically stratified random sampling plan was adopted on weekdays and weekends, from 9:00 a.m. to 7:00 p.m., to ensure that the population visiting the Bald Eagle State Park would be adequately represented. Subjects were recruited at various locations, such as the visitor center, beach, picnic area, camping site, trail, and fishing area. All subjects were 18 years of age or older, and the enrollment of participants was equitable; no attempt to encourage participation was made beyond simply asking. Subjects were approached on site and interviewed to ascertain their willingness to participate. If they were willing to take part, they were requested to review an Implied Informed Consent Form. Participants were given the consent form to keep for their records. The participation recruitment did not involve any use of promotional material, and the survey was anonymous in order to preserve confidentiality. Questionnaires were dispatched by the investigator. Some of the participants at the camping area as well as some of the local participants handed in or mailed their questionnaires to the investigators later at their request. The survey was approved by Penn State's Social Science and Biomedical Institutional Review Boards (IRB) and the Bald Eagle State Park administration for the use of human participants.

Chapter 4

DATA ANALYSIS AND INTERPRETATION

This chapter presents details regarding the major findings of this investigation. The first section provides a descriptive profile of the social and environmental attributes, as well as the reliability analysis of the recreationists' responses to each landscape unit. The second section presents the results of the model examination and modification.

Sample Description and Data Examination

Participant Profiles

Notwithstanding the unavoidability of some missing data, 843 on-site surveys were collected with sufficient information to be used in further analysis for this study. The information on respondents' socio-demographic backgrounds is provided in Table 4.1.

Of the 837 respondents, 418 recreationists were female (49.9% of the sample population) and 419 were male (nearly 50.1%), suggesting a fairly equal distribution in sampling.

The age frequency of respondents was also rather evenly distributed in each category, to a certain degree suggesting the diverse recreational attractions at the Bald Eagle State Park. The largest group of respondents was the 25–34 age group—about one-fifth of the survey population (19.9%); this percentage was not significantly different from other categories: for example the 35–44 age group (18.2%), and the 45–54 age group (18.5%). Approximately 15.2% of the participants were under the age of 24. Visitors aged 65 or older constituted the smallest group, but still provided 12.5% of the respondents.

Table 4.1

Socio-demographic Profile of Respondents

Socio-demographic Variable	Frequency (n)	Percentage (%)	
Gender			
Female	418	49.9	
Male	419	50.1	
	837	100.0	
Age			
Less than 29 years old	126	15.2	
25–34	165	19.9	
35–44	151	18.2	
45–54	154	18.5	
55–64	131	15.8	
65 years and older	104	12.5	
	831	100.0	Mean = 43.55 S.D. = 16.52
Education			
High school	323	39.0	
2-year college	153	18.5	
4-year college	192	23.2	
Master's	101	12.2	
Doctorate	60	7.2	
	829	100.0	
Income			
Less than $20,000	63	13.7	
$20,000–39,999	122	26.5	
$40,000–59,999	139	30.2	
$60,000–79,000	63	13.7	
$80,000–99,999	21	4.6	
$100,000 or more	52	11.3	
	460	100.0	Mean = 56,807.39 S.D. = 65,193.38
Race			
White, not of Hispanic origin	750	90.4	
African-American	13	1.6	
Hispanic	12	1.4	
Native American/Alaskan Native	3	.4	
Asian or Pacific Islander	50	6.0	
Other	2	.2	
	828	100.0	

Based on sampling, approximately 40% of the respondents had a high school education, and the remaining 61% had received at least an undergraduate college education. Around 12% (101 respondents) possessed a master's degree, and 60 participants (7.2%) indicated that they had a doctoral degree.

About 45.4% of the participants refused to provide income information. Of the 460 responses, the median annual salary before tax for the sample was located in the category of $40,000 and $59,999, which represented the largest group of respondents (30.2%). Approximately one-tenth of participants reported an income of $100,000 or more. Another 13.7% of respondents (63) claimed income below $20,000.

In terms of race, the majority of participants were Caucasian (90% of the total survey sample). Fifty respondents (6%) were from Asia or the Pacific Islands. African-Americans and those of other origins comprised less than 4% of the sample.

In regard to the respondents' travel spatial pattern, the majority of visitors, about 36% of the sample, resided within 20 miles of Bald Eagle State Park (Table 4.2), and approximately 80% of respondents lived about 100 miles from the park. Of the 833 respondents, 656 (78.8%) were Pennsylvania residents, and about 20% had journeyed from other states (such as Hawaii) and other countries (e.g., Australia, Iran, Netherlands, Germany). As shown in Figure 4.1, the plot for the respondent population against the distance at the Cartesian coordinates demonstrated a fairly clear inverse curve. The trajectory of distribution is likely to be proportional to 1/2^n, implying that the park's attractiveness abated as the travel distance increased. The travel behavior pattern of respondents, to a certain degree, reflected the phenomenon of distance-decay in gravity models (cf. Morrill & Kelley, 1970; Sheppard, 1995) on the behavior of park visiting. While locating only the residences of Pennsylvania respondents on the map using the 5-digit ZIP code and the ArcGIS program, the finding shows that those areas holding higher visiting frequency did not all adjoin each other; in fact, they were scattered throughout the entire park area (Fig. 4.2).

Table 4.2

Profile of Travel Distance Range from Residence

Socio-demographic Variable	Frequency (N)	Percentage (%)	Cumulative Percent	Mean	S.D.
Distance					
Less than 20 miles	299	35.9	35.89		
20–39.99	197	23.6	59.54		
40–59.99	103	12.4	71.91		
60–79.99	39	4.7	76.59		
80–99.99	32	3.8	80.43		
100–119.99	15	1.8	82.23		
120–139.99	19	2.3	84.51		
140–159.99	25	3.0	87.52		
160–179.99	20	2.4	89.92		
180–199.99	26	3.1	93.04		
200–219.99	16	1.9	94.96		
220–239.99	17	2.0	97.00		
240–259.99	2	.2	97.24		
260–279.99	0	0	97.24		
280–299.99	1	.1	97.36		
300 miles and more	22	2.6	100.00		
	833	100.0		79.59	222.30
Pennsylvania Residents	656	78.75			

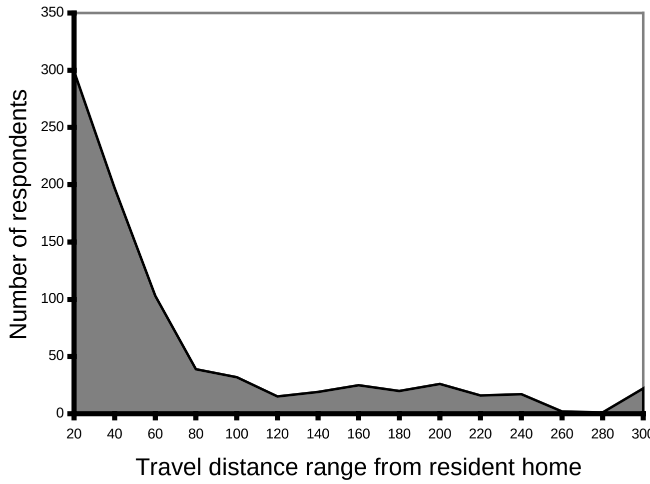


Figure 4.1. Distance-decay curve for visiting Bald Eagle State Park.

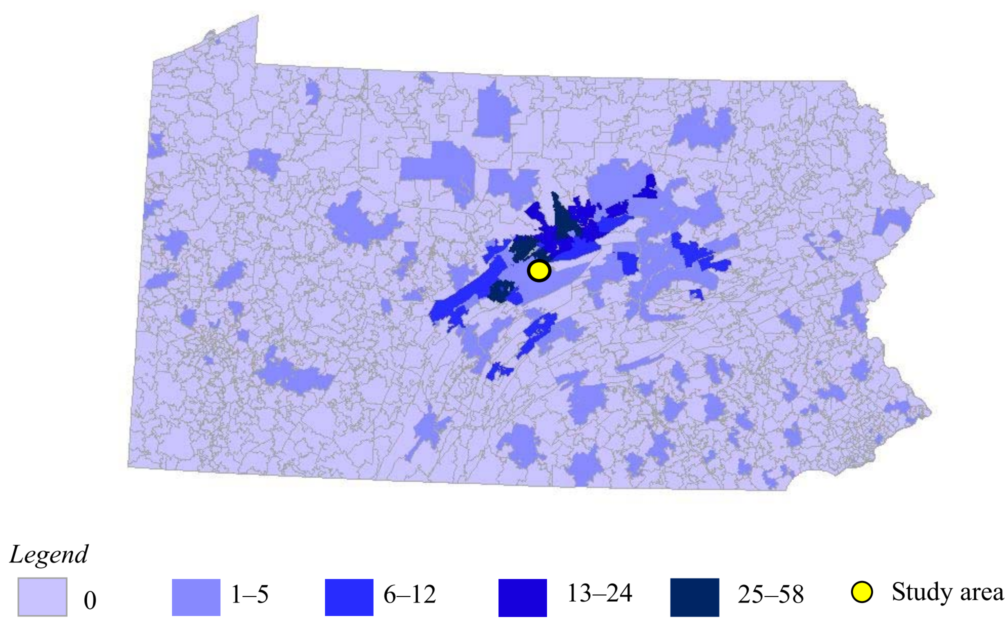


Figure 4.2. Spatial residence distribution of the respondents in Pennsylvania.

Profiles of Landscape Compositions

Outcome of the Landscape Composition Digitization

The visibility surfaces of all 155 landscape units were delineated in polygons with ArcGIS based on the data collected in the field. The landscape classification data layer was *clipped* using the visibility surface polygons to generate the landscape attributes for each landscape unit. The results for two examples of the landscape units, #18 and #32, are represented in Figure 4.3. The irregular shape of the outside boundary in each landscape unit showed that the partial view was blocked by physical obstacles, such as vegetation and terrain. The color scheme represented the varied landscape elements, such as forest, shrub land, water body, etc., and the spatial relationships among the landscape elements provided the information about landscape structure. These parameters were assembled and transformed to qualitatively reflect the landscape tidings in a given photo.

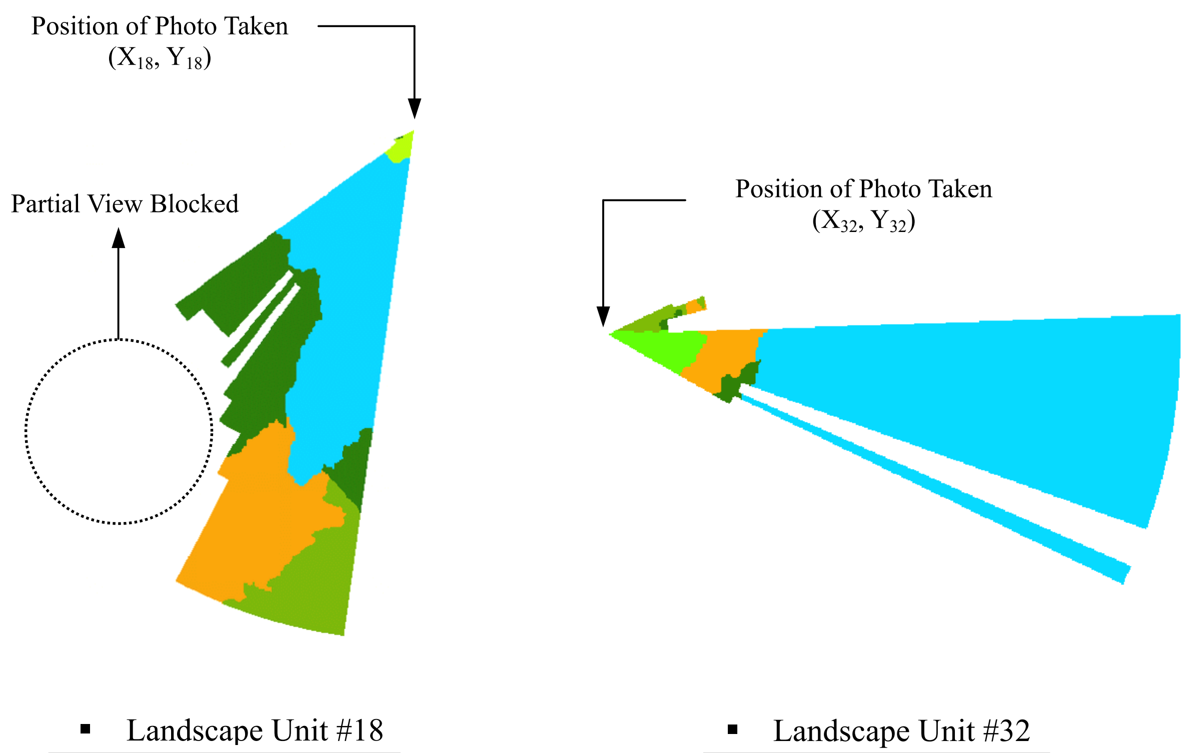


Figure 4.3. Two examples of landscape units: #18 and #32. The whole landscape within the visibility surface represents a landscape unit that contains the information of landscape structure and elements. Each color scheme denotes one type of landscape element.

Computation of Landscape

The parameters of both landscape structure and elements were calculated via Patch Analyst. The profile of the 155 landscape units is shown in Table 4.3.

Table 4.3

Profile of the Landscape Compositions of the 155 Landscape Units

Exogenous Latent Construct *Variable*	Measurement	Mean	S.D.
Landscape structure			
MPS	Mean Patch Size	.589	3.010
AWMSI	Area-Weighted Mean Shape Index	1.162	1.918
IJI	Interspersion Juxtaposition Index	4165.713	29.457
ED	Edge Density	4371.653	34.330
Landscape Element			
Forest	Total area of forest	.327	1.132
Shrub Land	Total area of shrub land	.183	.457
Weedy Field	Total area of weedy field	.110	.326
Lawn Ground	Total area of lawn ground	.064	.112
Water Body	Total area of water body	2.461	3.829

Note. Sample size = 155 (landscape units).

Data Examination

Before the respondents' subjective scores (Likert scale rating from 1 to 9) were adjusted among 31 groups for the purpose of comparability, data for both the baseline and non-baseline groups in all 31 groups were examined via reliability analysis on the 13 questionnaire items for each stimulus (Table 4.4). The lowest Cronbach's Alpha score, .843, appeared on the #A baseline stimulus in the 3rd group, which still exceeded the critical level of .800. The results suggested a high reliability of the data for further analysis.

Table 4.4

Overall Reliability Tests of 13 Questionnaire Items for both Non-baseline and Baseline Stimulus in Each Group

Group	Landscape ID	Cronbach's Alpha	n
G1	#1	.912	26
	#2	.927	26
	#3	.920	26
	#4	.937	26
	#5	.965	26
	#A	.949	26
	#C	.931	26
	#E	.955	26
G2	#6	.902	30
	#7	.942	30
	#8	.898	30
	#9	.896	30
	#10	.949	30
	#A	.935	30
	#C	.932	30
	#E	.943	30
G3	#11	.866	26
	#12	.867	26
	#13	.925	26
	#14	.921	26
	#15	.944	26
	#A	.822*	26
	#C	.890	26
	#E	.936	26
G4	#16	.922	28
	#17	.890	28
	#18	.903	28
	#19	.894	28
	#20	.904	28
	#A	.918	28
	#C	.899	28
	#E	.902	28
G5	#21	.935	26
	#22	.920	26
	#23	.901	26
	#24	.850	26
	#25	.956	26
	#A	.920	26
	#C	.905	26
	#E	.950	26
G6	#26	.947	28
	#27	.928	28
	#28	.888	28
	#29	.936	28
	#30	.964	28
	#A	.928	28
	#C	.932	28
	#E	.956	28
G7	#31	.946	26
	#32	.958	26
	#33	.958	26
	#34	.949	26
	#35	.963	26
	#A	.937	26
	#C	.959	26
	#E	.956	26
G8	#36	.945	28
	#37	.953	28
	#38	.947	28
	#39	.942	28
	#40	.927	28
	#A	.928	28
	#C	.916	28
	#E	.927	28
G9	#41	.925	28
	#42	.956	28
	#43	.897	28
	#44	.958	28
	#45	.960	28
	#A	.950	28
	#C	.952	28
	#E	.966	28
G10	#46	.901	26
	#47	.933	26
	#48	.863	26
	#49	.840	26
	#50	.908	26
	#A	.915	26
	#C	.929	26
	#E	.935	26
G11	#51	.914	28
	#52	.948	28
	#53	.937	28
	#54	.929	28
	#55	.942	28
	#A	.919	28
	#C	.898	28
	#E	.962	28
G12	#56	.902	28
	#57	.957	28
	#58	.922	28
	#59	.910	28
	#60	.956	28
	#A	.919	28
	#C	.945	28
	#E	.962	28
G13	#61	.843	28
	#62	.907	28
	#63	.873	28
	#64	.899	28
	#65	.916	28
	#A	.924	28
	#C	.879	28
	#E	.875	28
G14	#66	.940	28
	#67	.940	28
	#68	.938	28
	#69	.954	28
	#70	.956	28
	#A	.942	28
	#C	.951	28
	#E	.958	28
G15	#71	.940	28
	#72	.976	28
	#73	.961	28
	#74	.968	28
	#75	.958	28
	#A	.951	28
	#C	.963	28
	#E	.959	28
G16	#76	.920	28
	#77	.954	28
	#78	.890	28
	#79	.874	28
	#80	.932	28
	#A	.950	28
	#C	.949	28
	#E	.934	28
G17	#81	.922	27
	#82	.944	27
	#83	.897	27
	#84	.916	27
	#85	.952	27
	#A	.949	27
	#C	.950	27
	#E	.937	27
G18	#86	.948	28
	#87	.935	28
	#88	.929	28
	#89	.928	28
	#90	.940	28
	#A	.934	28
	#C	.932	28
	#E	.938	28
G19	#91	.919	28
	#92	.919	28
	#93	.882	28
	#94	.894	28
	#95	.946	28
	#A	.947	28
	#C	.928	28
	#E	.938	28
G20	#96	.941	26
	#97	.924	26
	#98	.891	26
	#99	.910	26
	#100	.953	26
	#A	.924	26
	#C	.930	26
	#E	.945	26
G21	#101	.945	26
	#102	.885	26
	#103	.896	26
	#104	.951	26
	#105	.939	26
	#A	.944	26
	#C	.879	26
	#E	.946	26
G22	#106	.941	25
	#107	.926	25
	#108	.933	25
	#109	.920	25
	#110	.902	25
	#A	.946	25
	#C	.939	25
	#E	.926	25
G23	#111	.823	28
	#112	.913	28
	#113	.914	28
	#114	.942	28
	#115	.937	28
	#A	.912	28
	#C	.913	28
	#E	.937	28
G24	#116	.901	26
	#117	.950	26
	#118	.871	26
	#119	.917	26
	#120	.942	26
	#A	.947	26
	#C	.952	26
	#E	.962	26
G25	#121	.955	26
	#122	.929	26
	#123	.967	26
	#124	.949	26
	#125	.936	26
	#A	.939	26
	#C	.930	26
	#E	.945	26
G26	#126	.951	28
	#127	.911	28
	#128	.877	28
	#129	.834	28
	#130	.953	28
	#A	.942	28
	#C	.930	28
	#E	.956	28
G27	#131	.961	30
	#132	.954	30
	#133	.932	30
	#134	.932	30
	#135	.946	30
	#A	.930	30
	#C	.941	30
	#E	.970	30
G28	#136	.962	26
	#137	.931	26
	#138	.898	26
	#139	.946	26
	#140	.963	26
	#A	.908	26
	#C	.944	26
	#E	.948	26
G29	#141	.846	31
	#142	.954	31
	#143	.929	31
	#144	.948	31
	#145	.970	31
	#A	.934	31
	#C	.932	31
	#E	.971	31
G30	#146	.905	29
	#147	.954	29
	#148	.949	29
	#149	.961	29
	#150	.930	29
	#A	.947	29
	#C	.934	29
	#E	.942	29
G30	#146	.905	29
	#147	.954	29
	#148	.949	29
	#149	.961	29
	#150	.930	29
	#A	.947	29
	#C	.934	29
	#E	.942	29
G31	#151	.923	15
	#152	.927	15
	#153	.938	15
	#154	.921	15
	#155	.972	15
	#A	.930	15
	#C	.884	15
	#E	.905	15

Note. Total number of survey participants was 843. *Lowest Cronbach's Alpha score.

The scores for the non-baseline stimuli were transformed according to the values of the baseline stimuli using the RMRATE program through all 31 groups. The original scores for all 843 respondents were replaced one by one with the transformed *Z* value, an adjusted subjective score. The sum of the respondents' adjusted subjective scores for each item in each group was further generated in order to represent the attributes of each landscape unit. The subjective attributes of all landscape units then went through reliability analyses again and gained high Cronbach's Alpha scores in each endogenous latent construct (all exceeded the value of .90). The results and other data profiles are shown in Table 4.5.

Table 4.5

Data Profile of the Respondents' Adjusted Scores for the 155 Landscape Units

Endogenous Latent Construct *Variable*	Measurement Items	Mean ♠	S.D.♠	Alfa if Item Deleted ♠♥	Alpha ♠♥
Preference					.938
Coherence	The elements in this landscape belong together.	-.042	.454	.695	
Complexity	The variety in this landscape looks just right.	-.059	.514	.663	
Mystery	This landscape seems to invite me to enter it more deeply.	.448	.844	.889	
Legibility	It would be easy to find my way in this place.	.799	1.07	.867	
Prospect	I have a clear view of the surroundings.	.248	.946	.816	
Refuge	I find this place comforting.	.270	.812	.923	
Hazard	I feel safe here.	.485	.873	.892	
Place Tenacity					912
Place Identity	I identify with this place.	.358	.800	N/A	
Affordance	I can do things I like here.	.558	.942	N/A	
Behavioral Intention					.970
Exploration	I would like to explore around here.	.349	.804	.967	
Restoration	I would like to relax here.	.524	.960	.956	
Affiliation	I would like to get to know this place better.	.428	.900	.962	
Territoriality	I would like to spend more time here.	.494	.882	.958	
All above 13 items					.973

Note. ♠Based on the transformed *Z* scores, and $N = 155$ (landscape units). ♥Reliability analysis did not apply to the objective environmental measurements of the landscape attributes.

Hypothesis Testing and Model Trimming

Initial Model Examination

Structural equation modeling (SEM) techniques with AMOS and SAS were adopted to examine how landscape structure and elements may influence recreationists' recreational behavioral intentions through their place tenacity and landscape preference.

The results indicated that the initial hypothesized model did not fit the data well. The value of χ^2 / df was less than 2 ($\chi^2_{initi} = 1.787$), and the Root Mean Square Residual (RMSEA) was less than 0.1 ($RMSEA_{initi} = .072$), giving an acceptable statistic to support the "initiative model." However, the fit statistic for the Goodness of Fit Index (GFI) was only .782. Further, most of the path-coefficient examinations between latent constructs did not reach the significance level ($p > .05$), with the exception of the relation between landscape structure and preference. In short, the initial hypothesized model was not well supported by the data and had to be modified to gain a better fit. The estimation of path coefficients and model fit statistics is detailed in Table 4.6.

Model Trimming

This hypothesized structural model was more exploratory based on the relative theory reviews, suggesting the rationale for model modification. To conduct a post-hoc revision of the model, some criteria, such as the squared multiple correlation and modification indices (MI), were taken into account to eliminate some measurement variables and enhance the model fit. During the process, the principle of parsimony (Popper, 1959) was also considered in order to trim the number of measurement items for a latent construct. For instance, the estimated parameters within the latent construct of landscape preference were condensed from 7 to 2 to better fit the data collected in the field (cf. Boomsma & Hoogland, 2001).

Building on the initial hypothesized model, the revised nested model showed a much better outcome as suggested by two indices of the *absolute fit measures* (Table 4.6). The statistic for GFI was higher than .9 ($GFI_{revised} = .904; GFI_{initi} = .782$), which indicated that the revised model fit the data reasonably well. On the other hand, the value of *RMSEA* was curtailed $RMSEA_{revised} = .068$; $RMSEA_{initive} = .072$), which also showed the strength of the revised model.

As compared with the initial model, the testing for the difference in the χ^2 statistics and the degree of freedom ($\Delta\chi^2 / \Delta df$) between models rejected the *Null* hypothesis ($\mathrm{H_O}$: if the initial model is incorrect) due to a low *p-value* (p < .05), suggesting that it does not significantly distinguish between the models (Table 4.6). However, both the statistics of χ^2_{initi} and the df_{initi} (degree of freedom) in the revised model were diminished (χ^2 from 359.28 to 96.30; df from 201 to 57). Moreover, the proportion of χ^2 / df dwindled from 1.79 to 1.69. These statistics suggested that the revised model offered a better fit with the data.

While estimating the regression path among the latent constructs, it was observed that the revised model gained a decisively better result than the initial model, as all of the estimations for all of the critical ratios for regression weights reached the significance level (p < .05) (Table 4-6). Furthermore, the value of all path coefficients was .3 or higher.

Table 4.6

Comparison between the Hypothesized Model and Revised Model

Variables			Hypothesized Model SRW	Hypothesized Model CR	Hypothesized Model P	Revised Model SRW	Revised Model CR	Revised Model P	
Structure Level									
Structure	↔	*Element*	♥	.868	.385	.624	3.578	***	
Structure	→	*Tenacity*	.059	.079	.937	.610	2.873	.004	
Structure	→	*Preference*	-.013	-.078	.938	.406	2.445	.014	
Element	→	*Preference*	♥	1.697	.090	-.308	-1.976	.048	
Element	→	*Tenacity*	♥	-1.505	.132	-.676	-3.160	.002	
Tenacity	→	*Preference*	.937	9.258	***	.766	5.104	***	
Tenacity	→	*Intention*	.471	2.318	.020	.540	3.566	***	
Preference	→	*Intention*	.479	2.342	.019	.449	2.897	.004	
Measurement Level♠									
Structure	→	*MPS*				.464	♦	♦	
Structure	→	*ED*				-.883	-5.171	***	
Structure	→	*AWMSI*				-.701	-4.609	***	
Structure	→	*IJI*				.732	4.506	***	
Element	→	*Shrub land*				.756	♦	♦	
Element	→	*Weed field*				.689	5.628	***	
Tenacity	→	*Place identity*				.873	♦	♦	
Tenacity	→	*Affordance*				.954	15.524	***	
Preference	→	*Complexity*				.589	♦	♦	
Preference	→	*Refuge*				.959	6.745	***	
Intention	→	*Restoration*				.891	♦	♦	
Intention	→	*Exploration*				.963	17.537	***	
Intention	→	*Affiliation*				.943	16.784	***	
χ^2			359.276			96.295			
DF			201			57			
χ^2/df			1.787			1.689			
GFI			.782			.904			
RMSEA			.072			.065			
$\Delta\chi^2$♣									262.981
Δ DF♣									144
Test of Model Difference									***

Note. SRW = Standardized Regression Weights. CR = critical ratio for regression weight. P = *p-value* (***: P<.001). ♠Only showing the variables for the final model as most SRWs among constructs did not reach the significance level at .05. ♥No further report due to p-value not reaching the significant level. ♦No report due to the fact that the path coefficient estimate was constrained as 1. ♣Value difference between the hypothesized model and the revised model.

In terms of the first-order direct effect, in detail, the change in landscape structure influenced the recreationists' place tenacity (beta = .61, $p < .05$) and their preference (beta = .41, $p < .05$); the landscape element also altered visitors' perceptions of place tenacity (beta = -.68, $p < .05$) and preference (beta = -.31, $p < .05$). The perceptions of visitors' place tenacity swayed their preference (beta = .77, $p < .05$), and the recreational behavioral intention of the respondents was curbed by their place tenacity (beta = -.54, $p < .05$) and preference (beta = -.45, $p < .05$). Furthermore, the landscape structure and landscape elements were correlated with each other ($r = .62$, $p < .05$). The all-path diagram is demonstrated in Figure 4.4.

In summary, when the moderating mechanism presented in the model was taken into account, landscape structure had a total effect of .721 (beta) on visitors' recreational behavioral intentions via two mediators: perceptions of place tenacity and landscape preference (Table 4.7). The landscape structure also influenced visitors' preferences with a .872 (beta) total effect; this was due not only to a direct operation but was also moderated by the perception of place tenacity.

The landscape element had an indirect influence of -.736 (beta) on visitors' recreational behavioral intentions through the operation of two mediators: perceptions of place tenacity and preference. The landscape element also induced a change in recreationists' preferences (beta = -.825) via a direct effect, as well as an indirect influence moderated by perceptions of place tenacity.

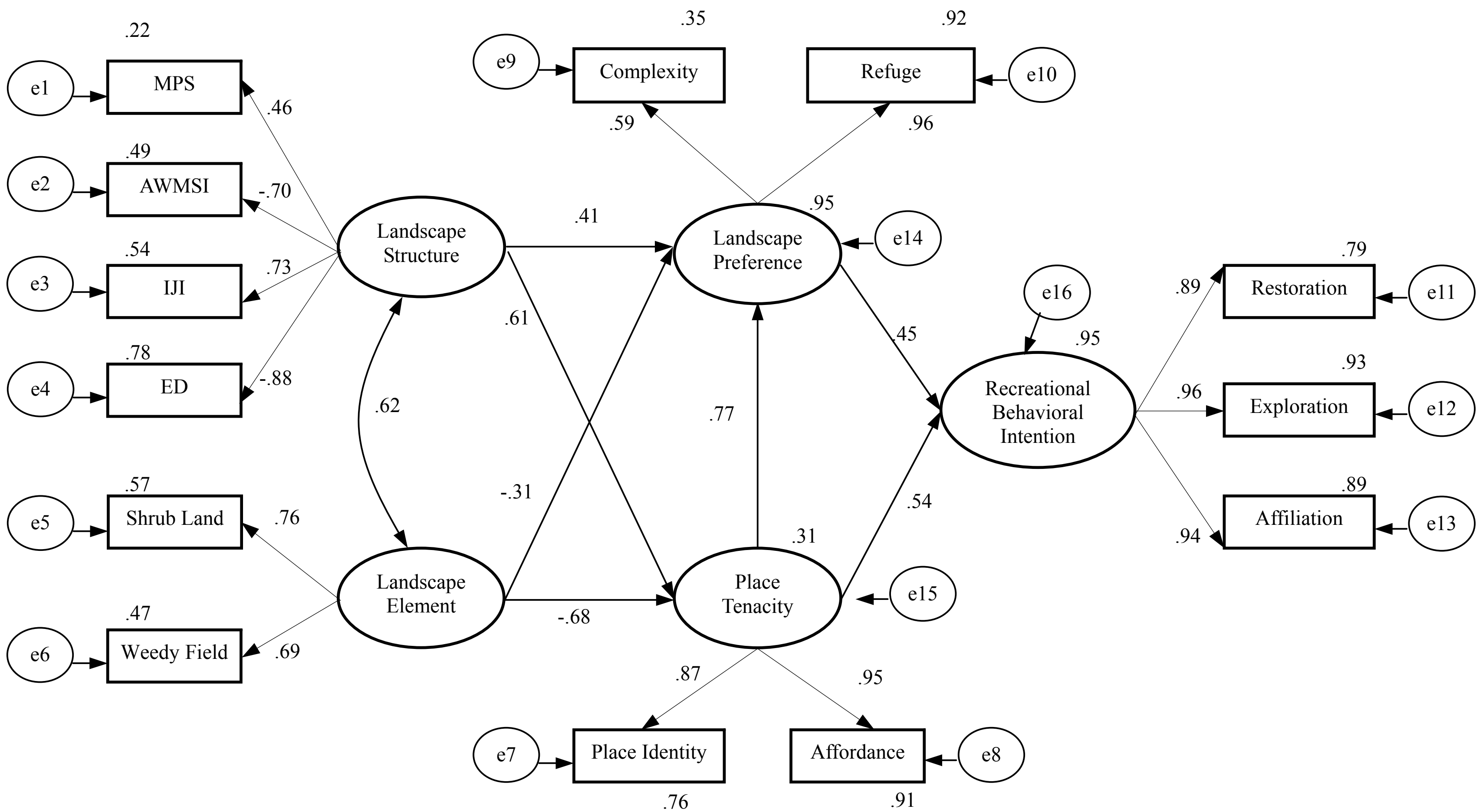


Figure 4.4. Standardized estimates of the final model.

Table 4.7

Standardized Total Effects

	Element	Structure	Tenacity	Preference
Tenacity	-.676	.610		
Preference	-.825	.872	.766	
Intention	-.736	.721	.884	.449

Chapter 5

DISCUSSION AND CONCLUSIONS

This chapter summarizes the study's research procedures and findings. It also explores the implications of the results and makes recommendations for future research.

Procedure

The structural equation modeling (SEM) technique was used to validate the model in which the functions among latent constructs and measurement variables are estimated together to identify the degree of model fit. The statistical unit used to perform the SEM technique in this study was "landscape unit." This unit was decided upon because the researcher was interested in integrating both the physical and psychological measurement variables into a model to observe how landscape composition might influence recreationists' behavioral intentions via perceptual mediators. Because the set of the stimuli (landscape photos) and questions is too sizable to be evaluated in a section, landscape photos and recreationist participants were divided into several groups to facilitate the evaluation process; a reference-group design method was adopted in this research to help adjust the rating scale difference of judgment/evaluation among groups (cf. Brown & Daniel, 1990).

Studying the influence of spatial attributes on human perceptions or recreational behavior in natural settings is not a popular area, in part because of the limitations of technology. In recent decades, most research has tended to describe/evaluate landscape structure using subjectively verbal descriptions, such as "openness" and "contrast" (e.g., Calvin et al., 1972; DeLucio & Múgica, 1994; Kaplan et al., 1989; Williams & Cary, 2002). Although some research has made efforts to quantitatively derive spatial information via pictures taken on the ground (cf. Brush & Shafer, 1975), these methods did not take horizontal geographic information, latitude and longitude, into account. The process of this study was much more complicated than earlier efforts to assess human perceptions of spatial attributes, but this research demonstrates an alternative and advanced approach to objectively and precisely quantifying spatial patterns. This study measured a set of landscape scenery with landscape metrics in a geographic coordinate system (latitude and longitude) using aerial photos and GIS. A measurement of recreationists' perceptions with precise geographic information may facilitate practical park management.

Landscape elements were integrated with landscape structure to simultaneously estimate their effects on the recreationists' perceptions and behavioral intentions as recorded using the model. Research indicated that certain natural elements, such as water, may significantly arouse human response (e.g., Hammit, 1987; Ulrich, 1983). In addition, recent studies have argued that the whole is greater than the sum of its parts, suggesting the importance of studying the environment from a holistic perspective (Antrop, 1998; Tress & Tress, 2001). Understanding the functions of elements through their context, such as landscape structure, has also been proposed. By taking into account the natural elements and their spatial relationships, the model used in the present research may well present the landscape in a realistic way.

The "viewshed" represented the visibility surface corresponding to the landscape shown in each photograph. Although analyzing visibility surface with DEM data in GIS is a much more convenient technique, it encounters problems in regard to geodesic height in that the "offset" between the terrain and the vegetation is ignored. The offset may be regarded as a measurement error that will be significantly amplified in a relatively small-scale landscape. The on-site survey with a laser rangefinder and other equipment provided more accurate data than DEM in delineating the viewshed in GIS.

Findings and Discussion

Sample Description

Because there is insufficient data regarding the total population, and its composition, that visit the Bald Eagle State Park in any given period, it is difficult to conclude whether the sampling during the survey periods gave a good representation of the recreationist population. In general, however, the research did contain a large enough sample for each category for each socio-demographic attribute. In addition, except in the category of race, the sample size for each category was fairly similar. Also, most of the demography of the sample fairly represented the population structure at varied geographic scales. For instance, during the sampling process, male respondents and female respondents (49.9%) were almost equally drawn, which is similar to the demographic structure in Centre County (female, 48.6%) and Pennsylvania (female, 51.4%) (2006 U.S. census). However, only 1.6% of respondents were African-American, which was about approximately half of the population percentage of African-Americans in Centre County (blacks, 3.0%) and much lower than the demography in Pennsylvania (blacks, 10.7%) (2006 U.S. census); the major sample of this study was Caucasian (90.4%), close to the demographic structure of Centre County (90.9%) (2006 U.S. census). The reason for the low participation rate of blacks in this research remains unknown. However, according to Payne et al. (2002), some socio-demographic attributes, such as race, do contribute to recreationists' park preferences and visiting behaviors. Kaplan and Talbot (1988) indicated that there were substantial preference differences between whites and blacks in regard to parks. Philipp (1993) indicated that blacks were more likely then whites to disfavor wild-land recreation areas. Six percent of participants were Asian or from the Pacific Islands, higher than the population percentage in Centre County and Pennsylvania (2006 U.S. census), most likely due to the proximity of the Pennsylvania State University. The majority of those visiting the park who represented ethnic minorities were Asian students at Penn State, and the park was one of their most frequently visited recreational areas.

Model Discussion

Ulrich (1977) argued that human perceptual and informational biases in regard to the landscape are a function of evolution. Drawing on biological and evolutionary theory, this study discussed human perceptions of natural settings and the effects of those settings on behavioral intentions in regard to outdoor recreation. Previous studies had indicated that visual preferences, as well as many behaviors and activities (such as locomotion, self-ornamentation, sociality), unconsciously manifest the underlying biological motivations and evolutionary adaptations of human beings (cf. Fessler, 2003; Haselton et al., 2007; Schneider, 2006). Although niche-preference and niche-approaching behaviors in outdoor recreation might be controlled/motivated by other parameters, such as social–cultural and personal experiences, this research did not conduct biological experiments to support a model that took those other possible parameters into account. However, regardless of the underlying factors or evolutionary mechanisms that may be associated with the behavioral intentions of humans in regard to natural settings, the current research adopted psychological measurement variables primarily derived from a biological basis such as that put forward by human evolution theory. The data collected in this study supported the model well.

Recreational Behavioral Intentions

Understanding recreationists' behavioral intentions may facilitate park management. Although there is considerable variation in both methods and measurement variables from study to study, previous investigations have documented that the attribute perceptions of a particular setting may attract recreationists (Schreyer & Beaulieu, 1986; Vining & Fishwick, 1991). The results of this research, based on biological perspectives, further extend the theories and applications in outdoor recreation and natural resource management. Related empirical research has indicated that the objective environment may have an effect on recreationists' subjective interpretations (Graefe & Fedler, 1986). Similarly, the present study suggested that recreational behavioral intentions are subject to situational environment settings (landscape structure, beta = .721; landscape element = -.736) through two mediators: perceptual constructs of landscape preference (beta = .45) and place tenacity (beta = .54). Knowledge of the mechanism(s) by which park settings elicit recreationists' perceptions and influence their decisions to visit (or not visit) would provide essential information for use in park planning/design, recreation management, etc.

Preference

Appleton's prospect–refuge theory (1996) was integrated with Kaplan's informational model (e.g., Kaplan, 1987) in this research to represent the construct of landscape preference. The construct was measured by seven measurement scales in the initiative model, but only complexity and refuge were retained. Though complexity, according to Kaplan, played a less important role in detecting environmental preference (cf. Kaplan et al., 1989), it turned into a strong predictor in this study. Refuge also played a salient role in measuring preference. In this research, preference was a function of place tenacity, as well as the landscape composition (structure and element). This finding also partially supports Whisman and Hollenhorst's (1998) conceptual model, which suggested that situational variables (such as resource settings) may impact subjective evaluations of preference.

Place Tenacity

Place tenacity is an innate attachment to particular settings, a *niche*. As discussed, many psychological approaches have predicted environmental preference with various spatial context cues (cf. Appleton, 1996; Kaplan, 1987;). The lens model had demonstrated an explicit process showing how setting attributes are focused through perceptual judgment (Brunswik, 1956). Since affection may be biologically unconditioned (unlearned) and some level of emotional bond with and affective attachment to particular settings is aroused without cognitive judgment (cf. Wilson, 1984), place tenacity in this research was hypothesized as a relatively intuitive perception that may influence a recreationist's judgment of the environment, and, therefore, it functioned as a mediator of preferences.

Landscape Elements

Water in general is favorable in outdoor recreation with about two-thirds of public recreation areas in the U.S. including or adjoining water resources (Pitt, 1989). Previous investigations have indicated water as the key element eliciting preference in many settings (Herzog & Barnes, 1999; Purcell et al., 1994;). However, water as a key element in eliciting preference was not supported in this research. The presence or lack of a water body did not significantly influence visitors' place tenacity or landscape preference. The mechanism for the lack of impact made by water elements was unclear; however, it is suspected that variables within the landscape structure offset any preference in this regard. Previous research has generally not simultaneously measured the effects of spatial information and water elements on human perceptions. It might be true that a water body interspersed with weedy land or lawn would possess a distinct attractiveness for humans and cause different preference ratings. Similarly, a water body adjoining a forest with an irregular or regular boundary/edge might result in a different preference evaluation. Also, the patch size (area) of a water body might impact human perception. Indeed, based on the practical experience of recreation management, not every water landscape attracts visitors. Actually, some research has indicated that water is an important factor—but not the most important—in regard to exerting an effect on human preference (Arriaza et al., 2004; Hammitt et al., 1994). The results regarding the element of water suggest that future research could bring a benefit to the field by focusing on ways to avoid the strong potential for confounding landscape structure and landscape elements.

When landscape structure was taken into account, neither forest nor lawn significantly contributed to place tenacity or landscape preference. The results of the current study supported and further extended the findings of Kaplan et al. (1989). Unlike the current research, which used landscape metrics for its objective evaluation, Kaplan et al. treated spatial information with subjective rating by a panel. However, cut grassland and forest still received relatively neutral ratings and did not have significantly positive effects on preference in their study. Some investigations have stated that people in North America are consistently preoccupied with the lawns in their yards (Bormann et al., 2001), which is suggestive of a "beauty for every American home" notion as well as of a semantic representation of modern leisure (Jenkins, 1994). It is interesting that in this study the function of the lawn element was not significant in the public recreation area. However, some respondents complained in person that lawn maintenance caused environmental problems, such as chemical and fertilization pollution, and hence did not support the idea that lawns should be cultivated in the park.

While spatial attributes were taken into account in the model, both weedy field and shrub land had a negative impact on visitors' perceptions of place tenacity and preference. The results support the findings of Kaplan et al. (1989) in which they also indicated that both weedy field and scrubland were significant negative predictors of landscape preference. Human dislike of weedy and scrub landscapes leaves park managers with the problem of reconciling human perceptions/preferences with the need for wildlife conservation. Eliminating such vegetation may improve park attractiveness, but it also lessens essential habitats for numerous small mammals, birds, and insects (Ricklefs, 1990).

Landscape Structure

This study proved that certain landscape structures positively influence recreationists' behavioral intentions via the functions of place tenacity and preference. Landscape structure in this study was detected with four measurement scales, including Mean Patch Size (MPS), Area-Weighted Mean Shape Index (AWMSI), Interspersion Juxtaposition Index (IJI), and Edge Density (ED), which held contributions to landscape structure with the standardized regression weights of .46, -.70, .73, and -.88 (beta), respectively. The findings suggest that visitors are more likely to be attracted to a landscape with a higher MPS and IJI and a lower value on the AWMSI and ED. As Forman (1995) pointed out, a landscape shape might not be restructured by the information of a single index. There is a rich array of landscape metrics to measure spatial pattern, but the current research chose only four indices that were most practical in terms of addressing the perceptional and ecological interests of outdoor recreation management. Adopting subjective rating for the spatial attributes, Kaplan et al. (1989) indicated that the subjective perception-based variables, such as openness, possessed predictive power for environmental preference. Similarly, with an objective measurement using landscape metrics, this research found that landscape structure significantly impacted recreationists' perceptions.

MPS. Based on the results, the higher the patch size, the more it elicited positive interest from the recreationists. From an ecological perspective, most large mammals prefer larger habitat patches in order to best fulfill their biological needs (Forman, 1995). Humans are also likely to prefer a larger patch. Based on Orians's habitat selection theory (cf. Orians, 1986), a larger patch implies that more substantial resources are available to support varied activities over time. This study did not estimate the effect of Total Landscape Area (TLA) due to the consideration of model parsimony. However, when the patch number was held constant, a higher mean patch size in general suggested a broader landscape. This may also compare to Strumse's (1994) finding that openness is a positive predictor of landscape preference.

ED. Edge Density was a negative predictor for measuring the landscape structure in this research. Previous research has indicated that when looking at photos or paintings, people's eye movements frequently focus on a pattern's edges (e.g., Mackworth & Morandi, 1967). Based on the lens model (cf. Brunswik, 1956), a higher edge density implies that there is more information (e.g., denser "distal cues") in the scenery than a lower edge density suggests. Thus, in order to make a judgment, greater perceptual efforts are required to process information when a higher edge density is present, and in this process more energy is consumed. The mechanism reveals that settings with higher edge density tend to cause observers to fatigue—this is contrary to the recreationists' restoration need and, thus, resulted in a negative impact on behavioral intention.

AWMSI. The Area-Weighted Mean Shape Index was also a negative predictor to measure the landscape structure in this research. A higher AWMSI value suggests a higher irregularity of patches in a landscape. Similar to the mechanism of ED on human perception, greater irregular shapes might cause the perceiver to exert more effort in analyzing the information inhering in a given recreation setting, which degrades visitors' interests.

IJI. The Interspersion Juxtaposition Index measures the neighborhood relations between patch types. The finding in regard to IJI suggested that landscapes with a highly interspersed and juxtaposed pattern elicited stronger perceptions of place tenacity and preference; these patterns also increased recreational behavioral intentions of visiting. That is, recreationists seemed more attached to landscapes in which the patch types were equally/evenly adjacent to each other, and disfavored a lower level of contiguity among land-cover types. From the perspective of landscape ecology, a landscape with an even adjacency among varied patch types implies easier accessibility to varied natural resources in line with the functional proprieties of affordance. Such landscapes, consequently, may attract and soothe recreationists and so result in higher evaluation ratings.

Implications and Recommendations

Facilitating the Applications of Outdoor Recreation Management

The results of this model have the potential to facilitate many applications in the contemporary outdoor recreation management context. Carrying Capacity (CC) was originally applied to wildlife management, and Wagar (1964) used the concept early on in outdoor recreation management. It has also been used to determine the maximum number of people who may use a recreation area without "destroying" its essential qualities (Glasson et al., 1995). This concept was more concrete in regard to the Carrying Capacity Assessment Process (C-CAP) framework (cf. Shelby & Heberlein, 1984; Washburne, 1982). Adopting the concept of Recreation Opportunity Spectrum (ROS) (Clark & Stankey, 1979; Driver & Brown, 1978) and C-CAP, the Limits of Acceptable Change (LAC) focuses on determining how much change or impact can be undergone in a landscape before the goal of achieving desired future conditions (such as resources and social conditions) is compromised. The model then prescribes actions for achieving these conditions in order to maximize conservation of the resources and the quality of visitors' experience (McArthur, 2000; Stankey et al., 1985). Based on Shelby and Heberlein's concepts (1984), Visitor Impact Management (VIM) (Graefe et al., 1990) provided a more practical framework for identifying the causes of visitor impacts and generating strategies to deal with them. All the frameworks aforementioned stress the importance of monitoring/evaluating existing resources and social conditions, a process to which the techniques and findings introduced by this study have the potential to positively contribute.

In terms of natural resources management, taking an example of monitoring vegetation loss in a specified recreational area, comparing landscape patterns at varied time periods using satellite images and landscape metrics provides a convenient way to detect and interpret landscape changes. This method may help gather essential information for evaluating habitat quality (such as habitat attrition and fragmentation; cf. Forman, 1995) and, therefore, the method may facilitate management's decision-making processes.

On the other hand, a change in landscape composition also implies the alteration of social conditions, such as changes in landscape preference and recreational behavioral intentions as shown in the model used by this study. Beyond the conventional measurement methods, this research demonstrates an alternative way of investigating visitors' recreational experiences. Importantly, even the prediction/monitoring of future social conditions is possible if the data of the landscape composition are known (Fig. 5.1). A future landscape may be established in various ways, such as using the concept of the Markov chain. Once visitor perceptions can be regressed with the landscape parameters at the present time, knowing the future landscape (such as via the Markov chain) presents the possibility of picturing future social conditions.

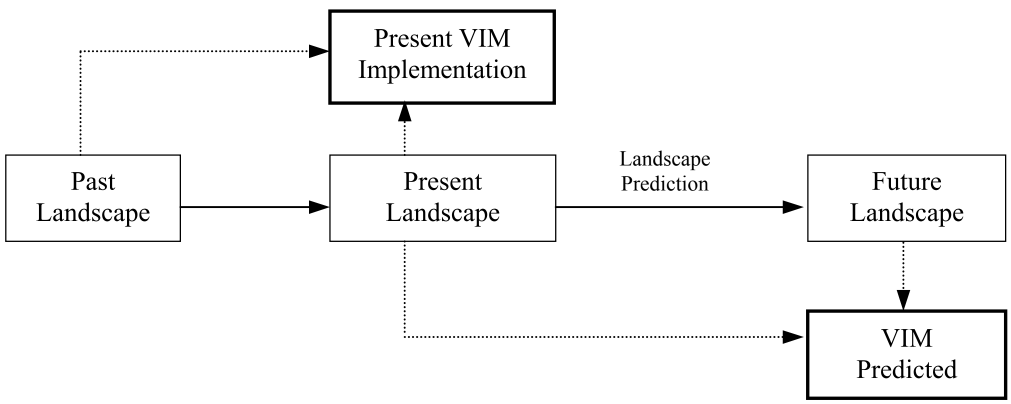


Figure 5.1. Example of predicting future natural and social conditions.

Strengthening the Theory and Improving Technology for Scenic Evaluation

By adopting landscape metrics to measure recreationists' perceptions, this research presented a new direction using a physical–perceptual approach to landscape evaluation of natural settings in a park. The physical–perceptual methods in environmental perception and evaluation research have been criticized for lacking theoretical background and/or intuitive sense (Bell et al., 2001). However, the theory in the field of landscape ecology and related disciplines may clarify the potential of and rationale for adapting landscape metrics to measure humans' environmental perceptions as shown in this research, which also further extends the traditional biological perspectives on landscape evaluation, such as the prospect–refuge theory (Appleton, 1996), the informational model (Kaplan & Kaplan, 1995), and the habitat-selection theory (Orians, 1980).

Modeling recreationists' landscape perceptions and behavioral intentions with landscape metrics is a convenient method as it takes advantage of the accessibility of aerial photographs and satellite images. The physical–perceptual approach frequently adopts scenic photographs as stimuli. However, this research shows the potential for predicting recreationists' perceptions directly using bird's-eye view photos/images in the future. To some extent, then, researchers may easily measure environmental quality without conducting an on-site survey.

The Complex Relationships between Sustainability and Recreationists' Preferences

Ingram (1991) stated that the "identification of the full range of possibilities and associated trade-offs for integration of habitat values with those related to wild land recreation and visual amenities is still problematic" (p. 109). Parsons (1995) also pointed to the conflicts between landscape aesthetics and ecological sustainability. Traditionally, the outdoor recreation management frameworks (e.g., C-CAP, LAC, VIM) have stressed the importance of maintaining the equilibrium between natural resources and social conditions. This research aptly shows the dilemma faced by those determining and implementing management policy. Previous research has indicated that people tend to prefer a park-like landscape (Ulrich, 1986), but such a landscape might be not an optimal habitat for certain species. Landscapes for which visitors indicate a higher preference or attachment do not always support ecological sustainability. In this research, visitors showed less attraction to weedy fields and scrublands; yet, these are important habitats for wildlife conservation. A landscape possessing a higher edge density (i.e., higher ED value) or irregular shape (i.e., higher AWMSI scores) implies more ecotone habitats, which some generalist species favor (Dramstad et al., 1996; Forman, 1995; Forman & Godron, 1986; Thorne & Huang, 1991). But this habitat was disfavored by recreationists in this study.

However, this research also suggested some management options for potential coexistence between recreationists and wildlife. A landscape with a higher mean patch size (i.e., higher MPS value) was not only preferred by visitors, it also benefited larger mammal and interior species (the specialists). Furthermore, a landscape with a higher degree of interspersion and juxtaposition (i.e., higher IJI scores) not only scored high in terms of the recreationists' preferences and visiting intentions, it also benefits some wildlife and game management (cf. Leopold, 1933).

Future Research

Therapeutic Benefit

The therapeutic effects of recreationists' interactions with the landscape may become clearer in future research. Therapeutic benefit is an evolving theme in recreation studies (Dattilo, 2000). Related research indicates that natural settings may improve the psychological condition of convalescents. For instance, in one study, surgical patients assigned to a room with a view of trees had a higher recovery rate than those whose rooms had a view of brick walls (Ulrich, 1984). In addition, wilderness experiences may also contribute psychological benefits (Kaplan & Talbot, 1983). Actually, healing gardens have been proposed to help with clinical practice for alleviating patient stress and improving health outcomes (Barnes, 1999; Ulrich, 1999). However, not all natural settings would be beneficial to the well-being of convalescents or indeed of those taking part in outdoor recreation. The model of this current study offers some preliminary knowledge, suggesting that certain landscape compositions (such as a shrub land with a high edge density) may not provide a sense of refuge and may repel recreationists seeking restoration. Nevertheless, more extensive research is required, such as studies focusing on the relationship between landscape parameters (e.g., pattern/process) and certain human health problems (e.g., Alzheimer's disease) as they affect certain groups (e.g., gender or race) in outdoor recreation settings.

The Co-existence of Wildlife and Recreationists

What would be an optimal niche(s) that would both preserve ecosystem integrity and foster human pleasure/health? Although the general public may be likely to view outdoor recreation as a low-pollutant industry, it, in fact, seriously threatens wildlife. Outdoor recreation is considered to be one of the major contributing factors to the decline of 258 endangered species in the U.S.—its effects are considered to be worse than those of grazing and logging (Losos et al., 1995). The creation of recreation amenities (e.g., visiting centers and trails) often modifies habitat structure and components; thus, it fragments habitat into remnants and impacts the mobility of gap-sensitive species (e.g., flightless, ground-dwelling animals), which may result in an overall population decline (Mader et al., 1990; Stacy & Taper, 1992; Wynhoff et al., 1995). In addition, recreation activities (e.g., sightseeing, hunting, camping) also influence the behavior of wildlife species. For example, some bird species show a reduction in the frequency of their primary song and even change the pattern of it due to pedestrian movement. And, such a change may affect their population, spatial distribution, and nesting rates (Gutzwiller et al., 1994, 1997;

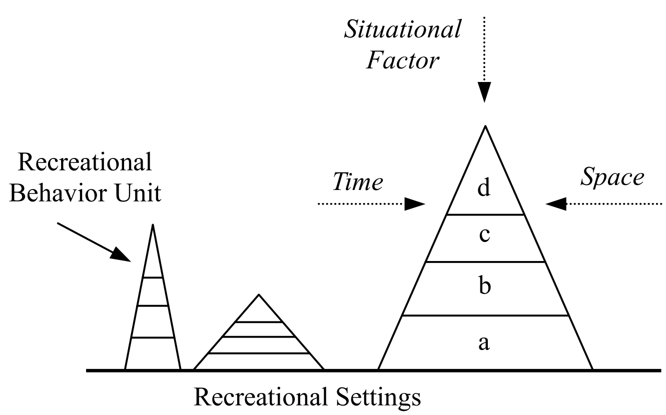
van der Zande & Vos, 1984; van der Zande et al., 1984). Elks move away from preferred winter grazing areas after hunting starts, which negatively affects their winter energy budget and survivorship (Liddle, 1997). In addition, antler deer are very timid in the hunting area (Behrend & Lubeck, 1968). Also, if a recreationist is accompanied by a dog, the negative impact on species density will be more significant (van der Zande et al., 1984). To compensate for the negative impacts caused by outdoor recreation in natural settings, it is essential to manage landscape compositions in order to support an equilibrium condition for both pleasing/restoring visitors and maintaining wildlife species.

Methodology

To understand the biological roots of the inherent mechanism(s) driving recreationists' responses to natural settings would be to present essential information to park management professionals, whose job it is to both protect natural settings and attract people to them. Behavioral complexities, such as synchronization, migration/dispersal, clustery behaviors, individual distance, guild behavior, tolerance, and aggression and territorial behavior, are common in many outdoor recreation activities and settings at varied spatial and temporal scales. Such manifestations may be evolutionarily significant or vestigial behaviors/reflexes during adaptive/maladaptive processes in the natural environment. Understanding these behaviors is integral to park management because doing so will help ensure that appropriate measures are put in place to prevent or solve problems such as vandalism and crowding.

Although both ethical and technical perspectives present obstacles to conducting human laboratory research in order to obtain biological evidence of genetically controlled behavioral variations, it is worthwhile to consider alternative approaches, such as quasi experimental methods that can elucidate interactions between human instinct and response, including perception and behavior, in regard to natural recreational settings (e.g., Fig 5.2). Also, conducting the research with varied demographic contexts (e.g., race, gender, age, and culture) may improve the model's robustness.

Computer simulations may enable future research to precisely control landscape parameters such as vegetation texture, landform, climate, etc. A priori photos were applied as stimuli to detect recreationists' perceptions. Although these pictures accurately presented the on-site reality, some landscape variables (e.g., vegetation texture and color, landform, climate, light, etc.) were not controlled in the model of current research, and they could have confounded the results. Future study may consider building 2D or 3D simulated settings as stimuli in the questionnaire.



Legend:

[a]Human instinct. [b]Niche preference. [c]Behavioral intention. [d]Behavior.

Figure 5.2. Hypothetical concept of behavioral responses to recreational settings. Behaviors are hierarchically constrained by lower biological factors and also constrained by time, space, and other situational parameters.

Post-occupancy Evaluation (POE) on the Spatiotemporal Behavioral Pattern

Observations of recreationists' behavior in the context of specific landscape settings is suggested in order to examine intention–behavior consistency and further support or challenge the findings of the current study. This study primarily measured recreationists' behavioral intentions of approaching/avoiding natural-based recreational settings via self-report instruments; however, discrepancy between behavioral intention and actual behavior may occur (Webb & Sheeran, 2006). Evidence of recreationists' spatial and temporal behavioral interactions with settings may be discovered through varied methods, such as distribution density mapping, cluster analysis, and autocorrelation examination, etc.

REFERENCES

Alland, A., Jr. (1973). *Evolution and human behavior: An introduction to Darwinian anthropology*. Garden City, NY: Anchor Press.

Anderson, J., & Tindall, M. (1972). The concept of home range: New data for the study of territorial behavior. In W. J. Mitchell (Ed.), *Environmental design: Research and practice: Vol. 1* (pp. 1–7). Los Angeles: University of California Press.

Antrop, M. (1998). Landscape change: Plan or chaos? *Landscape and Urban Planning, 41*(3/4), 155–161.

Antrop, M., & van Eetvelde, V. (2000). Holistic aspects of suburban landscapes: Visual image interpretation and landscape metrics. *Landscape and Urban Planning, 50*(1/3), 43–58.

Aplet, G. H. (2000). A landscape approach to managing southern rocky mountain forests. In R. L. Knight, F. W. Smith, S. W. Buskirk, W. H. Romme, & W. L. Baker (Eds.), *Forest fragmentation in the southern Rocky Mountains* (pp. 361–376). Boulder: University Press of Colorado.

Appleton, J. (1975). Landscape evaluation: The theoretical vacuum. *Transactions of the Institute of British Geographers, 66* (Nov.)*,* 120–123.

Appleton, J. (1984). Prospects and refuges revisited. *Landscape Journal, 3*(2), 91–103.

Appleton, J. (1990). *The symbolism of habitat: An interpretation of landscape in the arts*. Seattle: University of Washington Press.

Appleton, J. (1996/1975). *The experience of landscape.* London: John Wiley & Sons.

Arriaza, M., Cañas-Ortega, J. F., Cañas-Madueño, J. A, & Ruiz-Aviles, P. (2004). Assessing the visual quality of rural landscapes. *Landscape and Urban Planning, 69*(1), 115–125.

Arthur, L. M. (1977). Predicting scenic beauty of forest environments: Some empirical tests. *Forest Science, 23*(2), 151–159.

Badcock, C. (1991). *Evolution and individual behavior: An introduction to human sociobiology.* Oxford: Basil Blackwell.

Balling, J. D., & Falk, J. H. (1982). Development of visual preference for natural environments. *Environment and Behavior, 14*(1), 5–28.

Bammel, G., & Burrus-Bammel, L. L. (1996). *Leisure and human behavior.* Dubuque, IA: Times Mirror Higher Education Group.

Barnes, M. (1999). Design philosophy. In C. C. Marcus (Ed.), *Healing gardens: Therapeutic benefits and design recommendations* (pp. 84–114). New York: John Wiley & Sons.

Beach, F. A. (1945). Current concepts of play in animals. *The American Naturalist, 79*(785), 523–541.

Behrend, D. F., & Lubeck, R. A. (1968). Summer flight behavior of white-tailed deer in two Adirondack forests. *Journal of Wildlife Management, 32*(3), 615–618.

Bell, P. A., Greene, T. C., Fisher, J. D., & Baum, A. (2001). *Environmental psychology*. Orlando, FL: Harcourt College.

Bentham, J. (1789). *An introduction to the principles of morals and legislation*. London: Printed for T. Payne & Son.

Berlyne, D. E. (1960). *Conflict, arousal, and curiosity.* New York: McGraw-Hill.

Boaz, N. T. (1979). Hominid evolution in eastern Africa during the Pliocene and early Pleistocene. *Annual Review of Anthropology, 8*(Oct.), 71–85.

Bollen, K. A. (1989). *Structural equations with latent variables*. New York: John Wiley & Sons.

Boomsma, A., & Hoogland, J. J. (2001). The robustness of LISREL modeling revisited. In R. Cudeck, S. du Toit, & D. Sörbom (Eds.), *Structural equation models: Present and future* (pp. 139–168). Lincolnwood, IL: Scientific Software International.

Bormann, F. H., Balmori, D., & Geballe, G. T. (2001). *Redesigning the American lawn: A search for environmental harmony.* New Haven, CT: Yale University Press.

Bourassa, S. C. (1990). A paradigm for landscape aesthetics. *Environment and Behavior, 22*(6), 787–812.

Bradbard, M. R., & Endsley, R. C. (1980). How can teachers develop young children's curiosity? What current research says to teachers. *Young Children, 35*(5), 21–32.

Bricker, K. S., & Kerstetter, D. L. (2000). Level of specialization and place attachment: An exploratory study of whitewater recreationists. *Leisure Sciences, 22*(4), 233–257.

Brockmann, H. J. (1979). Nest-site selection in the great golden digger wasp, *Sphex ichneumoneus* L. (Sphecidae). *Ecological Entomology, 4*(3), 211–224.

Brown, B. B. (1987). Territoriality. In D. Stokols & I. Altman (Eds.), *Handbook of environmental psychology: Vol. 1* (pp. 505–531). New York: John Wiley & Sons.

Brown, T. C., & Daniel, T. C. (1990). *Scaling of ratings: Concept and methods* (Res. Pap. RM-

293). Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Brunswik, E. (1956). *Perception and the representative design of psychological experiments*. Berkeley: University of California Press.

Brush, R. O., & Shafer, E. L. (1975). Application of a landscape-preference model to land management. In E. H. Zube, J. G. Fabos, & R. O. Brush (Eds.), *Landscape assessment: Value, perception, and resources* (pp. 168–187). Stroudsburg, PA: Dowden, Hutchinson, & Ross.

Burghardt, G. M. (1984). On the origins of play. In P. K. Smith (Ed.), *Play in animals and humans* (pp. 5–41). Oxford: Basil Blackwell.

Calvin, J. S, Dearinger, J. A., & Curtin, M. E. (1972). An attempt at assessing preferences for natural landscapes. *Environment and Behavior, 4*(4), 447–470.

Campbell, B. G. (1998). *Human evolution: An introduction to man's adaptations.* Hawthorne, NY: Aldine De Gruyter.

Cardille, J. A., & Turner, M. G. (2002). Understanding landscape metrics. In S. E. Gergel & M. G. Turner (Eds.), *Learning landscape ecology*: *A practical guide to concepts and techniques* (pp. 85–100). New York: Springer-Verlag.

Case, T. J. (2000). *An illustrated guide to theoretical ecology*. New York: Oxford University Press.

Cartwright, J. (2000). *Evolution and human behaviour: Darwinian perspectives on human nature*. Cambridge, MA: MIT Press.

Chalmers, N. (1984). Social play in monkeys: Theories and data. In P. K. Smith (Ed.), *Play in animals and humans* (pp. 119–141). Oxford: Basil Blackwell.

Charlesworth, W. R. (1976). Human intelligence as adaptation: An ethological approach. In L. Resnick (Ed.), *The nature of intelligence*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Clark, R. N., & Stankey, G. H. (1979). *The Recreation opportunity spectrum: A framework for planning, management, and research* (Gen. Tech. Rep. PNW-98). Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station.

Clayton, S. (2003). Environmental identity: A conceptual and an operational definition. In S. Clayton & S. Opotow (Eds.), *Identity and the natural environment: The psychological significance of nature* (pp. 45–65). Cambridge, MA: MIT University Press.

Clayton, S., & Opotow, S. (2003). Introduction: Identity and the natural environment. In S. Clayton & S. Opotow (Eds.), *Identity and the natural environment: The psychological significance of nature* (pp. 1–24). Cambridge, MA: MIT University Press.

Cohen, D. (1975). *Human nature–animal nature: The biology of human behavior.* New York: McGraw-Hill Book Company.

Cordell, H. K., & Super, G. R. (2000). Trends in Americans' outdoor recreation. In W. C. Gartner & D. W. Lime (Eds.), *Trends in outdoor recreation, leisure and tourism* (pp. 133–144). New York: CABI.

Daniel, T. C., & Boster, R. S. (1976). *Measuring landscape aesthetics: The scenic beauty estimation method* (Res. Pap. RM-167). Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Darwin, C. (1859). *On the origin of species by means of natural selection, or, The preservation of favoured races in the struggle for life.* London: John Murray.

Darwin, C. (1872). *The expression of the emotions in man and animals.* London: John Murray.

Dattilo, J. (2000). *Facilitation techniques used in therapeutic recreation*. State College, PA: Venture.

DeLucio, J. V., & Múgica, M. (1994). Landscape preferences and behaviour of visitors to Spanish national parks. *Landscape and Urban planning, 29*(2/3): 145–160

Dewey, J. (1958). *Art as experience.* New York: Capricorn Books.

Dramstad, W. E., Olson, J. D., & Forman, R. T. T. (1996). *Landscape ecology principles in landscape architecture and land-use planning*. Washington, DC: Island Press.

Drickamer, L. C., & Vessey, S. H. (1982). *Animal behavior: Concepts, processes and methods.* Belmont, CA: Wadsworth.

Driver, B. L., & P. J. Brown. (1978). The opportunity spectrum concept and behavioral information in outdoor recreation resource supply inventories. In H. G. Lund, V. J. LaBau, P. F. Ffolliott, & D. W. Robinson (Eds.), *Integrated inventories of renewable natural resources* (Gen. Tech. Rep. RM-55, pp. 24–31). Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Driver, B., Nash, R., & Haas, G. (1987). Wilderness benefits: A state of knowledge review. In R. C. Lucas (Ed.), *Issues, state-of-knowledge, future directions* (Gen. Tech. Rep. INT–220, pp. 294–319). Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station.

Eibl-Eibesfeldt, I. (1988). The biological foundation of aesthetics. In I. Rentschler, B. Herzberger, & D. Epstein (Eds.), *Beauty and the brain: Biological aspects of aesthetics* (pp. 29–69). Basel, Boston: Birkhäuser Verlag.

Elkie, P., Rempel, R. S., & Carr, A. P. (1999). *Patch Analyst user's manual: A tool for quantifying landscape structure* (Tech. Man. TM–002). Thunder Bay, Ontario: Ontario Ministry of Natural Resources, Northwest Science & Technology.

Ellis, M. J. (1973). *Why people play.* Englewood Cliffs, NJ: Prentice Hall.

Fairbanks, L. A. (2000). The developmental timing of primate play. In S. T. Parker, J. Langer, & M. L. McKinney (Eds.), *Biology, brains, and behavior: The evolution of human development* (pp. 131–158). Santa Fe, NM: School of American Research Press.

Farina, A. (1998). *Principles and methods in landscape ecology*. New York: Chapman & Hall.

Farina, A. (2000). *Landscape ecology in action.* Dordrecht, Netherlands: Kluwer Academic.

Fessler, D. M. T. (2003). No time to eat: An adaptationist account of periovulatory behavioral changes. *Quarterly Review of Biology, 78*(1), 3–21.

Forman, R. T. T. (1995). *Land Mosaics: The ecology of landscapes and regions.* Cambridge: Cambridge University Press.

Forman, R. T. T., & Godron, M. (1986). *Landscape ecology.* New York: John Wiley & Sons.

Gartner, W. C. (1993). Image formation process. *Journal of Travel and Tourism Marketing, 2*(3), 191–212.

Gebhard, U., Nevers, P., & Billmann-Mahecha, E. (2003). Moralizing trees: Anthropomorphism and identity in children's relationships to nature. In S. Clayton & S. Opotow (Eds.), *Identity and the natural environment: The psychological significance of nature* (pp. 91–111). Cambridge, MA: MIT Press.

Geist, V. (1978). *Life strategies, human evolution, environmental design: Toward a biological theory of health.* New York: Springer-Verlag.

Gibson, J. J. (1979). *The ecological approach to visual perception.* Boston: Houghton Mifflin.

Glass, A. L., & Holyoak, K. J. (1986). *Cognition.* New York: Random House.

Glasson, J., Godfrey, K., Goodey, B., Absalom, H., & van der Borg, J. (1995). *Towards visitor impact management: Visitor impacts, carrying capacity and management response in Europe's historic towns and cities*. Aldershot, UK: Avebury.

Godbey, G. (2000). The future of leisure studies. *Journal of Leisure Research, 32*(1), 37–41.

Godron, M., & Forman, R. T. T. (1983). Landscape modification and changing ecological characteristics. In H. A. Mooney & Godron M. (Eds.), *Disturbance and ecosystems: Components of response*. (pp. 12–28). New York: Springer-Verlag.

Goldsmith, T. (1991). *Biological roots of human nature: Forging links between evolution and behavior.* New York: Oxford University Press.

Goodale, T., & Godbey, G. (1988). *The evolution of leisure: Historical and philosophical perspectives*. State College, PA: Venture.

Graefe, A. R., & Fedler, A. J. (1986). Situational and subjective determinants of satisfaction in marine recreational fishing. *Leisure Sciences, 8*(3), 275–295.

Graefe, A. R., Kuss, F., & Vaske, J. (1990). *Visitor impact management: The planning framework.* Washington, DC: National Parks and Conservation Association.

Greenbie, B. B. (1982). The landscape of social symbols. *Landscape Research, 7*(3), 2–6.

Greenfield, P. M., Maynard, A. E., Boehm, C. B., & Schmidtling, E. Y. (2000). Cultural apprenticeship and cultural change. In S. T. Parker, J. Langer, & M. L. McKinney (Eds.), *Biology, brains, and behavior: The evolution of human development* (pp. 237–277). Santa Fe, NM: School of American Research Press.

Gutzwiller, K. J., Kroese, E. A., Anderson, S. H., & Wilkins, C. A. (1997). Does human intrusion alter the seasonal timing of avian song during breeding periods? *The Auk, 114*(1), 55–65.

Gutzwiller, K. J., Wiedenmann, R. T., Clements, K. L., & Anderson, S. H. (1994). Effects of human intrusion on song occurrence and singing consistency in subalpine birds. *The Auk, 111*(4), 28–37.

Hair, J. F., Jr., Anderson, R. E, Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis.* Upper Saddle River, NJ: Prentice Hall.

Hammitt, W. E. (1987). Visual recognition capacity during outdoor recreation experiences. *Environment and Behavior, 19*(6), 651–672.

Hammitt, W. E., Patterson, M. E., & Noe, F. P. (1994). Identifying and predicting visual preference of southern Appalachian forest recreation vista. *Landscape and Urban Planning, 29*(2/3), 171–183.

Harker, D., Libby, G., Harker, K., Evans, S., & Evans, M. (1999). *Landscape restoration handbook*. New York: Lewis.

Harlow, H. F., Harlow, M. K., & Meyer, D. R. (1950). Learning motivated by a manipulation drive. *Journal of Experimental Psychology, 40*(2), 228–234.

Hartig, T., Korpela, K., Evans, G. W., & Gärling, T. (1997). A measure of restorative quality in environments. *Scandinavian Housing and Planning Research, 14*(4), 175–194.

Haselton, M. G., Mortezaie, M., Pillsworth, E. G., Bleske-Rechek, A., & Frederick, D. A. (2007). Ovulatory shifts in human female ornamentation: Near ovulation, women dress to impress. *Hormones and Behavior, 51*(1), 40–45.

Heerwagen, J. H., & Orians, G. H. (1993). Humans, habitats, and aesthetics. In S. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 138–172). Washington, DC: Island Press.

Heidegger, M. (1977). Building dwelling thinking. In D. F. Krell (Ed), *Basic writings: From being and time (1927) to the task of thinking (1964)* (pp. 323–339). New York: HarperCollins.

Hendee, J. C., & Stankey, G. H. (1973). Biocentricity in wilderness management. *BioScience, 23*(9)*,* 535–538.

Henle, K. (1996). Survival of lizards in habitat islands in central Europe: Introduction and summary conclusion. In J. Setteles, C. Margules, P. Poschlod, & K. Henle (Eds.), *Species survival in fragmented landscapes* (pp. 237–240). Dordrecht, Netherlands: Kluwer Academic.

Herzog, T. R. (1985). A cognitive analysis of preferences for waterscapes. *Journal of Environmental Psychology, 5*(3), 225–241.

Herzog, T. R., & Barnes, G. J. (1999). Tranquility and preference revisited. *Journal of Environmental Psychology, 19*(2): 171–181.

Herzog, T. R., Herbert, E. J., Kaplan, R., & Crooks, C. L. (2000). Cultural and developmental comparisons of landscape perceptions and preferences. *Environment and Behavior, 32*(3), 323–346.

Hester, R. (1979). A womb with a view: How spatial nostalgia affects the designer. *Landscape Architecture, 69*(Sept.), 475–481.

Hiss, T. (1990). *The experience of place.* New York: Vintage Books.

Huizinga, J. (1955). *Homo ludens: A study of the play element in culture*. Boston: Beacon Press.

Hull, R. B., IV, & Revell, G. R. B. (1989). Cross-cultural comparison of landscape scenic beauty evaluations: A case study in Bali. *Journal of Environmental Psychology, 9*(3), 177–191.

Hutchinson, G. E. 1957. Concluding remarks. In K. B. Warren (Ed), *Cold Spring Harbor Symposia on Quantitative Biology: Vol. 22. Population studies: Animal ecology and demography* (pp. 415–427). Cold Spring Harbor, Long Island, NY: Biological Laboratory.

Ingram, G. B. (1991). Habitat, visual and recreational values and the planning of extractive development and protected areas: A tale of three islands. *Landscape and Urban Planning, 21*(1/2), 109–129.

Iso-Ahola, S. E. (1980). *The social psychology of leisure and recreation.* Dubuque, IA: Wm. C. Brown Company.

Izard, C. E. (1977). *Human emotions*. New York. Plenum Press.

Izard, C. E., & Buechler, S. (1980). Aspects of consciousness and reality. In R. Plutchik & H. Kellerman (Eds.), *Emotion: Theory, research, and experience* (pp. 165–187). New York: Academic Press.

Jackson, J. B. (1986). The vernacular landscape. In E. C. Penning-Rowsell & D. Lowenthal (Eds), *Landscape meanings and values* (pp. 65–81). London: Allen & Unwin.

Jackson, J. F. (1988). Crevice occupation by musk turtles: Taxonomic distribution and crevice attributes. *Animal Behaviour*, *36*(3), 793–801.

Jackson, W. (1996). *Becoming native to this place.* Washington, DC: Counterpoint.

James, W. (1962/1892). *Psychology: The briefer course*. New York: Collier Books.

Jenkins, V. S. (1994). *The lawn: A history of an American obsession*. Washington, DC: Smithsonian.

Kaplan, R. (1978). The green experience. In S. Kaplan & R. Kaplan (Eds.). *Humanscape: Environments for people* (pp. 186–193). Belmont, CA: Duxbury Press.

Kaplan, R. (1983). The role of nature in the urban context. In I. Aitman & J. F. Wohlwill (Eds.), *Human behavior and environment: Vol. 6. Behavior and the natural environment* (pp. 127–161). New York: Plenum Press.

Kaplan, R., & Kaplan, S. (1995/1989). *The experience of nature: A psychological perspective.* New York: Cambridge University Press.

Kaplan, R., Kaplan, S., & Brown, T. (1989). Environmental preference: A comparison of four domains of predictor. *Environment and Behavior, 21*(5), 509–530.

Kaplan, R., & Talbot, J. F. (1988). Ethnicity and preference for natural settings: A review and recent findings. *Landscape and Urban Planning, 15*(1/2), 107–117.

Kaplan, S. (1975). An informal model for the prediction of preference. In E. H. Zube, R. O. Brush, & J. G. Fabos (Eds.), *Landscape assessment: Value, perception, and resources* (pp. 92–101). Stroudsburg, PA: Dowden, Hutchinson & Ross.

Kaplan, S. (1987). Aesthetics, affect, and cognition: Environmental preference from an evolutionary perspective. *Environment and Behavior, 19*(1), 3–32.

Kaplan, S. (1992). The challenge of environmental psychology: A proposal for a new functionalism. *American Psychologist, 27*(2), 140–143.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*(3), 169–182.

Kaplan, S., & Kaplan, R. (1978). Evolution. In S. Kaplan & R. Kaplan (Eds.), *Humanscape: Environments for people* (pp. 7–9). Belmont, CA: Duxbury.

Kaplan, S., & Kaplan, R. (1982). *Cognition and environment: Functioning in an uncertain world*. New York: Praeger.

Kaplan, S., & Talbot, J. F. (1983). Psychological benefits of a wilderness experience. In I. Aitman & J. F. Wohlwill (Eds.), *Human behavior and environment: Vol. 6. Behavior and the natural environment* (pp. 163–203). New York: Plenum Press.

Kellert, S. R. (1993). The biological basis for human values of nature. In S. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 42–69). Washington, DC: Island Press.

Kellert, S. R. (1997). *Kinship to mastery: Biophilia in human evolution and development.* Washington, DC: Island Press.

Kelley, J. R. (1972). Work and leisure: A simplified paradigm. *Journal of Leisure Research, 4*(1), 50–62.

Knopf, R. C. (1987). Human behavior, cognition, and affect in the natural environment. In D. Stokols & I. Altman (Eds.), *Handbook of environmental psychology: Vol. 1* (pp. 783–825). New York: John Wiley & Sons.

Kolasa, J., & Waltho, N. (1998). A hierarchical view of habitat and its relationship to species abundance. In D. L. Peterson & V. T. Parker (Eds.), *Ecological Scale* (pp. 55–76). New York: Columbia University Press.

Korpela, K. M. (1989). Place-identity as a product of environmental self-regulation. *Journal of Environmental Psychology, 9*(3), 241–256.

Langer, S. K. (1953). *Feeling and form: A theory of art.* New York: Macmillan.

Leopold, A. (1933). *Game management*. New York: Charles Scribner's Sons.

Liddle, M. (1997). *Recreation ecology*. London: Chapman & Hall Press.

Lombardo, T. J. (1987). *The reciprocity of perceiver and environment: The evolution of James J. Gibson's ecological psychology.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Lorenz, K. Z. (1952). *King Solomon's ring: New light on animal ways.* New York: Thomas.

Lorenz, K. Z. (1956). Plays and vacuum activities. In Fondation Singer-Polignac (Ed.), *L'instinct dans le comportement des animaux et de l'homme* (pp. 633–645). Paris: Masson et C^ie^ Éditeture.

Lorenz, K. Z. (1966). *On aggression.* New York: Harcourt, Brace & World.

Losos, E., Hayes, J., Phillips, A., Wilcove, D., & Alkire, C. (1995). Taxpayer-subsidized resource extraction harms species. *BioScience, 45*(6), 446–455.

Lynch, K. (1997/1960). *The image of the city*. Cambridge, MA: MIT Press.

Mackworth, N. H., & Morandi, A. J. (1967). The gaze selects informative details within pictures. *Perception and Psychophysics, 2*(11), 547–552.

Mader, H. J., Schell, C., & Kornacker, P. (1990). Linear barriers to arthropod movements in the landscape. *Biological Conservation, 54*(3), 209–222.

Mannell, R. C., & Kleiber, D. A. (1997). *A social psychology of leisure*. State College, PA: Venture.

Maslow, A. H. (1954). *Motivation and personality*. New York: Harper & Row.

McAndrew, F. T. (1993). *Environmental psychology*. Pacific Grove, CA: Brooks/Cole.

McArthur, S. (2000). Beyond carrying capacity: Introducing a model to monitor and manage visitor activity in forests. In X. Font & J. Tribe (Eds.), *Forest tourism and recreation: Case studies in environmental management* (pp. 259–278). New York: CABI.

McDougall, W. (1908). *An introduction to social psychology*. London: Methuen.

McGarigal, K., & Marks, B. J. (1995). *FRAGSTATS: Spatial pattern analysis program for quantifying landscape structure* (Gen. Tech. Rep. PNW-351). Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Meeus, J. H. A., Wijermans, M. P., & Vroom, M. J. (1990). Agricultural landscape in Europe and their transformation. *Landscape and Urban Planning, 18*(3/4), 289–352.

Mehrabian, A., and Russell, J. A. (1974). *An approach to environmental psychology.* Cambridge, MA: MIT Press.

Meitner, M. (2004). Scenic beauty of river views in the Grand Canyon: Relating perceptual judgments to locations. *Landscape and Urban Planning, 68*(1), 3–13.

Mill, J. S. (1871). *Utilitarianism.* London: Longmans, Green, Reader, & Dyer.

Milton, K. (2002). *Loving nature: Towards an ecology of emotion.* London: Routledge.

Moore, R. L., & Graefe, A. R. (1994). Attachments to recreation settings: The case of rail-trail users. *Leisure Sciences, 16*(1), 17–31.

Mora, F., & Iverson, L. (2002) A spatially constrained ecological classification: Rationale, methodology, and implementation. *Plant Ecology, 158*(2), 153–169.

Morrill, R. L., & Kelley, M. B. (1970). The simulation of hospital use and the estimation of location efficiency. *Geographical Analysis, 2*(3), 283–300.

Myers, G., & Russell, A. (2003). Human identity in relation to wild black bears: A natural–social ecology of subjective creatures. In S. Clayton & S. Opotow (Eds.), *Identity and the natural environment: The psychological significance of nature* (pp. 67–90). Cambridge, MA: MIT Press.

Nassauer, J. I. (1995). Culture and changing landscape structure. *Landscape Ecology, 10*(4), 229–237.

Nissen, H. W. (1951a). Pylogenetic comparison. In S. S. Stevens (Ed.), *Handbook of experimental psychology* (pp. 347–386). New York: John Wiley & Sons.

Nissen, H. W. (1951b). Social behavior in primates. In C. P. Stone (Ed.), *Comparative psychology* (pp. 423–386). New York: Prentice-Hall.

Neulinger, J. (1974). *Psychology of leisure: Research approaches to the study of leisure.* Springfield, IL: Charles C. Thomas.

Norberg-Schultz, C. (1965). *Intentions in architecture*. Cambridge, MA: MIT Press.

Norberg-Schultz, C. (1979). *Genius loci: Towards a phenomenology of architecture.* New York: Rizzoli.

O'Neill, R.V., Krummel, J. R., Gardner, R. H., Sugihara, G., Jakson, B., DeAngelies, D. L., et al. (1988). Indices of landscape pattern. *Landscape Ecology, 1*(3), 153–162.

Orians, G. H. (1980). Habitat selection: General theory and application to human behavior. In J. S. Lockard (Ed.), *The evolution of human social behavior* (pp. 49–66). New York: Elsevier.

Orians, G. H. (1986). An ecological and evolutionary approach to landscape aesthetics. In E. C. Penning-Rowsell & D. Lowenthal (Eds.), *Landscape meanings and values* (pp. 3–25).

London: Allen and Unwin.

Orr, D. W. (1993). Love it or lose it: The coming biophilia revolution. In S. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 415–440). Washington, DC: Island Press.

Palmer, J. F., & Zube, E. H. (1976). Numerical and perceptual landscape classification. In E. H. Zube (Ed.), *Studies in landscape perception* (pp. 70-142). Amherst: University of Massachusetts, Institute for Man and Environment.

Parsons, R. (1995). Conflict between ecological sustainability and environmental aesthetics: Conundrum, canard or curiosity. *Landscape and Urban Planning, 32*(3), 227–244.

Partridge, L. (1974). Habitat selection in titmice. *Nature, 247*(5442), 573–574.

Partridge, L. (1978). Habitat selection. In J. R. Krebs & N. B. Davies (Eds.), *Behavioral ecology: An evolutionary approach* (pp. 351–376). Oxford: Blackwell.

Paton, P. W. C. (1994). The effect of edge on avian nest success: How strong is the evidence? C*onservation Biology, 8*(1), 17–26.

Payne, L. L., Mowen, A. J., & Orsega-Smith, E. (2002). An examination of park preferences and behaviors among urban residents: The role of residential location, race, and age. *Leisure Sciences, 24*(2), 181–198.

Pfeiffer, J. E. (1985). *The emergence of humankind.* New York: Harper & Row.

Philipp, S. F. (1993). Racial differences in the perceived attractiveness of tourism destinations, interests, and cultural resources. *Journal of Leisure Research, 25*(3), 290–304.

Pigram, J. J., & Jenkins, J. M. (1999). *Outdoor recreation management.* London: Routledge.

Pitt, D. G. (1989). The attractiveness and use of aquatic environments as outdoor recreation places. In I. Altman & E. H. Zube (Eds.), *Human behavior and environment: Vol. 10. Public places and spaces* (pp. 217–254). New York: Plenum.

Plutchik, R. (1980). *Emotion: A psychoevolutionary synthesis.* New York: Harper & Row.

Plutchik, R. (1991). *The emotions: Facts, theories, and a new model.* Lanham, MD: University Press of America.

Popper, K. R. (1959). *The logic of scientific discovery*. New York: Harper & Row.

Poschlod, P. J., Bakker, S. B., & Fischer, S. (1996). Dispersal of plants in fragmented landscapes: Changes of dispersal processes in the actual and historical man-made landscape. In J. Setteles, C. Margules, P. Poschlod, & K. Henle (Eds.), *Species survival in fragmented landscapes* (pp. 123–127). Dordrecht, Netherlands: Kluwer Academic.

Power, T. G. (2000). *Play and exploration in children and animals.* Mahwah, NJ: Lawrence Erlbaum Associates.

Proshansky, H. M. (1976). The appropriation of space. In P. Korosec-Serfaty (Ed.), *Appropriation of space* (pp. 31–45). Strasbourg: Institut Louis Pasteur.

Proshansky, H. M., Fabian, A. K., & Kaminoff, R. (1983). Place-identity: Physical world socialization of the self. *Journal of Environmental Psychology, 3*(1), 57–83.

Purcell, A. T., Lamb, R. J., Mainardi Peron, E., & Falchero, S. (1994). Preference or preferences for landscape? *Journal of Environmental Psychology, 14*(3), 195–209.

Real, E., Arce, C., & Sabucedo, J. M. (2000). Classification of landscapes using quantitative and categorical data, and prediction of their scenic beauty in north-western Spain. *Journal of Environmental Psychology, 20*(4), 355–373.

Reynolds, P. C. (1981). *On the evolution of human behavior: The argument from animal to man*. Berkeley: University of California Press.

Ricklefs, R. E. (1990). *Ecology*. New York: W. H. Freeman & Company.

Ridley, M. (1997). *Origins of virtue: Human instincts and the evolution of cooperation.* New York: Viking Penguin.

Ridley, M. (2003). *Nature via nurture: Genes, experience, and what makes us human.* New York: HarperCollins.

Riitters, K. H., O'Neill, R. V., Hunsaker, C. T., Wickham, J. D., Yankee, D. H., Timmins, S. P., et al. (1995). A factor analysis of landscape pattern and structure metrics. *Landscape Ecology, 10*(1), 23–39.

Rossman, B. B., & Ulehla, Z. J. (1977). Psychological reward values associated with wilderness use: A functional reinforcement approach. *Environment and Behavior, 9(1),* 41–66.

Sack, R. D. (1983). Human territoriality: A theory. *Annals of the Association of American Geographers, 73*(1), 55–74.

Schmiegelow, F. K. A., & Mönkkönen. M. (2002). Habitat loss and fragmentation in dynamic landscapes: Avian perspectives from the boreal forest. *Ecological Application, 12*(2), 375–389.

Schneider, J. E. (2006). Metabolic and hormonal control of the desire for food and sex: Implications for obesity and eating disorders. *Hormones and Behavior, 50*(4), 562–571.

Schoggen, P., & Schoggen, M. (1985). Play, exploration, and density. In J. F .Wohlwill & W. van Vliet (Eds.), *Habitats for children: The impacts of density* (pp. 77–95). Hillsdale, NJ:

Lawrence Erlbaum Associates.

Schreyer, R., & Beaulieu, J. T. (1986). Attribute preferences for wildland recreation settings. *Journal of Leisure Research, 18*(4), 231–247.

Scott, J. P. (1958). *Animal behavior*. Chicago: University of Chicago Press.

Seligman, M. E. P. (1970). On the generality of the laws of learning. *Psychological Review, 77*(5), 406–418.

Shafer, E. L., Jr., & Mietz, J. (1969). Aesthetic and emotional experiences rate high with northeast wilderness hikers. *Environment and Behavior, 1*(2), 187–197.

Shafer, E. L., Jr., & Mietz, J. (1970). *It seems possible to quantify scenic beauty in photographs* (Res. Pap. NE-162). Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station.

Shelby, B., & Heberlein, T. (1984). A conceptual framework for carrying capacity determination. *Leisure Sciences, 6*(4), 433–451.

Sheppard, E. S. (1995). Modeling and predicting aggregate flows. In S. A. Hanson (Ed.), *The geography of urban transportation* (pp. 100–128). New York: Guilford Press.

Smith, E. O. (1978). A historical view of the study of play: Statement of the problem. In E. O. Smith (Ed.), *Social play in primates* (pp. 1–32). New York: Academic Press.

Sommer, R. (2003). Trees and human identity. In S. Clayton & S. Opotow (Eds.), *Identity and the natural environment: The psychological significance of nature* (pp. 179–204). Cambridge, MA: MIT University Press.

Stacey, P. B., & Taper, K. (1992). Environmental variations and the persistence of small populations. *Ecological Applications, 2*(1), 18–29.

Stankey, G. H., Cole, D. N., Lucas, R. C, Petersen, M. E, & Frissell, S. S. (1985). *The Limits of Acceptable Change (LAC) system for wilderness planning* (Gen. Tech. Rep. INT–176). Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station.

Strumse, E. (1994). Environmental attributes and the prediction of visual preferences for agrarian landscapes in western Norway. *Journal of Environmental Psychology, 14*(4), 293–303.

Symons, D. (1978). *Play and aggression: A study of rhesus monkeys*. New York: Columbia University Press.

Talbot, J. F., & Kaplan, R. (1984). Needs and fears: The response to trees and nature in the inner city. *Journal of Arboriculture, 10*(8), 222–228.

Tress, B., & Tress, G. (2001). Bridging human and natural sciences in landscape research. *Landscape and Urban Planning, 57*(3/4), 137–141.

Thorne, J. F., & Huang, C-S. (1991). Toward a landscape ecological aesthetic: Methodologies for designers and planners. *Landscape and Urban Planning, 21*(1/2), 61–79

Tuan, Y. (1974). *Topophilia: A study of environmental perception, attitudes and values.* Englewood Cliffs, NJ: Prentice-Hall.

Tuan, Y. (1976). Humanistic geography. *Annals of the Association of American Geographers, 66*(2), 266–276.

Tuan, Y. (1977). *Space and place: The perspective of experience.* Minneapolis: University of Minnesota Press.

Tuan, Y. (1980). Rootedness versus sense of place. *Landscape, 24*(1), 3–8.

Turner, M. G. (1989). Landscape ecology: The effect of pattern on process. *Annual Review of Ecology and Systematics, 20*(Nov.), 171–197.

Turner, M. G., Gardner, R. H., & O'Neill, R. V. (2001). *Landscape ecology in theory and practice: Pattern and process.* New York: Springer-Verlag.

Turner, S. J., O'Neill, R. V., Conley, W., Conley, M. R., & Humphries, H. C. (1991). Pattern and scale: Statistics for landscape ecology. In M. G. Turner & R. H. Gardner (Eds.), *Quantitative methods in landscape ecology* (pp. 17–49). New York: Springer-Verlag.

Ulrich, R. S. (1977). Visual landscape preference: A model and application. *Man-Environment Systems, 7*(5), 279–293.

Ulrich, R. S. (1983). Aesthetic and affective response to natural environment. In I. Altman & J. F. Wohlwill (Eds.), *Human behavior and environment: Vol. 6. Behavior and the natural environment* (pp. 85–125). New York: Plenum.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, *224*(4647), 420–421.

Ulrich, R. S. (1986). Human responses to vegetation and landscapes. *Landscape and Urban Planning, 13*(1), 29–44.

Ulrich, R. S. (1993). Biophilia, biophobia, and natural landscapes. In S. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 73–137). Washington, DC: Island Press.

Ulrich, R. S. (1999). Effects of gardens on health outcomes: Theory and research. In C. C. Marcus (Ed.), *Healing gardens: Therapeutic benefits and design recommendations* (pp. 27–86). New York: John Wiley & Sons.

van der Zande, A. N., Berkhuizen, J. C., van Latesteijn, H. C., ter Keurs, W. J., & Poppelaars, A. J. (1984). Impact of outdoor recreation on the density of a number of breeding bird species in woods adjacent to urban residential areas. *Biological Conservation, 30*(1), 1–39.

van der Zande, A. N., & Vos, P. (1984). Impact of a semi-experimental increase in recreation intensity on the densities of birds in groves and hedges on a lake shore in The Netherlands. *Biological Conservation, 30*(3), 237–259.

Vining, J., & L. Fishwick, L. (1991). An exploratory study of outdoor recreation site choices. *Journal of Leisure Research, 23*(2), 114–132.

von Schiller, F. (1905). *Essays aesthetical and philosophical.* London: George Bell & Sons.

Wagar, J. A. (1964). *The carrying capacity of wild lands for recreation* (Forest Science Monograph No. 7). Washington, DC: Society of American Foresters.

Washburne, R. F. (1982). Wilderness recreation carrying capacity: Are numbers necessary? *Journal of Forestry, 80*(11), 726–728.

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intention engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin, 132*(2), 249–268.

Wecker, S. C. (1964). Habitat selection. *Scientific American, 211*(4)*,* 109–116.

Welker, W. (1978). Ontogeny of play and exploratory behaviors: A definition of problems and a search for new conceptual solutions. In D. Müller-schwarze (Ed.), *Benchmark papers in animal behavior*: *Vol. 10. Evolution of play behavior* (pp. 181–206). Stroudsburg, PA: Dowden, Hutchinson & Ross.

Whisman, S. A., & Hollenhorst, S. J. (1998). A path model of whitewater boating satisfaction on the Cheat River of West Virginia. *Environmental Management, 22*(1), 109–17.

Williams, D. R., & Patterson, M. (1996). Environmental meaning and ecosystem management: Perspectives from environmental psychology and human geography. *Society and Natural Resources, 9*(5), 507–521.

Williams, D. R, Patterson, M. E., Roggenbuck, J. W., & Watson, A. E. (1992). Beyond the commodity metaphor: Examining emotional and symbolic attachment to place. *Leisure Sciences, 14*(1), 29–46.

Williams, K. J. H., & Cary, J. W. (2002). Landscape preference, ecological quality and biodiversity protection. *Environment and Behavior, 34*(2), 257–274.

Wilson, E. O. (1975). *Sociobiology: The new synthesis*. Cambridge, MA: Harvard University Press.

Wilson, E. O. (1978). *On human nature.* Cambridge, MA: Harvard University Press.

Wilson, E. O. (1984). *Biophilia.* Cambridge, MA: Harvard University Press.

Wohlwill, J. F. (1973). The environment is not in the head! In W. F. E. Preiser (Ed.), *Environmental design research: Vol. 2* (pp. 166–181). Stroudsburg, PA: Dowden, Hutchinson & Ross.

Wohlwill, J. F. (1976). Environmental aesthetics: The environment as a source of affect. In I. Altman and J. F. Wohlwill (Eds.), *Human behavior and environment: Vol. 1* (pp. 37–85). New York: Plenum.

Wynne-Edwards, V. C. (1962). *Animal dispersion in relation to social behavior.* New York: Hafner.

Wynhoff, I. Oostermeijer, J. G. B., Scheper, M., & van der Made, J. G. (1995). Effects of habitat fragmentation on the butterfly *Maculinea alcon* in The Netherlands. In J. Settele, C. Margules, P. Poschlod, & K. Henle (Eds.), *Survival in fragmented landscapes* (pp. 15–23). London: Kluwer Academic.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist, 35*(2), 151–175.

Zube, E. H. (1976). Perception of landscape and land use. In I. Altman & J. F. Wohlwill (Eds.), *Human behavior and environment: Vol. 1* (pp. 87–121). New York: Plenum.

Zube, E. H., Pitt, D. G., & Anderson, T. W. (1975). Perception and prediction of scenic resource values of the Northeast. In E. H. Zube, R. O. Brush, & J. G. Fabos (Eds.), *Landscape assessment: Values, perceptions, and resources* (pp. 151–167). Stroudsburg, PA: Dowden, Hutchinson & Ross.

Appendix A

SAMPLE OF PHOTO ORGANIZER*

M74		
		
M74_1_268	M74_2_315	M74_3_4
		
M74_4_30	M74_5_292	M74_6_340
M75		
		
M75_1_103	M75_2_153	M75_3_199
		
M75_4_237	M75_5_128	M75_6_177

Note. *The layout size and resolution have been adjusted to accommodate the thesis format.

Appendix B

FACILITATOR OF PHOTO ELECTION

The device for facilitating photo election (refer to the picture below). Candidate photos were sorted on self-made white boards and bound using celluloid bands at the bottom, to facilitate review in the lab.

Appendix C

ANGLE TRANSFORMATION BETWEEN THE COORDINATE SETTINGS OF THE COMPASS AND ARCGIS

System	Angle Transformation in Coordinate																																												
Compass	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90
ArcGIS	*90*	*88*	*86*	*84*	*82*	*80*	*78*	*76*	*74*	*72*	*70*	*68*	*66*	*64*	*62*	*60*	*58*	*56*	*54*	*52*	*50*	*48*	*46*	*44*	*42*	*40*	*38*	*36*	*34*	*32*	*30*	*28*	*26*	*24*	*22*	*20*	*18*	*16*	*14*	*12*	*10*	*8*	*6*	*4*	*2*	*0*
Compass	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120	122	124	126	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156	158	160	162	164	166	168	170	172	174	176	178	180
ArcGIS	0	358	356	354	352	350	348	346	344	342	340	338	336	334	332	330	328	326	324	322	320	318	316	314	312	310	308	306	304	302	300	298	296	294	292	290	288	286	284	282	280	278	276	274	272	270
Compass	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270
ArcGIS	*270*	*268*	*266*	*264*	*262*	*260*	*258*	*256*	*254*	*252*	*250*	*248*	*246*	*244*	*242*	*240*	*238*	*236*	*234*	*232*	*230*	*228*	*226*	*224*	*222*	*220*	*218*	*216*	*214*	*212*	*210*	*208*	*206*	*204*	*202*	*200*	*198*	*196*	*194*	*192*	*190*	*188*	*186*	*184*	*182*	*180*
Compass	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318	320	322	324	326	328	330	332	334	336	338	340	342	344	346	348	350	352	354	356	358	360
ArcGIS	*180*	*178*	*176*	*174*	*172*	*170*	*168*	*166*	*164*	*162*	*160*	*158*	*156*	*154*	*152*	*150*	*148*	*146*	*144*	*142*	*140*	*138*	*136*	*134*	*132*	*130*	*128*	*126*	*124*	*122*	*120*	*118*	*116*	*114*	*112*	*110*	*108*	*106*	*104*	*102*	*100*	*98*	*96*	*94*	*92*	*90*

Appendix D

SAMPLE OF THE SURVEY QUESTIONNAIRE

The original questionnaire size is 11 by 17 inches. There are 31 types of questionnaire. Each type of questionnaire consists of 5 reference and 3 baseline photos. The following page only shows one type of questionnaire.

PENNSTATE
Health & Human Development
Recreation, Park and Tourism Management G6

The information you supply will greatly help park management! This survey will take about 15 minutes. Answers are strictly confidential. We highly appreciate your help. *Prof. **Alan Graefe** & **PoChing Wang**

Cont.: **E-mail**: pnw100@psu.edu; **Tel.**: 814-8612586; **Add.**: 1744 Blue Course Drive, State College, PA 16801

◆ **PLEASE TELL MORE ABOUT YOURSELF:**

■ What is your residential zip code: ____________
■ Are you: _________ Female; _________ Male
■ Year of birth: _________
■ Highest level of education: ____ High school; ____ 2-year college; ____ 4-year college; ____ Master ; ____ Doctor
■ Your approximate household income before taxes: ____________ dollars.
■ Do you consider yourself to be? ____ White, not of Hispanic origin; ____ African-American; ____ Hispanic; ____ Native American/ Alaskan Native; ____ Asian or Pacific Islander; ____ Other (please specify): ______________

◆ **COMPARE & RATE:** Based on the eight landscapes shown below, please answer each question according to a scale of …
1 (Not at all) to 9 (Very much so).

	#A	#B	#C	#D	#E	#F	#G	#H
• The elements in this landscape belong together.								
• The variety in this landscape looks just right.								
• This landscape seems to invite me to enter it more deeply.								
• It would be easy to find my way in this place.								
• I have a clear view of the surroundings.								
• I find this place comforting.								
• I feel safe here.								
• I identify with this place.								
• I can do things I like here.								
• It is easy for me to move within or through this place.								
• It is easy for me to travel with undue effort in this place.								
• I like this setting.								
• I would be pleased to be in this place.								
• I would like to explore around here.								
• I would like to relax here.								
• I would like to get to know this place better.								
• I would like to spend more time here.								

A

B

C

D

E

F

G

H

VITA

Po-Ching Wang

Po-Ching Wang's interests and expertise involve multidisciplinary experiences encompassing healthy environments and recreation/landscape ecology. He has both a professional and academic background in tourism and environmental planning, community regeneration, sustainable design, and public art. Before enrolling in Penn State's Ph.D. program in recreation, park and tourism management (with a minor in forest resources), Po-Ching was a research fellow and guest lecturer for one year and was engaged for six years in professional practice (with landscape firms and the army corps of engineers), working on tourism planning and architecture/landscape planning, design, and construction projects in communities, military bases, riparian/harbor areas, and National Scenic Areas, among others, in Taiwan. In addition to his Ph.D., Po-Ching is a master's candidate in architecture at Penn State. He received his M.S. in ecology from Penn State in 2004 and has a master's degree in landscape architecture from TungHai University, Taiwan. He received first prize in the student competition at the International Federation of Landscape Architects (IFLA) Eastern Regional Conference in 1994 and has also won several prizes in public art competitions in Taiwan.