THE IMPACT OF INVASIVE PLANTS ON THE RECREATIONAL VALUE OF FLORIDA'S AQUATIC AREAS

By

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In memory of Blanca Luzuriaga, my dear grandma

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By

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Invasive plants are impacting the regeneration and management of public and private aquatic areas. These species are considered a serious problem as they impact human uses of water resources and affect their ecological value through the degradation of water quality. In Florida the situation is one of the most severe, since invasive plants affect 96% of the state's public lakes and rivers, comprising about 1.26 million acres. This situation has had an important effect on the recreational value of Florida's aquatic areas, given that invasive plants impact natural outdoor activities such as fishing, boating, swimming among others. In turn, this restriction on recreation is having a substantial effect on the state's economy and the quality of life of its inhabitants because such activities involve millions of people who spend billions of dollars annually.

This study was intended to examine and measure the impact of invasive plants on recreational activities in aquatic areas[1] using a "multi-attribute utility model" (MAUM). A survey, electronically distributed, was applied to Florida residents. In this survey participants were asked to choose from a set of pair-wise alternatives comprising a group of attributes at

[1] Two types of areas were examined; namely, river/lake and ocean/beach parks.

varying levels, including levels and coverage of invasive species as well as other four park attributes[2] that are important when choosing recreational activities. Then, with the use of a conditional Logit model, a functional relationship between the public's utility—derived from participation on nature-based recreational activities—and the presence of invasive plants in aquatic areas in Florida was appraised.

The results showed that people assign a negative weight to the presence of invasive plants in aquatic parks, reflected in a negative marginal value for this attribute. In addition, the marginal value, derived from the "presence of invasive plants" attribute, was higher than that for the "positive attributes" (facilities, animal species and plant species). Therefore, the large negative number associated with the former indicates a strong aversion of respondents to the presence of invasive plants. It also implies that an enhancement of the "positive attributes" of a park would not be sufficient in order to reduce the harmful impact on the public's utility due to the presence of invasive plants. On the contrary, it is recommended to take direct actions in order to control and attack this problem; especially if its potential impact for the entire Florida's population is estimated in -$1,065,516,700 for ocean/beach parks and -$992,595,790 for river/lake parks per year. Hence the implementation of programs to reduce the presence of invasive plants in aquatic areas in Florida is justified. Nevertheless, the results obtained from these programs would be stronger if they are accompanied by aggressive awareness campaigns since it was determined that the impact of invasive plants on people's utility would be approximately $500 million larger in each location[3] if the population were adequately informed.

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[2] The other four attributes were: condition of facilities, diversity of animal species, diversity of plant species, and fees.

[3] In other words if the population would be well-informed, the impact due to the presence of invasive species would reach to -$1,615,092,363 for OB parks and -$1,451,284,807 for RL parks.

CHAPTER 1
INTRODUCTION

Invasive species are defined as “alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.” (Federal Register, 1999). Today there are an estimated 5,000 to 6,000 invasive species in the United States (Pimentel, 2003; Burnham, 2004) invading about 700,000 hectares of natural areas per year (Pimentel, 2000). Damages from invasive species cost government agencies and private citizens more than $138 billion per year[4], excluding ecosystem impacts (Pimentel, 2002). In the case of aquatic and wetland habitats in the United States, these species are considered a serious problem as they impact human uses of water resources and affect their ecological value through the degradation of water quality (Madsen, 1997). In Florida the situation is one of the most severe, since invasive plants affect 96% of State’s public lakes and rivers that comprise 1.26 million acres.

One specific concern about invasive species is their impact on individuals’ satisfaction when they engage in outdoor recreational activities in aquatic areas. For example, fishing attracts over 34 million participants to Florida who spend in excess of $35 billion annually (Adams and Lee, 2006). This recreational activity is affected by invasive aquatic plants (e.g., hydrilla, water hyacinth, and water lettuce), which can cover the surface of aquatic areas (e.g., rivers and lakes) driving fish away. Invasive aquatic species can also affect swimming, boating, and other recreational uses. Hence the impact on recreational activities by invasive plants in Florida’s aquatic areas can be substantial.

This study proposes to examine and measure the impact of invasive plants on recreational activities in aquatic natural areas using a multi-attribute utility model (MAUM). Study participants were asked to choose from a set of pair-wise alternatives comprising a group of

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[4] From this $138 billion, approximately $34 billion is related exclusively to the impact of invasive plants.

attributes at varying levels, including levels of invasive species coverage and other variables important to decisions about recreational activities. The MAU survey was electronically distributed to Florida residents following a prescribed methodology (Milon and Hodges, 2002; Alvarez, Sherman and VanBeselaere, 2003; Tsuge and Washida, 2003; Lee, Adams, and Rossi, 2006). Finally, with the use of a conditional Logit model (McFadden, 1974), the alternatives that visitors would prefer from a set of services were predicted. With the payment attribute included, the model also estimated the visitor's marginal willingness to pay for recreational activities in aquatic parks with fewer invasive plants and more positive attributes such as facilities and the presence of native animal and plant species. This study provides useful information for further analyses of public programs to control invasive aquatic plants in Florida.

Problem Setting

Florida possesses 1.5 million acres of lakes and rivers, including 7,700 lakes and ponds and 1,400 rivers and streams. The state also has over 1,197 miles of coastline and over 663 miles of beaches. These geographic conditions along with a favorable climate have resulted in Florida having one of the highest levels of plant diversity in the nation. Additionally the conditions that foster plant diversity also make Florida's land and water vulnerable to newly introduced (non-native) plants.

Non-native plants that overrun natural areas are called "invasive" because they thrive, spread, and take over native plant habitats aggressively. An invasive plant tends to survive because "insects, diseases, and other environmental stresses that naturally keep its growth in check in its native range are not present in its new habitat" (Center for Aquatic and Invasive Plants, 2005).

Aquatic areas in Florida are not free from this threat of invasive plants, which have caused damages such as 1) a decrease in the concentrations of dissolved-oxygen, which impacts aquatic life; 2) an increase in the amount of sediments; 3) restriction of water flow, resulting in flooding along rivers; and 4) promotion of breeding environments for mosquitoes and other bothersome insects (Florida Department of Environmental Protection).

All these ecological impacts have also an important effect on the recreational value of Florida's aquatic areas, since they restrict natural outdoor activities such as fishing, boating, and swimming. This restriction on recreation activities, in turn, will have a substantial impact on the state's economy and the quality of life of its inhabitants, since involve millions of people who spend billions of dollars annually.

All these arguments justify the importance of examining and measuring the impact invasive plants have on recreational activities in Florida's aquatic areas as a means to help reduce their effect on the state's economy and people's quality of life.

Objectives

The general objective of this study is to appraise the value that Florida's population gives the problem of invasive plants through the determination of a functional relationship between the public's utility—derived from participation on nature-based recreational activities—and the presence of invasive plants in aquatic areas in Florida.

Along with the general objective the study has three specific objectives:

- To identify and select three relevant attributes for valuing recreation in aquatic areas in Florida.
- To determine the extent of knowledge of Florida's residents about invasive plants in order to establish the necessary information that should be provided to the public to obtain an informed value of the invasive plants problem in aquatic areas in Florida.
- To design a multi-attribute utility survey based on the selected attributes, in order to estimate the relationship between the value of recreational use and the presence of invasive plants in Florida's aquatic areas.

Hypotheses

The following hypotheses were evaluated in this study:

- The public assigns a negative value to the presence of invasive plants, reflected in less willingness to pay when residents engage in recreational activities in aquatic areas with a high presence of invasive plant species.
- The value that the public assigns to the problem of invasive plants, though important, is inferior in absolute value when compared to the assessment that the public gives to other attributes and services that these aquatic areas provide.
- The value that the public assigns to the presence of invasive plants is contingent on the level and extent of knowledge that they have about this problem and their previous experience.
- The public's demographic characteristics will influence their expressed assessment of value to the problem of the presence of invasive plants in aquatic areas in Florida.

Literature Review

In this section relevant literature related to the measurement of the economic value of natural amenities as well as studies related to the economic impact of invasive species and their implications for recreational activities will be analyzed. For this purpose we have divided this section in three parts. The first in which literature about economic assessment of natural amenities is analyzed; a second part in which relevant literature about the general economic impact of invasive species is discussed and finally a section in which it is summarized the most important studies about the specific economic impact of invasive species on recreational activities.

Economic Assessment of Natural Amenities

The literature about valuation of natural environments based upon various forms of outdoor recreation activities is extensive. Two of the most complete reviews about these works are the survey paper of Walsh et al. (1992), which collects most of the literature available until

1989, and the Rosenberger and Loomis (2001) study, which summarizes all the relevant literature from 1967 to 1998 (covering 21 recreational activities).

One of the most complete analysis of the demand and value of outdoor recreation in the United States is the study of Bergstrom and Cordell (1991). In this study using a travel cost for activities related exclusively to aquatic parks the recreational value for these parks was estimated. The average recreational value was of $19.28 per person per day (ppd). Previously Bergstrom et al. (1990) had established (using contingency valuation) that the recreation value of general activities was of $15.19 ppd.

In 1990 McCollum et al determined the net economic value of recreation on the national forests using twelve types of primary activities across nine Forest Service regions. The estimated values ranged from $3.04 ppd for camping to $30.04 ppd for hiking. In this specific study, it was also established that the recreational value for fishing ranged from $8.35 ppd to $24.08 ppd.

Waddington et al. (1991), using contingent valuation, determined the net economic values for bass and trout fishing, deer hunting, and wildlife watching. The most important conclusion of this study was that hunting has the highest value among all the outdoor recreational activities; though it was also found that fishing has an important value for visitors of natural areas. This last finding is strengthened by other studies such as: McConnell (1979); Vaughan and Russell (1982); and Rowe, et al. (1985); which reports values as high as $86 ppd for this specific activity.

In the specific case of Florida, Milon et al. (1986) studied the fishing activity in Orange and Lochloosa Lakes and found that local fishermen spent in a range of $21 ppd to $43 ppd. Whereas the range for non-local fishers was substantially higher; that is, it was between $93 ppd and $192 ppd. Later on, Milon and Welsh (1989) in another study of Lakes Harris and Griffin in

Lake County, Florida, found that expenditures in fishing activities were as high as the values found in the previous study, with an average of $24.25 ppd for local fishermen, $67 ppd for other Florida fishermen and $91 ppd for non-Florida fishermen. This study also found the willingness to pay to assure the condition of the lakes at $41 per person per year.

All these studies demonstrated the importance of natural recreation activities for the US economy as well as the fact that the economic relevance of these activities is closely related to the natural processes and environmental conditions of landscapes. Thus any disruption in these processes and/or conditions of any natural area can produce a serious impact on visitors' welfare through a diminishing in their utility when engaging in recreational activities. This provides the correct justification to analyze how a biological problem such as the invasive species presence has an extensive impact on the economy of Florida and their population's welfare.

General Economic Impact of Invasive Species

One of the first relevant attempts to measure the ecological and economic impacts of invasive species was the research report, compiled by the Office of Technology Assessment (OTA) of the U.S. Congress in 1993 titled "Harmful Non-Indigenous Species in the United States." In this report, 54 non-indigenous plant species (NIS) were analyzed. From these plants, it was established that the most harmful are the Salt Cedar, Purple Loosestrife, Melaleuca, and Hydrilla. For example, in the specific case of Melaleuca, the OTA determined that this species has degraded the Florida Everglades wetlands system rapidly by "out-competing indigenous plants and altering topography and soils." The OTA study estimated a cumulative loss from invasive plants' damages as a minimum of approximately $600 million, with a worst-case scenario of $4.6 billion.[5] One important conclusion of this study was that the effect of invasive

[5] The total value estimated in this study for the impact of all the types of invasive species was $96 billions or $134 billions in a worst-cast scenario.

species in Florida and Hawaii is unusually serious in each place and it requires more attention and urgent actions than in other states. It was determined that in Hawaii and Florida, "the problem has been particularly hard because of their distinctive geography, climate, history, and economy." Another important finding provided in this study was that in the United States a total of $100 million is invested annually to control invasive aquatic species.

In 2000, David Pimentel et al. from the College of Agriculture and Life Sciences of Cornell University published a study in which they attempted to estimate the costs of the impact of invasive species in United States. They estimated that the total number of invasive species in the U.S. is approximately 5,000, which was later updated to over 6,000 species (Burnham, 2004). One of the most important findings of Pimentel et al. (2000) was that invasive plant species are spreading and invading approximately 700,000 hectares of U.S. natural areas per year. They established that, in the specific case of Florida, "exotic aquatic plants such as hydrilla, water hyacinth, and water lettuce are altering fish and other aquatic animal species, choking waterways, altering nutrient cycles, and reducing recreational use of rivers and lakes." Florida spends about $14.5 million each year on hydrilla control; however, there are specific cases (Lake County and Lake Harris) in which hydrilla infestations have caused an estimated $10 million in lost recreational income annually (Center, et al. 1997). But besides all these important facts, the most important contribution of the Pimentel et al. (2000) study was a new estimation of the total economic damages and associated control costs for the U.S. due to invasive species, which was about $138 billion annually, from which $35 billion is exclusively from the impact of invasive plants.

Edward Evans (2003) outlined the importance of understanding the economic dimensions of the problem of invasive species. He established that the causes of biological invasions are often related to economic activities. Furthermore, he also stated that the economic consequences of this problem are not only related to direct control costs and damages but also to other areas such as nutrition, prices, and market effects. Finally, he stressed that the most important solutions to the invasive species problem must be "firmly grounded in both science and economics," as economics has the "capacity to value various market and non-market impacts and provides a means for assessing important tradeoffs among various management alternatives, which can improve greatly the decision-making process" (Evans, 2003). Evans' argument is strengthened by other authors such as Shogren (2000) and Perrings, et al. (2002), who also addressed the importance of incorporating economics into the impact analysis of invasive species, with the idea that both the "solutions and causes of the invasive species problem are economic in nature and, as such, require economic solutions" (Shogren, 2000). Additionally, they also developed the idea that "the exclusion and control of invasive species can be considered as a public good" (Perrings, et al., 2000). Consequently, for successful control and management, it is necessary to build incentives in society "to change human behavior so as to enhance protection against the introduction, establishment, and spread of invasive species" (Shogren, 2000).

Specific Economic Impact of Invasive Species on Recreational Activities

In the specific case of the impact of these species on recreational activities, the literature is diverse (Milon, et al., 1986; Milon and Joyce, 1987; Colle, et al., 1987; Milon and Welsh, 1989; Newroth and Maxnut, 1993; Henderson, 1995; and Bell 1998).

In 1987 Colle, et al. determined that hydrilla "forms dense canopies at the water surface that raise surface water temperatures, changes pH, excludes light, and consumes oxygen, resulting in native plant displacement and stunted sport fish populations"; these biological effects can expand up the point that they affect recreation negatively, as well as businesses that depend upon recreation to make a living.

One the most important contributions in the economics literature related to the impact of invasive species on recreation activities has been the determination of B/C ratios, based on the impacts on recreation expenditures, due to the presence of these species and their control costs. These analyses found different B/C values, among which we have: Singh, et al. (1984), from 8:1 to 24:1 (24:1 to 91:1 adjusted); Colle, et al. (1987) from 1:1 to 300:1; Newroth and Maxnut (1993) 243:1; and Milon (1986 and 1987) 10:1. These ratios have facilitated the task of determining the benefits derived from invasive aquatic control and their cost of implementation and management. This can be regarded as an important tool for policy decisions about investing in control programs for these noxious species. As a result Rockwell (2003), using these B/C ratios, determined the benefits of controlling invasive species, first for the state of Florida and later for the entire U.S. The control benefits for Florida were estimated to be $250 million. This value was obtained using an inflation-adjusted estimation of $25 million for the cost of treating invasive species and a Benefit/Cost (B/C) rate of 10:1. This B/C ratio came from the total-recreation-expenditures to willingness-to pay relationship established in the two studies of Walter Milon's (1986 and 1987). For the U.S. case, Rockwell (2003) extrapolated the results for Florida and determined that the national impact of aquatic invasive species is in the range of $500 million to $1 billion.

Methods and Procedures

In this part we will explain two different methodologies utilized for valuing public goods or goods that lack explicit markets. These methods differ in their assumptions as well as in their data origin and collection method. Revealed preference data are obtained from the past behavior of consumers, while stated preference data are collected through surveys.

Revealed Preference Methods

These methods are grounded in Paul Samuelson's revealed preference theory (1938), which states that it is possible to discern people's preferences on the basis of their behavior. That means that people's preferences can be revealed by their habits and decisions. Hence if we note that a person chose the bundle px^1 over the bundle px^0 (this relationship can be expressed as $px^1 \geq px^0$), then it can be inferred that the utility of x^1 must be at least as large as the utility of x^0 ; that is, $u(x^1) \geq u(x^0)$. In this case it can be said that x^1 is revealed preferred to x^0. Additionally, if the condition is established as $px^1 > px^0$ and as a consequence $u(x^1) > u(x^0)$, we can say that x^1 is strictly revealed preferred to x. To sum up, a preference is revealed when people confronted with two affordable consumption bundles x^0 and x^1, and x^1 is chosen and x^0 not, even though they have the same price p.

Hence methods based on revealed preferences use observations of the actual choices made by people in order to measure their preferences. These methodologies are also called indirect valuation methods, since in the case of non-market goods they rely on the price or cost of surrogate goods or services to reveal the public's willingness to pay for the non-market goods.

The advantage of this methodology is that it relies on actual choices, making it more reliable than those methods associated with hypothetical responses. However their disadvantage is that these methods are not viable when we want to analyze changes that may lie outside of the actual state of the world; that is, outside of the current set of experience of the people. To be precise, these methods are largely limited to observable states of the world.

Stated Preferences Methods

These methods have two important characteristics: first, they ask people explicitly to state their preferences instead of using actual behaviors (which in this case are not observed), and second, they rely heavily on hypothetical scenarios. In other words, these methodologies build their information from people's answers to propositions in which they are asked to judge one or more hypothetical options and to express their preferences for them.

These methods are suitable when there are not proxy markets from which to estimate revealed preference values. In other words the complementary relation between a market and non-market required for applying revealed preference methods does not exist. Additionally, for the specific case of a non-market good, "non-use values" can only be estimated by stated preference techniques, which are an important limitation for revealed preference methods, given the importance of this value component for non-market goods.[6] The stated preferences methods can be classified in two categories: contingent valuation techniques (CV) and multi-attribute techniques.

Contingent Valuation Techniques (CV)

Direct survey techniques, which obtain information from people through their valuation for different outcomes. This technique permits us to elicit people's preferences for non-market goods by finding out what their willingness to pay is for specified improvements in these goods. The main assumption of this technique is that the stated willingness to pay is consistently related to people's actual preferences.

The first contingent valuation study was conducted by Davis (1963) to estimate the value of hunting in Maine; and since that time results from CV have raised skepticism and criticism. Among the critiques one of the most known was the argument stated by Scott (1965) who

[6] Non-use values are values expressed by humans for environmental resources that are unrelated to human use. These values include concern, sympathy, and respect for the rights or welfare of non-human beings (Hajkowicz, et al., 2000).

concluded that this methodology was an inaccurate short cut in which through “hypothetical questions” the only thing that the researcher may get was “hypothetical answers”.

Later on, diverse studies appeared in which estimations of willingness to pay obtained from CV were similar to those obtained from other methods such as travel cost and cash transaction models; this has provided certain level of validity to this methodology (Carmines and Zeller, 1979). It is important to take into consideration that in the last decade this methodology has increased its academic acceptation. A proof of that is the increasing number of journals where CV studies have been published in both the economic field as well as in other academic disciplines (Hanemann, 1984 and Randall, 1998).

Multi-Attribute Techniques (MA)

Survey based methodologies for modeling preferences for goods, which are described in terms of an explicit combination of their attributes at designated levels. In other words, people express their preferences using simultaneously all the dimensions that define any non-market good. These methodologies ask people to rank, rate, or choose the best option from a bundle of similar goods, based on a set of relevant attributes at a range of specified levels. To sum up the objective of a MA study is to estimate economic values for a technically divisible set of attributes of a good.

These methods offer an important advantage over CV techniques, in that they permit us to estimate the incremental benefits that consumers derive from the different relevant attributes of a non-market good; that is, provide detailed information about public preferences for multiple states of the good. Additionally it allows the characterization of people’s underlying utility function for any non-market good or service.

The foundation for the MA techniques is the “hedonic methods” which state that the demand for goods is derived from the combination of their attributes. The basic approach of the hedonic method is that any good is really a bundle of attributes; thus even though people pay a bundled price for the good they are really paying for a mix of individual attributes. One of the first theoretical foundations for hedonic models was articulated by Lancaster (1966) who developed a model of characteristics, in which it was stated that consumers care only about the intrinsic characteristics of goods. Therefore consumers purchase these goods because they deliver a “desired characteristic mix,” adjusting appropriately for prices.

Luce and Tukey (1964) also proposed a measurement technique in which the utility derived from a good can be estimated from decomposing judgments regarding a set of complex alternatives into the sum of weights on attributes of the alternatives. This method known as “conjoint measurement” was rapidly accepted by marketing researchers. They recognized its value since it provides information about the relative importance of goods’ attributes necessary when designing new products. Additionally including price as an attribute in these MA methodologies permits the estimation of economic welfare measures such as the willingness to pay.

Implementation of a MA analysis should follow the seven steps suggested by Adamowicz, Louviere, and Swait, 1998; and Louviere, Hensher and Swait, 2000:

- Identify the economic problem
- Identify and describe the most relevant attributes that impact the utility of people.
- Develop an experimental design in order to construct the alternatives that will be presented to the respondents.
- Develop the questionnaire
- Collect the data
- Estimate the model econometrically and with that determine welfare measures and/or predictions of behavior.

- Interpret the results for policy analysis and decision support based on these welfare measures and/or predictions of behavior.

It is important to emphasize that in any MA analysis the most important step is to determine the appropriate attributes for the decision, since they are the core of the decision problem. These attributes must satisfy the following requirements:[7]

- Each attribute should reflect an independent dimension of the good in order to avoid redundancy.
- The attributes must be measurable and easy for respondents to understand.
- Theoretically, the number of attributes that can be utilized in a MA analysis is unlimited, but due to the restricted cognitive skills and memory of most people, the number of attributes in practice should not be more than nine.

In this study a MA technique will be applied through the application of a survey in which respondents were requested to value trade-off changes in attribute levels against the cost of making these changes. This will be applied in a framework of random utility maximization, in which it is assumed that the utility is the sum of systematic (ϕ) and random components (ε_j):

(1-1) $U_j = \phi\ (x_j, p_j; \beta) + \varepsilon_j$

where U_j is the indirect utility associated with profile j, x_j is a vector of attributes associated with profile j, p_j is the price of profile j, β is a vector of preference parameters, and ε_j is a random error term with zero mean.

Choice behavior is deterministic from the perspective of the individual but from the researcher perspective this behavior is random; thus the error term ε represents uncertainty about the choice. Additionally it is assumed that the utility is defined by a lineal function:

(1-2) $$U_j = \sum_{k=1}^{n} \beta_k x_{jk} + \beta_p p_j + \varepsilon_j$$

[7] Following from Keeney and Raiffa, 1976; Louviere, 1988; Saaty, 1980; de Palma, et al. 1994; and Miller, 1956.

where β_k is the preference parameter associated with the attribute k; x_{jk} is the k^{th} attribute in profile j, and β_p is the cost parameter. By differentiating (1-2) we found that each preference parameter β represents marginal utilities derived from each attribute:

$$(1\text{-}3) \qquad \beta_k = \frac{\partial U}{\partial x_k}$$

The parameter β_p is interpreted as the marginal utility of money because an increase in the price decreases individual wealth. β_p gathers the change in utility associated with a marginal decrease in wealth; thus it is expected that the sign of β_p be negative. Finally the marginal value of attribute k is computed as the ratio $-\beta_k/\beta_p$

In order to estimate the preference parameters econometric techniques parallel to the theory of rational and probabilistic choice will be applied. These types of models are called discrete-choice models, particularly formulated for economic analysis by McFadden (1974).

The conceptual foundation for McFadden's model lay in Thurstone's (1927) idea of random utility, Luce's choice axiom (1959) and the random utility model proposed by Marschak (1960). Using this framework McFadden developed an econometric model that combines hedonic analysis and random utility maximization. This model is known as the conditional (multinomial) *Logit*, which allows us to determine the effects of explanatory variables on a subject's choice of one of a discrete set of options.

In this methodology the choice problem is established in a way in which we ask respondents to choose the most preferred alternative from a choice set. Respondents focus their attention on the trade-off of attributes and the different levels that they can take. Then the model estimates will be based on utility differences among the alternatives. Thus the probability that a subject choose alternative i instead of alternative j will be expressed as:

(1-4) $$P(i|C) = P(U_i > U_j) = P(\phi_i + \varepsilon_i > \phi_j + \varepsilon_j), \forall j \in C$$

where C contains all of the alternatives in the choice set, U_i and U_j is the indirect utility associated with profile i and j, ϕ_i and ϕ_j are the systematic components of the utility, and ε_i and ε_j are the random components of the indirect utility. Equation (1-4) can be arranged in the following way:

(1-5) $$P(i|C) = P(U_i > U_j) = P(\phi_i - \phi_j > +\varepsilon_j - \varepsilon_i), \forall j \in C$$

Hence the probability that i is preferred to j depends on the probability that the differences between the systematic components (ϕ_i and ϕ_j) is greater than the difference between the random components (ε_i and ε_j). An econometrical specification of concepts provided in equations (1-4) and (1-5) is the following

(1-6) $$P(i|C) = \frac{e^{(\sum_{k=1}^{n} \beta_k x_{ik} + \beta_p p_i)}}{\sum_{j \in C_i} e^{(\beta_k x_{jk} + \beta_p p_j)}}$$

where x_{ik} denotes the values of the k explanatory variables (non-monetary attributes) conditional on the set C_i, which represents all the alternatives in the choice set of response; β is the vector of coefficients (weights) for the non-monetary attributes; and p_i and β_p is the cost attribute and its respective coefficient.

This choice-based methodology has proved to be useful for modeling use values as well as non-use values, which it is valuable for different analyses that range from policy/program evaluations (Viscusi et al. 1991; Hanley et al. 1998; Hanley, Wright and Adamowicz 1998) to recreational choice site studies (Boxall et al. 1996). In our case we will apply this model to determine how the value derived from outdoor recreation activities is affected by the presence of invasive plants, as a “negative” attribute in the random utility function of the average Floridian visitor. In other words this model will allow us to determine the trade-off between positive and negative attributes (invasive species) as well as their weight or relative importance.

CHAPTER 2
PUBLIC AWARENESS OF INVASIVE PLANTS IN FLORIDA

Introduction

In this chapter we will analyze the extent of Florida residents' knowledge about invasive plants; how this knowledge influences their enjoyment of outdoor activities and where they choose to pursue them. In addition, the main factors that influence the level of residents' knowledge about invasive plants will also be determined.

The conclusions obtained in this chapter will facilitate the design of a multi-attribute survey about invasive plants in Florida. In particular, through these findings it will be possible to determine the type and degree of information that the survey needs to provide in order to obtain accurate and unbiased responses about the value that Floridians ascribe to this problem.

Description of the Survey Process

The primary information about public awareness of invasive plants in Florida was collected through a Web survey of randomly selected Florida residents. For this preliminary survey, Expedite Email Marketing was selected to perform the e-mail broadcast through a cover letter (Appendix A). This letter contained an invitation to take the survey as well as a link to the Web address containing the survey (in this case SurveyMonkey.com). The survey (Appendix B) consisted of thirteen questions related specifically to the topic and nine questions about respondents' socio-economic characteristics.

The questions related to the topic of public awareness of invasive plants in Florida can be divided in the following four groups: 1) questions about respondents' residence status in Florida, 2) questions about the extent of knowledge of invasive plants that respondents think they have, 3) questions to establish the true degree of respondents' knowledge about invasive plants, and 4) questions to determine if respondents have been affected by invasive plants in their enjoyment of outdoor activities and where they pursue these activities.

Respondents who participated in the Web survey were told in the cover letter that the objective was to determine the level of knowledge that Floridians have about invasive plant species for use in a more extensive investigation about the impact of these plants on visitor satisfaction with Florida's natural areas.

In the first set of questions, respondents' residence status in the state of Florida was asked. First it was confirmed whether respondents reside in the state of Florida. Then they were asked if they live in the state year-round or seasonally and how long they have been living in Florida, as well as their specific location by county.

Subsequently we asked how respondents characterized the extent of their knowledge about invasive plant species in Florida's natural area. Respondents were also presented with a statement about these plants and asked to agree or disagree with it. These responses are contrasted with two questions in which the real (or observed) knowledge of respondents was tested. In these questions respondents were asked to classify twelve plants as either invasive or non-invasive.

Names and photos of the plants were provided to facilitate respondents' analysis. Then the survey continued with a series of questions about the impact of invasive species on respondents' welfare, including their enjoyment of outdoor activities and where they pursued them, as well as effects that they think invasive species have had on the natural environment. The survey ended up with a set of demographic questions to determine the gender, location, environmental attitudes, age, marital status, race/ethnic background, level of education, employment status, and household income of respondents.

Respondent Demographic Description

A total of 274 valid responses were obtained from the Web survey conducted with Florida residents. The main demographic characteristics of these respondents as well as comparable figures for the state population, obtained from the U.S. Census Bureau, are summarized in Table 2-1.

It can be verified from Table 2-1 that there are a group of characteristics (marital status and location) that matched to a high degree with the proportions of the Florida population. On the other hand, there are other characteristics in which the sample showed an important difference from the composition of Florida population. For example, the proportion of respondents who indicated that they were male was greater than that of the state population. We can also observe that the sample, compared with the state population, is skewed toward employed, highly educated, and high income earning people. That situation compelled us to be extremely careful in the conclusions and the applied methodology.

Finally, as part of the demographic part of the survey, respondents were asked to provide their environmental views. Respondents were asked how environmentally conscious they considered themselves to be. The composition of sample respondent was: not at all 1%, a little conscious 11%, moderately conscious 48%, very conscious 30%, and extremely conscious 10%.

Extent of Respondents' Knowledge and Their Attitudes Toward Invasive Plants

First, respondents were asked about how much they agree with the following statement: "At the moment non-native invasive species is an important problem for natural areas in Florida." Survey respondents answered in the following way: strongly disagree 2%, disagree 3%, agree 52%, strongly agree 32%, and do not know 11%.

Then respondents were asked about the extent of knowledge that they think they have about invasive plants in Florida. The answers obtained from this question had the following composition: 10% said that they have no knowledge; 30% asserted that they have little knowledge about invasive species, 47% said that they have a modest level of knowledge; 11% said that they are well versed in the topic, and 2% affirmed that they are experts on this topic. For compilation of the results, the categories "no knowledge" and "little knowledge" were merged into one category labeled "limited or no knowledge." The category "moderate level of knowledge" was retained and the categories "well versed" and "expert" were merged into a single category, "high level of knowledge". The result of this new classification is given in the Table 2-2 in the set of columns labeled "stated knowledge."

In the following two questions we tested the real level of knowledge of the respondents. We provided the names and photographs of twelve plants and respondents were asked to classify them as invasive or non-invasive species. Respondents had four alternatives: invasive species, non-invasive species, do not know, and never heard of it. A correct answer classifying the plant counted as a point for the respondent. A wrong answer or an answer such as "I do not know" or "I've never heard of it" counted as zero points. A person with a score less than six points was classified in the "limited or no knowledge" category. A person with a score between six and eight points was categorized as having a "moderate level of knowledge," and a person with a score higher than eight points was classified in the "high level of knowledge" category. The total result of this test for the sample is showed in the Table 2-2 in the set of columns labeled "Observed Knowledge."

From Table 2-2 we can observe that there is an important difference in the amount of knowledge that people say they have (stated knowledge) compared to the knowledge that they really have (observed knowledge), especially in the first two categories. In other words, we can see in Table 2-2 that the proportion of people who asserted that they possess a moderate level of knowledge of invasive species is higher than the real proportion of people who demonstrated a moderate level of knowledge. On the other hand, the proportion of people who claimed to have limited or no knowledge about invasive species is smaller than those who demonstrated this level of knowledge. The only proportion that is similar is the number of people who asserted that they possess a high level of knowledge.

But the question is whether these differences in the proportions are statistically significant. To answer this question, we conducted two tests comparing the samples; that is, we compared the extent of knowledge that people claimed to have with the knowledge that we determined that they really have. The two tests used were a simple comparison of proportions and a paired samples test. The result of the first test, the simple difference of proportions, is given in Table 2-2, while the results of the paired sample test[8] are shown in Table 2-3.

In both tests, we contrasted the null hypothesis that given a specific category the proportions in both samples (stated knowledge responses and observed knowledge responses) would be the same. Using the results of the two tests, shown in Tables 2-2 and 2-3, we concluded first that we cannot reject the null hypothesis of equivalence of proportions for both samples at 5% level of confidence for the third category (high level of knowledge) in both tests. On the other hand, for the first and second category the situation is the opposite, since we reject the null hypothesis of equivalence of proportions for both samples at 5% level of confidence in both tests. Therefore we conclude that an assertion made by an individual that s/he has a moderate level of knowledge of invasive species is not reliable, since it is likely that the respondent's demonstrated knowledge be less. In contrast, when a person asserts that s/he is well-versed or an

[8]Test that we considered adequate, since for each respondent two different treatments through two different and independent questions were conducted.

expert in non-native invasive species, it is not likely that we found any discrepancy between what s/he stated and what s/he really knows.

The discrepancy between the stated knowledge and the observed knowledge raises the question of which of these two is significant in order to model the level of knowledge and its determinants. With this in mind, we tested which of these "knowledges" (labeled as declared and observed) influenced respondents' behavior; especially when they have to discern how the presence of invasive species can affect their satisfaction.

For this analysis we used the information obtained from questions 9 and 10 of the web survey. In question 9 respondents were asked if they have been affected by invasive species in their choice of locations for outdoor activities; to which respondents answered in the following way: yes 25%, no 70%, and not sure 5%. In question 10 we asked if invasive species have affected respondents' enjoyment of outdoor activities, to which they answered yes 45%, no 47%, and not sure 8%.

A bivariate relationship is defined by a joint distribution of two categorical response variables X and Y. In which, Y is a dependent variable that represents whether or not a person was affected by any invasive species in either their enjoyment of outdoor activities or where they chose to pursue these activities. This variable has two levels; the "First Level" implies that the person declared that s/he was affected by invasive species in at least in one way; either in his/her choice of where s/he pursued outdoor activities or in their enjoyment of these activities. The "Second Level" represents all the negative or dubious responses provided for the effect of invasive species on both their choice of site and their enjoyment of outdoor activities.

On the other hand X is an explanatory variable that represents whether a person possesses a level of knowledge about invasive plant species. This variable has two levels, too. The "First

Level" implies that the person possesses either a high or moderate level of knowledge. The "Second Level" implies that the person has either limited or no knowledge about non-native invasive plant species. In addition, in order to determine which knowledge (stated or observed) is valid for modeling the behavior of respondents, we conducted an independence test using the two types of knowledge obtained from the survey.

The importance of these arrangements in a two-way contingency table is to examine the null hypothesis of statistical independence between the specific knowledge (either stated or observed) and the respondent's satisfaction impact caused by invasive species[9]. Then for testing independence we will use both the Pearson Chi square and Likelihood Ratio–Deviance statistics.

From Table 2-5 we can observe that the chi-squared statistics are: $\chi^2 = 0.012$ and $G^2 = 0.012$ based on a distribution with degree of freedom equal to 1. Then we cannot reject the null hypothesis of statistical independence between the stated knowledge and the impact of invasive species on respondents' satisfaction. We also used an adjusted residuals analysis for additional accuracy. Thus from Table 2-4 we can observe very small residuals (-0.11 and 0.11), which strengthen our previous conclusion to not reject the null hypothesis of statistical independence.

From Table 2-7 we can determine that the chi-squared statistics are: $\chi^2 = 19.93$ and $G^2 = 20.17$, based on a distribution with a degree of freedom equal to 1, that is, a chi-squared distribution with a mean and a standard deviation of 1. Therefore, values of 19.93 and 20.17 are fairly far out in the right hand tail; for that reason, each statistic has a p-value of <0.001. Then we cannot reject the null hypothesis of statistical independence. Thus both test statistics suggest that the observed knowledge of a respondent and his/her satisfaction are associated. Additionally,

[9] Eleven observations were eliminated in order to establish a system that match the real knowledge, the observed knowledge and the people's satisfaction impact due to the presence of invasive species.

using a residual analysis we found in Table 2-6 large positive residuals for people who possess observed knowledge of invasive species and those who stated some impact on their satisfaction by the presence of these plants, as well as for people who do not have observed knowledge and did not state any impact on their satisfaction by the presence of these species. This knowledge gap is more evident when we estimated the sample odds ratio given in Table 2-7 as a value of 3.19. That means that the odds that a person who has (observed or real) knowledge complains by the presence of invasive species is 3.19 times the odds of a person who does not have (observed or real) knowledge.

To sum up we found that only what we have called observed knowledge has an effect on whether respondents feel that an invasive plant has had an effect on either where they choose to pursue outdoor activities or their enjoyment of those activities. For that reason, we will use in our model the observed knowledge as a dependent variable, since only this knowledge is important for the decision and satisfaction of respondents.

Knowledge Model: Determinants of the Real (Observed) Knowledge of Respondents

In this section, we will use a multiple logistic regression model in order to estimate the determinants of respondents' (observed) knowledge. We will denote a set of eighteen variables (predictors) for a binary response Y, which represents whether a respondent has (observed) knowledge (Y=1) or not (Y=0). In our model, we have two types of predictors: nominal and ordinal. The ordinal predictors in the model are given in Table 2-8. The nominal predictor is the education variable, which takes a value of 1 for high school or less, 2 for some college courses, 3 for associate's degree, 4 for a bachelor's, 5 for some graduate courses, and 6 for a graduate/professional degree. Then the model is defined as follows:

(2-1)
$$Logit[\pi(x)] = Log\left(\frac{\pi(x)}{1-\pi(x)}\right) =$$
$$= \alpha + \sum_{i=1}^{2} \beta_i Location_i + \beta_3 Gender + \sum_{i=4}^{6} \beta_{i-3} EC_{i-3} + \sum_{i=7}^{11} \beta_{i-6} Age_{i-6} + \beta_{12} Education + \sum_{i=13}^{18} \beta_{i-12} Income_{i-12}$$

The maximum likelihood estimates for the proposed logistic regression model is given in Table 2-9.In order to test the accuracy of the model proposed in Table 2-9 we first conducted a set of global tests (Table 2-10) in which we contrasted the null hypothesis that all the estimators are not significant (β = 0). Then we applied a second set of tests to see if the model is correct in contrasting the null hypothesis, which stated that the model specification fits adequately. The idea underlying these tests is to compare the fitted expected values to the actual values. If these differences are large, we reject the null hypothesis for an alternative, which indicated that the specified model did not in fact fit.

We can observe in Table 2-10 that all the tests permit us to reject the null hypothesis that all the estimators are not significant. That is why we stated that the model is statistically significant; that is, that all their estimators are different from zero. On the other hand, the test values showed in Table 2-11 allow us to conclude that we cannot reject the null hypothesis that the specification of the model fits adequately. In other words, there is enough evidence to conclude that the model fits, so the model is adequate for analysis and prediction.

Using the estimated model, we calculate the probability that a person from the sample has knowledge about invasive species. This expected probability is equal to 40.03%, near to the observed probability of 38.69%. However, since our sample is highly skewed toward people with a high level of education and income, as well as male respondents, this probability is not adequate to use for representing the average person in Florida. For that reason, as a first step we will use the model and the characteristics of an average person in Florida in order to provide an approximation of the probability that s/he has knowledge about invasive species. This approximation gave us a value of 31.66%; however, this is not enough, since the model came from a sample with characteristics that differ from those of Florida's population.

Therefore, using the model and the characteristics of Florida's population we proceeded to conduct a Monte Carlo simulation and a bootstrap analysis, through which we determined an approximated probability distribution of the probability that a person knows about invasive species, and its subsequent population inference. The results obtained from the probability distribution are given in Table 2-12.

Applying the expected probability estimated from the Monte Carlo we found that the probability of finding a sample of average Floridian people with more of 40% knowing something about invasive species is approximately 42% (Figure 2-1 – right area). On the other hand, the probability of finding a sample of average Floridians with more than 31.66% knowing about invasive species is approximately 52.62% (Figure 2-2 – right area). That allowed us to conclude that a reasonable range of the possible proportion of people from the Florida's population who know something about invasive species is between 30% and 40%.

For additional analysis we estimated, with a bootstrap process, the percentiles and the cumulative distribution function of the percentage of the population that knows about invasive species. The results of this analysis are showed in Figure 2-3.

Nevertheless, up to this point we have not determined what the more important factors are that affect the probability of a person having knowledge about invasive species. For that purpose we calculated the odds ratio for the levels of each predictor as comparing relatively with their first level.

From the male estimator of the knowledge model presented in Table 2-9 we concluded that male respondents are more likely to know about invasive species than female respondents. That is, the odds of a male individual for knowing about invasive species are 1.88 times, or 88.38%, higher than the odds of a female.

In Table 2-14 we analyzed the impact of the respondent's location on his/her knowledge of invasive species. We found that the odds of a person knowing about invasive species increases based on whether respondents live in less urbanized areas. To be precise, the odds of an individual who lives in a suburban area knowing about invasive species are 2.43 times the odds of an individual who lives in an urban area. In addition a person who lives in a rural area is 3.98 times (1.64 times) more likely to have this knowledge than a person who lives in an urban area (suburban area).

When we talk about the impact of the level of environmental consciousness on the probability of knowing about invasive species, this is one of the traits that produce the highest level of impact on the odds of a person possessing that kind of knowledge. In Table 2-14 we can see that the maximum odds ratio between two levels of the variable environmental consciousness is between not conscious and very/extremely conscious category. In other words, the odds of knowing about invasive species of any respondent who declares him- or herself "very/extremely environmental conscious" is 8.76 times the odds of a person who considers him-or herself "not conscious at all".

In the case of education, for every one-level increase in the respondent's education, the odds of him or her of knowing about invasive species increases by 1.146 times, or 14.6%. Consequently, we concluded that the formal level of education does not have much impact in the odds of a person knowing about invasive species. Even more between the minimum and the maximum education category the odds ratio is about 1.97 times. A low value if we compared it with the highest odds ratio for categories such as environmental consciousness (8.76 times) and location (3.98 times).

Finally, regarding to the variables income and age, showed in Tables 2-15 and 2-16, we can assert that the impact of these variables are not monotonic. In the case of income the maximum impact is between the level \$20,000–\$39,999 and the level \$80,000 - \$99,999 in a value of 4.5 times. To be exact, the odds of knowing about invasive species for a person who has an income in the range of \$20,000–\$39,999 is 350% higher than the odds of a person with income in a range of \$80,000–\$99,999. In the case of age, the maximum impact is between the levels 56-65 and >65, since the odds of a person with an age in the range of 56–65 years old knowing about invasive plants are 1670.9% higher than the odds of a person older than 65 years old.

Conclusions

First we determined the importance of respondents having an adequate background of knowledge in order to fully discern the impact of non-native invasive plant species on their satisfaction with outdoor recreational activities. We also found that approximately between 30 and 40 percent of Florida's population has a moderate knowledge about invasive plant species. These two results allowed us to conclude that it is necessary to provide an adequate level of information about invasive species in the multi-attribute survey in order to obtain accurate information about people's valuations of the impact of these species on natural areas in Florida. At the same time, it can be argued that this information could produce a bias in the responses of this multi-attribute survey; however, that is not true since it was proved that this information helps people to elucidate the real value that they assign to this problem. In contrast, if we assumed that people have this knowledge and we neglect to provide it, the study can be compromised, since the odds of a person who does not possess a good level of knowledge to fully discern the real effect of these species on his/her welfare is 0.31 times the odds of a person who has a good level of knowledge. It was further found that there is a 44% probability that a person who thinks s/he has knowledge of invasive species actually possesses little or no knowledge.

Another important finding is that formal education is not a constraint for people to discern the impact of invasive plant species, since the effect of this variable in the likelihood of having this knowledge is small compared to other variables such as location, environmental consciousness, and age. That provides a greater level of importance to the knowledge that comes from another means, such as government campaigns, press coverage, and others. This is reinforced by the finding that formal education is not correlated with more important variables such as environmental consciousness (we found statistical independence between these two variables: $\chi^2 = 16.4368$, $G^2 = 15.9063$ with df = 20).

To sum up, it is necessary to provide a good background of information in the survey in order to obtain more accurate and correct results in the people's valuation of the invasive species problem, in contrast with the small importance of the highest level of education attained by respondents.

Table 2-1 Socioeconomic characteristics for the survey sample and comparisons to the Florida population.

Categories	Sample	Florida
Urban	48.2%	47.0%
Suburban	41.6%	44.0%
Rural	10.2%	9.0%
Male	51.3%	48.8%
Female	48.7%	51.2%
18 - 25 years	10.0%	7.8%
26 - 35 years	13.7%	16.9%
36 - 45 years	18.8%	20.1%
46 - 55 years	20.0%	16.8%
56 - 65 years	14.3%	12.6%
More than 65 years	23.2%	25.9%
Single	25.7%	23.8%
Married	54.3%	54.3%
Other	20.1%	21.9%
High school or less	9.9%	48.9%
Some college courses	13.3%	21.8%
Associate	11.6%	7.0%
Bachelor's	16.7%	14.3%
Some Graduate	14.7%	2.0%
Graduate	33.8%	6.0%
Unemployed	6.3%	3.2%
Employed	70.1%	54.9%
Not in labor force	23.6%	41.9%
Less than $20.000	23.9%	34.0%
$20,000 - $39,999	13.3%	15.0%
$40,000 - $59,999	14.9%	19.0%
$60,000 - $79,999	10.9%	14.0%
$80,000 - $99,999	9.3%	5.0%
$100,000 - $120,000	11.9%	4.0%
More than $120,000	15.7%	9.0%

Source: U.S. Census Bureau 2000

Table 2-2 Classification and sample proportion of the level of stated knowledge vs. the level of observed knowledge of survey respondents.

Extent of Knowledge	Type of Knowledge		Z-statistic	P-value
	Stated Knowledge	Observed Knowledge		
Limited or No Knowledge	40.51%	61.31%	4.871	0.00000
Moderate Level of Knowledge	46.72%	26.28%	4.969	0.00000
High Level of Knowledge	12.77%	12.41%	0.129	0.44877

Table 2-3 Paired-samples test for stated and observed knowledge of survey respondents

Stated vs. Observed	Mean	Std. Deviation	Std. Error Mean	t	DF	Sig. (2-tailed)
Limited or No	-0.2150	0.5535	0.0323	-6.6496	273	0.00000
Moderate	0.1945	0.5965	0.0348	5.5821	273	0.00000
High	0.0205	0.3787	0.0221	0.9256	273	0.35547

Table 2-4 Contingency table relating people's level of stated knowledge about invasive species and the impact of these species on respondents' satisfaction

Level of Knowledge	Satisfaction Impact	
	First Level	Second Level
First Level	79.00*	85.00*
	78.57**	85.43**
	0.11***	-0.11***
Second Level	47.00*	52.00*
	47.43**	51.57**
	-0.11***	0.11***

Note: *frequency, **expected frequency, ***residuals

Table 2-5 Independence test for the stated knowledge about invasive species and the impact of these species on respondents' satisfaction

Statistic	df	Value	Prob.
Pearson Chi-Square (χ^2)	1	0.012	0.91
Deviance - Likelihood Ratio (G^2)	1	0.012	0.91

Table 2-6 Contingency table relating the people's level of observed knowledge about invasive species and the impact of these species on respondents' satisfaction

Level of Knowledge	Satisfaction Impact	
	First Level	Second Level
First Level	67.00*	36.00*
	49.35**	53.65**
	4.46***	-4.46***
Second Level	59.00*	101.00*
	76.65**	83.35**
	-4.46***	4.46***

Note: *frequency, **expected frequency, ***residuals

Table 2-7 Independence test for the observed knowledge about invasive species and the impact of these species on respondents' satisfaction

Statistic	df	Value	Prob.	Odds Ratio	95% Confidence Limits	
Pearson Chi-Square (χ^2)	1	19.93	0.00	3.186	1.90	5.34
Deviance - Likelihood Ratio (G^2)	1	20.17	0.00			

Table 2-8 Ordinal predictors of the observed knowledge model

Variable	Definition
Location	Dummy variable that indicates the residence of respondents according to three categories: urban, suburban, and rural.
Gender	Dummy variable that indicates the respondent's gender.
EC	Dummy variable that represents respondents' answers about their degree of environmental consciousness.
Age	Dummy variable that represents different age ranges, which go from eighteen to more than sixty-five years old.
Income	Dummy variable that represents different ranges of income for respondents, which go from less than \$20,000 to more than \$120,000 annually.

Table 2-9 Coefficient estimates for the knowledge model

Variable	Definition	Estimates	Std Err.	χ^2	P-value
alpha	Intercept	-4.90	1.27	14.89	0.00
Location 1	Suburban	0.89	0.32	7.84	0.01
Location 2	Rural	1.38	0.50	7.58	0.01
Gender	Male	0.63	0.30	4.44	0.04
EC 1	Little conscious	0.47	0.17	7.76	0.01
EC 2	Moderate conscious	1.50	0.58	6.77	0.01
EC 3	Very/Extremely conscious	2.17	0.69	9.91	0.00
Age 1	18 – 25 years	2.28	1.16	3.89	0.05
Age 2	26 – 35 years	1.84	1.15	2.59	0.11
Age 3	36 – 45 years	2.03	1.13	3.22	0.07
Age 4	46 – 55 years	1.78	1.11	2.55	0.11
Age 5	56 – 65 years	2.87	1.14	6.37	0.01
Education	From high school and less to graduate	0.14	0.04	9.48	0.00
Income 1	\$20 - \$39 thousands annually	0.22	0.50	0.20	0.66
Income 2	\$40 - \$59 thousands annually	-0.33	0.14	5.51	0.02
Income 3	\$60 - \$79 thousands annually	-0.48	0.56	0.72	0.40
Income 4	\$80 - \$99 thousands annually	-1.28	0.60	4.59	0.03
Income 5	\$100 - \$120 thousands annually	-0.56	0.57	0.94	0.33
Income 6	More than 120 thousands annually	-0.25	0.13	4.11	0.04

Table 2-10 Global test of significance for the knowledge model's estimators

Global Null Hypothesis (Beta = 0)			
TEST	df	Value	p-value
LR	18	65.7161	0.0000
Score	18	57.0519	0.0000
Wald	18	42.4630	0.0010

Table 2-11 Goodness of fit test for the knowledge model

TEST	df	Value	P-value
Pearson $\chi 2$	255	278.85	0.146
Deviance	255	255.63	0.477
Homer Lemeshow	8	10.83	0.212

Table 2-12 Parameters of the simulated distribution function of the percentage of Floridians who know about invasive species

Statistics	Value
Mean	35.91%
Median Effective Level	33.96%
Standard Deviation	22.84%
Variance	5.22%
Mean Std. Error	0.02%
Skewness	0.33
Kurtosis	2.09
Coeff. of Variability	0.64

Table 2-13 Odds ratio and likelihood of awareness for location categories in rows against location categories in columns

	Location		
Location	Urban	Suburban	Rural
Urban	1.00 0.00%	0.41 -58.88%	0.25 -74.89%
Suburban	2.43 +143.17%	1.00 0.00%	0.61 -38.94%
Rural	3.98 +298.25%	1.64 +63.77%	1.00 0.00%

Table 2-14 Odds ratio and likelihood of awareness for environmental consciousness categories in rows against environmental consciousness categories in columns

Environmental Consciousness	Environmental Consciousness: Not conscious	Little conscious	Moderately conscious	Very/Extremely Conscious
Not conscious	1.00 0.00%	0.67 -37.22%	0.22 -77.60%	0.11 -88.58%
Little conscious	0.41 -59.28%	1.00 0.00%	0.36 -64.31%	0.18 -81.81%
Moderately conscious	2.46 +346.34%	2.80 +180.22%	1.00 0.00%	0.51 -49.04%
Very/Extremely Conscious	8.76 +775.83%	5.50 +449.86%	1.96 +96.23%	1.00 0.00%

Table 2-15 Odds ratio and likelihood of awareness for income categories in rows against income categories in columns

Income	Income: <20	20-39	40-59	60-79	80-99	100-120	>120
<20	1.00 0.00%	0.80 -19.85%	1.39 +38.76%	1.61 +61.06%	3.61 +260.93%	1.74 +74.42%	1.29 +28.84%
20-39	1.25 +24.77%	1.00 0.00%	1.73 +73.13%	2.01 +100.95%	4.50 +350.33%	2.18 +117.62%	1.61 +60.75%
40-59	0.72 -27.93%	0.58 -42.24%	1.00 0.00%	1.16 +16.07%	2.60 +160.10%	1.26 +25.70%	0.93 -7.15%
60-79	0.62 -37.91%	0.50 -50.24%	0.86 -13.84%	1.00 0.00%	2.24 +124.10%	1.08 +8.30%	0.80 -20.00%
80-99	0.28 -72.29%	0.22 -77.79%	0.38 -61.55%	0.45 -55.38%	1.00 0.00%	0.48 -51.67%	0.36 -64.30%
100-120	0.57 -42.67%	0.46 -54.05%	0.80 -20.44%	0.92 -7.66%	2.07 +106.93%	1.00 0.00%	0.74 -26.13%
>120	0.78 -22.38%	0.62 -37.79%	1.08 +7.70%	1.25 +25.01%	2.80 +180.13%	1.36 +35.38%	1.00 0.00%

Table 2-16 Odds ratio and likelihood of awareness for age categories in rows against age categories in columns

Age	18-25	26-35	36-45	46-55	56-65	>65
18-25	1.00	1.54	1.29	1.65	0.55	9.76
	0.00%	+54.34%	+28.53%	+65.12%	-44.88%	+876.20%
26-35	0.65	1.00	0.83	1.07	0.36	6.32
	-35.21%	0.00%	-16.72%	+6.98%	-64.29%	+532.49%
36-45	0.78	0.80	1.00	1.28	0.43	7.60
	-22.20%	+20.08%	0.00%	+28.47%	-57.11%	+659.51%
46-55	0.61	0.93	0.78	1.00	0.33	5.91
	-39.44%	-6.53%	-22.16%	0.00%	-66.62%	+491.21%
56-65	1.81	2.80	2.33	3.00	1.00	17.71
	+81.41%	+179.99%	+133.17%	+199.55%	0.00%	+1670.95%
>65	0.10	0.16	0.13	0.17	0.06	1.00
	-89.76%	-84.19%	-86.83%	-83.09%	-94.35%	0.00%

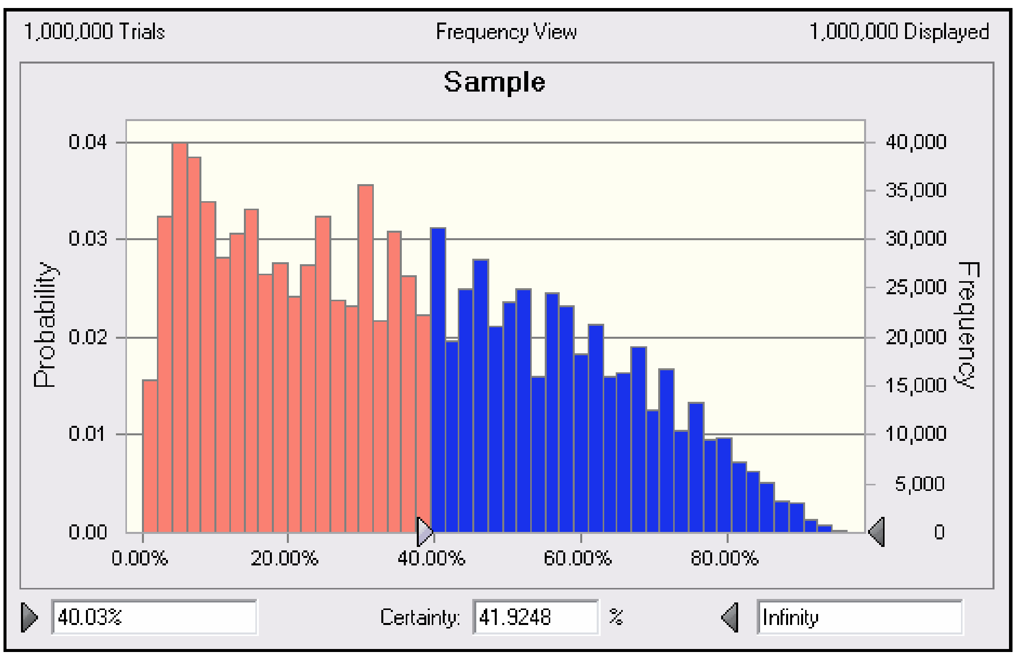

Figure 2-1 Distribution function of the percentage of Floridians who know about invasive species – P(X>0.4003)

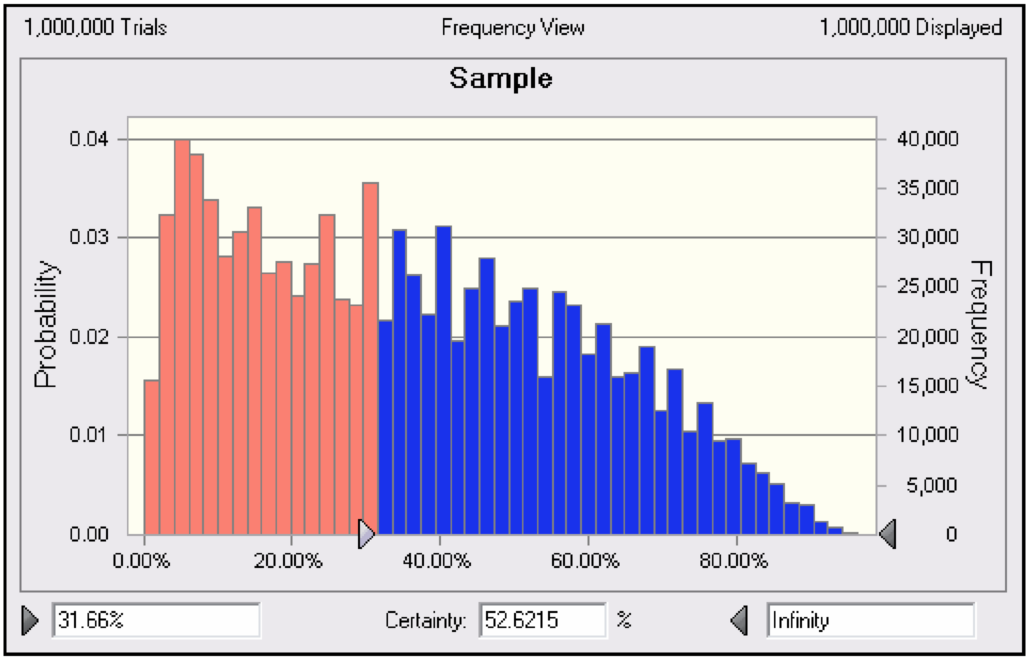

Figure 2-2 Distribution function of the percentage of Floridians who know about invasive species – P(X>0.40)

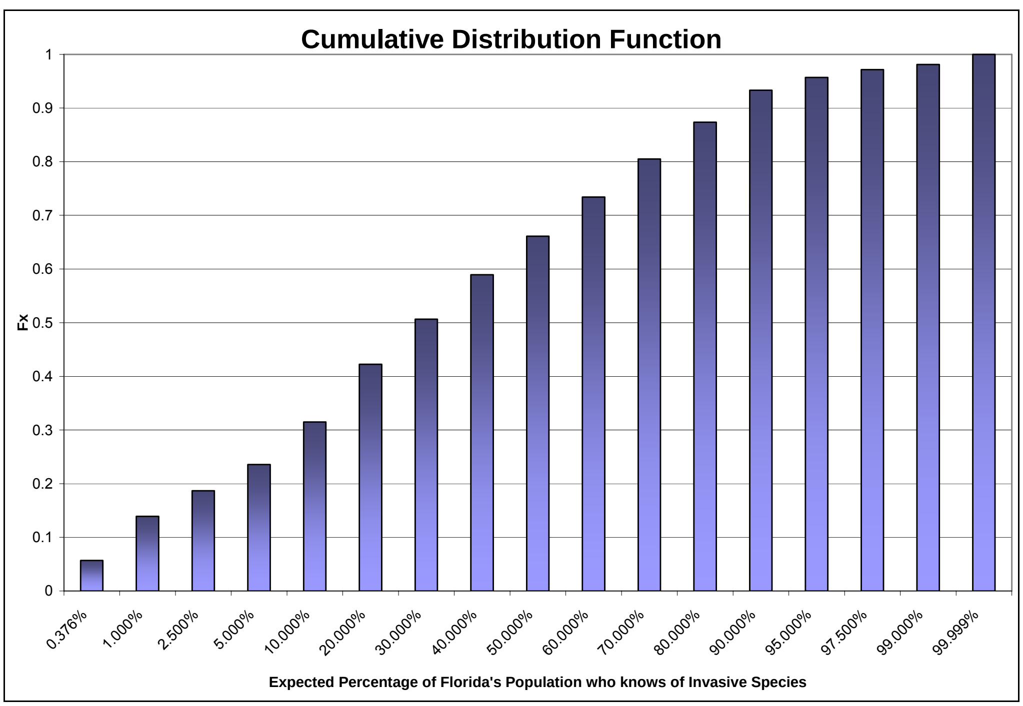

Figure 2-3 Cumulative distribution function of the percentage of Floridians who know about invasive species

CHAPTER 3
DETERMINATION OF RELEVANT ATTRIBUTES OF AQUATIC PARKS IN FLORIDA

Introduction

Multi-attribute utility (MAU) models are mathematical tools for evaluating alternatives whose apparent desirability depend on how their attributes are viewed by a specific individual or population. In other words, the preferences of any individual would be based on the weight that s/he gives to the different attributes of the object.

For example, when a person decides to buy a car s/he will evaluate different attributes among them: price, reliability, safety ratings, fuel economy, and style. Thus, the individual will make his/her decision of which car to buy based on the different attributes each car features and the importance that s/he ascribes.

According to the MAU theory, the overall evaluation V(x) of an object x by an individual can be defined as a weighted average of the specific importance of the different "relevant attributes" of the object. To be precise, the value function of an object by an individual can be defined by the following lineal function:

$$\text{(3-1)} \qquad V(x) = \sum_{i=1}^{n} w_i v_i(a)$$

where V(x) is the overall evaluation of the object x; w_i the specific weight (or relative importance) of the attribute i; $v_i(a)$ is the specific value of the relevant attribute i of the object in a specific level "a"; and n is the number of different relevant attributes of the object x.

Hence, in order to obtain an accurate valuation of an object x, it is important to first determine which of the relevant attributes are for a specific population. For that reason, in this chapter, we will explain the process that was used in order to determine the "relevant attributes" for aquatic parks in Florida. Subsequently, those attributes will be used in (Chapter 4) for an evaluation of the impact of invasive species in those locations.

Preliminary Relevant Attributes

The first step was to establish a preliminary set of relevant attributes in order to narrow them to only three in subsequent stages. We already have determined two attributes as fixed, given the requirements of the MAU preference elicitation method that will be applied afterward. These two attributes are “presence of invasive species” and “fees.” The first refers to the existence and extent of non-native plants known to disrupt ecosystems. The second attribute gathers all the costs of using natural state parks in Florida, such as fees for admission, parking, and camping.

With two attributes already established, the determination of the other three began with a detailed process that included an extensive literature review about people’s preferences when visiting natural areas and an opinion survey conducted with park managers regarding which attributes they think that visitors value the most (Appendix C).

The park managers’ survey was conducted with the purpose of obtaining general information about the Florida’s state parks. In this survey we asked for:

- The level of attendance per year and the maximum attendance per day;
- The impact of invasive species on the park and visitors;
- The satisfaction level of the park’s visitors and their more frequent complaints;
- The average amount of visitors’ expenditures, including fees;
- The financial priorities of the park; and
- The park’s attributes that visitors value the most.

Twenty nine park managers answered the survey and from their responses it was determined that the attributes that people value the most are the diversity of animal species, the diversity of plant species, and the condition and availability of facilities. At the same time, using the visitor complaints information that park managers provided, it was determined that people are also worried about the number of visitors in the park, that is, the level of congestion; the amounts of the diverse fees asked in the park; and the overall maintenance of the location.

These results were contrasted with the conclusions obtained from the literature review regarding the factors that have more influence on park visitors' satisfaction. A group of different studies in the field of recreation, leisure, and tourism were analyzed. We concentrated on research for which the focus was the analyses of the factors that influence the recreation demand (Ho et al. 2005; Mackenzie, 1992; Siderelis and Moore, 1998). Additionally, we evaluated research on how participants make choices about activities and site trips, as well as studies about participants' choice behaviors when specifying site demand. (Ditton et al. 1992; Williams, 1984). Consequently, it was possible from these studies to determine that the attributes having more influence on visitors' preferences for which parks they visited and their recreation demand are:

- Diversity of wildlife;
- Diversity of flora and vegetation;
- Condition and availability of facilities;
- Congestion or number of visitors in the park;
- Distance from the visitor's residence; and
- Fees asked in the park

This conclusion validates park managers' responses and strengthens the results obtained by the two methodologies. Thus, in the following stage, these six attributes will be tested for each of the two types of aquatic parks that we are studying ("ocean/beach parks" and "river/lake" parks). The purpose of this is to reduce the number of attributes to only three; for this purpose attributes will be ranked according to their importance, using Floridians' opinions, obtained from a survey.

The necessity of reducing our choice to only three attributes is based on the requirements of both the multi-attribute analysis and the survey process. This analysis provides a flexible tool to simultaneously consider a number of important attributes of a decision; however, it is important to include a feasible and manageable number of relevant attributes that take into consideration respondents' limitation both in time and ability to make complex choices. Therefore reducing the number of attributes to the optimal number based on these constraints is crucial for the success of the study.

General Description of the Survey

The information regarding aquatic parks' attributes that impact Floridians' choice to participate in outdoor recreational activities in those locations was collected through a Web survey. This survey was obtained from a randomly selected sample of Florida residents; Expedite Email Marketing was selected to perform the e-mail broadcast through a cover letter (Appendix D). This letter contained an invitation to take the survey (Appendix E) as well as a link to the Web address containing this survey (found on www.SurveyMonkey.com). The survey consisted of nineteen questions related to the topic and ten questions about respondents' socio-economic characteristics. The questions related to the topic (Florida residents' use of natural parks and participation in outdoor recreational activities) can be divided in the following groups:

- Type of outdoor recreational activities that respondents have participated in the last twelve months;
- Reasons for participating in outdoor recreational activities;
- Frequency with which respondents participate in outdoor recreational activities;
- Distance driven, money spent, and time used when respondents participate in outdoor recreational activities;
- Importance of each of the six chosen attributes when visiting each one of the two types of aquatic parks analyzed; and
- Preferences for parks' attributes based on their tax-use decisions.

Respondents, who participated in the Web survey, were told in the cover letter that the objective was to determine the criteria that Florida park visitors consider when choosing to visit a natural recreational park in order to use it in a more extensive investigation related to the impact of invasive plants on visitor satisfaction with Florida's natural areas. It is important to emphasize that this research was focused on the study of aquatic state parks in Florida, specifically two types: ocean/beach (OB) and river/lake (RL) parks.

Respondent Demographic Description

A total of 215 valid responses were obtained from the Web survey conducted with Florida residents. The main demographic characteristics of these respondents, as well as comparable figures for the state population, obtained from the U.S. Census Bureau, are summarized in Table 3-1. It can be verified from Table 3-1 that there is a group of characteristics (location, marital status, gender) that matched in a high degree with the proportions of the general Florida population. On the other hand, it can also be pointed out that there are other characteristics where the sample showed a degree of difference from the composition of the Florida population such as age, education, and income.

Finally, as part of the demographic component of the survey, respondents were also asked to provide their environmental tendencies, specifically how they considered themselves regarding their environmental consciousness. The composition of sample respondents was: Not at all 0%, a little conscious 5%, moderately conscious 40%, very conscious 38%, and extremely conscious 17%.

In the survey respondents were also asked different questions about their behavior patterns when participating in outdoor recreational activities in aquatic state parks in Florida. The survey asked them specifically about the following:

- Type of outdoor recreational activities and reasons for participating in the last twelve months;
- Frequency of participation in outdoor activities in aquatic state parks in Florida;
- Maximum and minimum distance traveled when visiting aquatic state parks in Florida;
- Time spent, on average, when visiting aquatic state parks in Florida; and
- Amount of money spent typically, per person, when visiting aquatic state parks in Florida.

The frequency with which respondents visit aquatic parks in Florida can be observed in Table 3-2. From those it can be determined that, on average, respondents go to both type of parks (OB and RL) seventeen times per year (or at least once per month). This figure reflects the relevance that outdoor recreational activities (in aquatic locations) have for Floridians' leisure time and as a consequence over their welfare. This justifies the importance of measuring the impact of invasive plant species in Florida's aquatic areas.

From Table 3-3 and Table 3-4, it is possible to estimate the average range of distance traveled for respondents to aquatic state parks. For OB parks, the range is between thirty-three and 124 miles, while for RL parks the distance range is between nineteen and ninety-eight miles. We can conclude that people are willing to travel longer distances when they go to an OB park than when they go to a RL park, even though the travel frequency for both locations are similar.

Furthermore as we can see in Tables 3-5 and 3-6 as well, OB parks are a more attractive location for Florida residents than RL parks. The average time spent by survey respondents in OB parks is sixteen hours, compared with the twelve hour average spent by respondents in RL parks. This difference is even more striking when we analyze the amount of money spent in these two types of parks. Respondents reported that they spend, on average, $32 when visiting RL parks compared with the $63 spent in OB parks, or almost double the first amount. To summarize, using the results obtained for time and money spent as well as distance traveled by survey respondents, it is possible to conclude that people give a higher value to OB than RL locations. However, given the frequency of visits to both types of parks, they presented a similar level of importance for respondents, but with a higher value for OB parks.

Model for the Degree of Importance of Park's Attributes on Floridians' Decision to Participate in Outdoor Recreational Activities in Aquatic Parks.

In this section, we will proceed to model, through an ordered probit, the level of importance of six relevant attributes on Floridians' decision to participate in outdoor recreational activities in two types of aquatic parks: OB and RL. The six relevant attributes used in this part were already determined by a literature review and a park managers' survey.

We will apply the ordered response model of Aitchison and Silvey (1957). In this model, the observed denotes outcomes representing ordered or ranked categories. In our specific case, the five categories represent the level of importance that people assign specific attributes of aquatic state parks in Florida. The five-point Likert scale used in this analysis is the following:

- Extremely important;
- Somewhat important;
- Indifferent;
- Somewhat unimportant; and
- Extremely unimportant.

Preferences were obtained through the following question in the survey: "Grade the importance to you of each of the following attributes when visiting an OB (RL) park in Florida." In this question a sixth alternative (Do not know) was also provided, and at the beginning it was planned to apply a Heckman or two-stage procedure to gather the effect of the "Do not know" responses, but the number of responses in this category was very small for both locations (one for OB and two for RL), so it was not necessary to apply this model. Instead, we eliminated these observations, since their effects are insignificant.

In order to be a little more specific, we will proceed to define different aspects of the applied model. As in the binary-dependent variable model, we can model the observed response by considering a latent (dependent) variable y_i^* that possesses more than two levels (in our case, five levels), based on the established rank of preferences, which will depend linearly on the explanatory variables (in our case demographic variables):

(3-2) $$y_i^* = x_i'\beta + \varepsilon_i$$

where x_i and ε_i are independent and identically distributed random variables. The observed y_i is determined from y_i^* using the rule:

(3-3) $$y_i = \begin{cases} 1 & if \quad y_i^* \leq \gamma_1 \\ 2 & if \quad \gamma_1 < y_i^* \leq \gamma_2 \\ 3 & if \quad \gamma_2 < y_i^* \leq \gamma_3 \\ 4 & if \quad \gamma_3 < y_i^* \leq \gamma_4 \\ 5 & if \quad \gamma_4 \leq y_i^* \end{cases}$$

It is worth noting that the actual values chosen to represent the categories in "y" are completely arbitrary. All the ordered specification requires is for ordering to be preserved so that $yi^* < y_j^*$ implies that $y_i < y_j$. It follows that the probabilities of observing each value of "y" are given by:

(3-4) $$P(y_i) = \begin{cases} \Pr(y_i = 1 | x_i, \beta, \gamma) = F(\gamma_1 - x_i'\beta) \\ \Pr(y_i = 2 | x_i, \beta, \gamma) = F(\gamma_2 - x_i'\beta) - F(\gamma_1 - x_i'\beta) \\ \Pr(y_i = 3 | x_i, \beta, \gamma) = F(\gamma_3 - x_i'\beta) - F(\gamma_2 - x_i'\beta) \\ \Pr(y_i = 4 | x_i, \beta, \gamma) = F(\gamma_4 - x_i'\beta) - F(\gamma_3 - x_i'\beta) \\ \Pr(y_i = 5 | x_i, \beta, \gamma) = 1 - F(\gamma_4 - x_i'\beta) \end{cases}$$

where F is the cumulative distribution function of ε.

The threshold values γ are estimated along with the β coefficients by maximizing the log likelihood function:

$$\text{(3-5)} \qquad \ln[L(\beta,\gamma)] = \sum_{i=1}^{N} \sum_{j=0}^{M} \log\left(\Pr(y_i = j \mid x_i, \beta, \gamma)\right)\delta(y_i = j)$$

where δ is an indicator function that takes the value 1 if the argument is true and 0 if the argument is false.

Additionally, the McFadden R-squared[10] will be used as a measure of the improvement in fit of the model due to the independent variables. The development of the McFadden R-squared starts with the log likelihood reported for the model. The log likelihood can be thought of as a measure of the magnitude of the error terms in the estimation. If the log likelihood is smaller (i.e., farther from zero), then the error is greater.

The McFadden R-squared compares the log likelihood in two models. The first model runs a regression including only the constant term, with no other explanatory variables, which does not explain much of the variation in the dependent variable, since there are no explanatory variables. This can be thought of as the "base case" (o). Then the log likelihood from the base case is compared to the log likelihood calculated from the full model (ω), which includes the explanatory variables. The following formula is used:

$$\text{(3-6)} \qquad R - Squared(McFadden) = 1 - \frac{L(\omega)}{L(o)}$$

where L(ω) is the log likelihood from the model with the explanatory variables and L(o) is the log likelihood from the base case model with just the constant term. This measure also satisfies two desirable properties of any measure of goodness of fit: (1) lies in the interval [0, 1], and (2) increases as more explanatory variables are added. All of this makes the McFadden R-squared, a measure simple to calculate and to understand, which is adequate for our analysis.

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10 This measure is also known as "pseudo R-squared" since it mimics the R-squared analysis, but is not an R-squared itself. Also, as was previously stated, the interpretation is not the same, but can be interpreted as an approximate variance (deviance) in the outcome, accounting for the influence of the explanatory variables.

Thus after defining the characteristics of the model and the goodness of fit measure, the explanatory variables are explained in Table 3-7. The maximum likelihood estimates for the ordered probit models for each of the six attributes in each location are presented in Figures 3-1 and 3-2.

In both the OB and RL models, the McFadden values are in the range above 0.09 and less than 0.32, indicating a moderate gain associated with the demographic and related variables, but this is not substantial. It can also be observed in Tables 3-8 and 3-9 that all the models have large LR statistics (and small p-values), thus the null hypothesis that all slope coefficients except the constant are zero can be rejected in all the models. As a consequence, it can be stated that all the models are statistically significant; that is, that all their estimators are different from zero.

Ranking of the Relevant Attributes and "Weighted Models"

Using the ordered probit models from Figures 3-1 and 3-2, the probability of each score for the average person (Likert scale) can be estimated for each park attribute, recalling that a score of one indicates the most favorable indicator. Combining the probabilities for scores one and two provides insight into the favorability of each attribute relative to neutrality or non-favorable opinions. It is necessary to remind that the five attributes analyzed in this study were: 1) Diversity of wildlife, 2) Diversity of flora and vegetation, 2) Condition and availability of facilities, 3) Congestion or number of visitors in the park, 4) Distance from the visitor's residence; and 5) Fees. In Figures 3-3 and 3-4, the probabilities of scoring one and two are shown, with the probabilities ranked using the importance criteria.

For both types of parks, the three more important attributes that influence visitors' decision to participate in outdoor recreational activities in those locations are: (1) plant species, (2) animal species, and (3) facilities. In the case of OB parks, the preferences are: 88.60%, 81.90%, and 79.00% for plant species, animal species, and facilities, respectively. In the case of RL parks, the preferences are: 93.41%, 90.92%, and 71.84%, respectively. From the analysis it can additionally be verified that the importance of the other three attributes is fairly high, because of the rate of acceptance of more than 50%, which validates the determination of the preliminary relevant attributes from both the literature review and the park managers' survey.

However, one problem exists that can raise questions about the applied procedure. This is the fact that three socio-demographics features of the sample, age, education, and income, are different from the proportions showed in the Florida population. That can produce a certain degree of bias in the results that must be corrected. For that reason, it was decided to apply a weighting procedure. It can be said that a weighting procedure is meant to transform a realized sample into estimates of the reference population, improving their precision. In our specific case, we will apply a weighting strategy because of the under-representation of people with low income, low education, aged 65 years and older. At the end, the objective would be to increase the representation in the adjusted sample of the strata that are underrepresented in order to obtain a sample that mirrors the population.

The procedure applied to correct the sample by weighting was the following: using the sample proportions and the population proportions of each category in each level, we determined a set of possible combinations of feasible weights. In other words, with seven socio-demographic categories, we constructed the weights using the formula:

$$w_{\alpha} = \frac{p^{gender_i}\, p^{location_j}\, p^{age_k}\, p^{marital_l}\, p^{education_m}\, p^{income_q}\, p^{employment_r}}{\pi^{gender_i}\, \pi^{location_j}\, \pi^{age_k}\, \pi^{marital_l}\, \pi^{education_m}\, \pi^{income_q}\, \pi^{employment_r}} \tag{3-7}$$

where p^{a_x} is the population proportion of the category "a" in the level "x" (e.g., the proportion of the population aged 26-35), and π^{a_x} is the sample proportion of the same category "a" in the same level "x." The level "x" of these two proportions is determined by the specific characteristic of each observation, with the levels being mutually independent in each category; this means that one observation cannot be in more than one level (in each category) at the same time.

In the end, applying this ratio comparison for each observation and its specific characteristics permitted us to obtain one weight for each observation. These weights were applied to all the variables and with that new maximum likelihood coefficients were estimated for the six attributes' models in each location. These estimates were obtained and showed in Figures 3-5 and 3-6. In addition from Tables 3-10 and 3-11 it can be concluded that all the weighted models are statistically significant; that is, that all their estimators are different from zero.

Using the ordered probit models from Figures 3-5 and 3-6, the probability of each score for the respondents in the weighted sample can be estimated for each park attribute, recalling that a score of one indicates the most favorable indicator. As in the first estimation, the probabilities for scores one and two were combined in order to provide insight into the favorability of each attribute relative to neutrality or non-favorable opinions.

In Figures 3-7 and 3-8, the probabilities of scoring one and two are shown with the probabilities ranked using the importance criteria. In this case this new estimation is a corrected estimation of respondents' preferences, which correspond more closely to the population behavior.

It can be verified from Figures 3-7 and 3-8 that, like in the un-weighted models, the three more important attributes that influence visitors' decisions to participate in outdoor recreational activities in both types of parks are: (1) plant species, (2) animal species, and (3) facilities. In the case of OB parks, the preferences are: 95.38%, 83.03%, and 82.25% for plant species, animal species, and facilities, respectively. In the case of RL parks, the preferences are: 94.06%, 89.56%, and 79.02%, respectively. From this analysis it can also be verified that the importance of the other three attributes is also fairly high. This is consistent with the results obtained from the preliminary literature review and park managers' survey.

It is important to emphasize that similar results were obtained with the application of the original sample model. The only difference was the magnitude or intensity of the preferences for the three more relevant attributes, which were higher than those obtained in the original models.

In order to attain a more explicit analysis of the correspondence and robustness of both procedures, the results obtained for each model in the five scores of each attribute (for each location) were compared. From Figure 3-9 to Figure 3-20 we can observe an important correspondence among the results obtained from the unweighted and the weighted models. The only difference that can be noted is the discrepancy between the percentages of acceptance in the three less important attributes models of each location. The weighted models provide a higher intensity of preference to the inferior categories scores than the superior ones when compared with the unweighted models.

In the three more important attribute models of each location, the situation is the inverse, where the weighted models provide a higher intensity of preference to the superior categories scores rather than the inferior ones when compared with the unweighted models. However, the three primordial attributes that are selected for visitors are the same as in the original model, which strengthens the conclusion that animal species, plant species, and facilities are the three most important attributes for people when they visit aquatic parks in Florida.

As an additional contrast, we can use the results obtained from a specific question in the survey: "If the state government wants to invest tax revenues in natural areas (either OB or RL), where would you want to see improvements?".

The results obtained from this survey question can be examined in Table 3-12, from which it can be inferred that the three most preferred improvements are related to the diversity and preservation of animal and plant species, as well as the maintenance and availability of facilities. In the case of OB parks, the investment that people most preferred was the maintenance and availability of facilities, with 33.47% of the responses, followed by investments in the preservation of animal species, with 28.29%, and plant species, with 18.73%. In RL parks, the investment most preferred was the conservation of animal species with 37.85% followed by maintenance and availability of facilities, with 28.29%, and preservation of plant species, with 20.72%. In both locations, the preference for these three types of governmental investments are over 80% of all the responses, which validates our previous conclusion of the relevance of these three attributes when members of the public visit either OB parks or RL parks.

Conclusions

This analysis helped to determine which attributes are the most relevant to people's decision to participate in outdoor recreational activities in both OB and RL parks in Florida. These attributes will be subsequently used in a multi-attribute survey, through which the importance that people give to the problem of invasive species in these natural locations in Florida, and their willingness to pay to address this problem, will be estimated.

It was stated that it was necessary to narrow the number of attributes in order to obtain a manageable and feasible MAU survey that at the same time provides accurate results. Three was considered an adequate number of attributes, given the cognitive and time limitations of respondents. For that purpose, a preliminary survey was conducted, in which respondents were asked to provide a valuation about the attributes they considered important when making the decision to participate in outdoor recreational activities in OB and RL parks in Florida. The responses to this survey were used for a posterior analysis in which an ordered probit was applied.

Initially, three attributes were obtained: plant species, animal species, and facilities; however, since a group of categories from the sample demographics did not match with Florida's population proportions, a refinement was applied to reduce the margin of error. Therefore, the sample was weighted using the probability of occurrence of each observation in the sample and the general population. That provided us with one weight for each observation of the sample. Using this weighted sample, new estimators were obtained and a new simulation was applied.

The results obtained were the same as those in the original model; that is, the three most important attributes of an aquatic park for people wee plant species, animal species, and facilities. This result was also contrasted with another survey question in which it was asked in which areas people considered governmental investment in those parks to be appropriate. The result was the same with a clear preponderance of the three attributes already selected. All of these allow us to reasonably conclude that for Floridians the three most important attributes for both types of aquatic parks (OB and RL) are plant species, animal species, and facilities. These attributes will be applied in the core analysis of this research, where we will estimate the value that people give to the problem of invasive species in natural locations in Florida.

Table 3-1 Socioeconomic characteristics for the survey sample and comparisons to the Florida population.

Category	Sample	Florida
Urban	46.51%	47.00%
Suburban	45.58%	44.00%
Rural	7.91%	9.00%
Male	48.84%	48.80%
Female	51.16%	51.20%
18 - 25 years	8.37%	7.80%
26 - 35 years	18.14%	16.88%
36 - 45 years	20.47%	20.12%
46 - 55 years	20.00%	16.75%
56 - 65 years	15.35%	12.59%
More than 65 years	17.67%	25.85%
Single	20.93%	23.80%
Married	59.07%	54.30%
Other	20.00%	21.90%
High school or less	22.33%	48.90%
Some college courses	13.02%	21.80%
Associate	5.12%	7.00%
Bachelor's	20.47%	14.30%
Some Graduate	13.02%	2.00%
Graduate	26.04%	6.00%
Unemployed	2.44%	3.20%
Employed	56.28%	54.90%
Not in labor force	41.28%	41.90%
Less than $20.000	26.51%	34.00%
$20,000 - $39,999	10.70%	15.00%
$40,000 - $59,999	9.30%	19.00%
$60,000 - $79,999	8.37%	14.00%
$80,000 - $99,999	12.09%	5.00%
$100,000 - $120,000	10.23%	4.00%
More than $120,000	22.80%	9.00%

Source: U.S. Census Bureau 2000

Table 3-2 Frequency of travel to state aquatic parks by survey's respondents.

Type of park	Daily	Weekly	Monthly	2 - 3 months	4 - 6 months	7 - 12 months	Not at all
Ocean / Beach	0.93%	16.28%	26.05%	28.84%	13.49%	8.84%	5.58%
River / Lake	2.10%	11.39%	16.28%	26.98%	15.35%	13.95%	13.95%

Table 3-3 Closest distance traveled to a state aquatic park by survey respondents

Type of Park	0 to 15 miles	16 to 30 miles	31 to 45 miles	46 to 60 miles	61 to 75 miles	More than 75 miles
Ocean / Beach	41.04%	14.62%	6.60%	15.09%	10.85%	11.79%
River / Lake	59.90%	21.32%	8.63%	4.57%	1.02%	4.57%

Table 3-4 Farthest distance traveled to a state aquatic park by survey respondents

Type of Park	0 to 40 miles	41 to 80 miles	81 to 120 miles	121 to 160 miles	161 to 200 miles	More than 200 miles
Ocean / Beach	20.50%	16.50%	14.00%	11.00%	10.00%	28.00%
River / Lake	32.72%	20.99%	9.88%	9.26%	10.49%	16.67%

Table 3-5 Time spent in a state aquatic park by survey respondents

Type of Park	Less than 1 hour	1 - 2 hours	3 - 6 hours	7 hours - one day	2 - 3 days	3 - 7 days	More than 7 days
Ocean / Beach	5.66%	18.40%	44.81%	18.87%	8.02%	3.30%	0.94%
River / Lake	10.81%	22.70%	39.46%	17.84%	7.57%	1.08%	0.54%

Table 3-6 Money spent in a state aquatic park by survey respondents

Type of Park	Less than $10	$10 - $50	$51 - $100	$101 - $150	$151 - $250	$251 - $350	$351 - $500	More than $500
Ocean / Beach	38.05%	39.51%	8.78%	3.90%	2.44%	2.93%	2.93%	1.46%
River / Lake	43.65%	44.75%	6.63%	2.76%	1.10%	1.10%	0.00%	0.00%

Table 3-7 Explanatory predictors for ordered probit models

Variable	Definition
Residence	Dummy variable that represents the respondent's type of residence in Florida.
Freq	Dummy variable that represents the frequency with which respondent participates in outdoor recreational activities in the specific natural location.
Time	Dummy variable that represents the time spent for each visit to the specific location.
Location	Dummy variable that indicates the residence of respondents, according to three categories: urban, suburban and rural.
Gender	Dummy variable that indicates the respondent's gender.
Age	Dummy variable that represents different ranges of age, which go from 18 to more than 65 years old.
Marital	Dummy variable that represents the marital status of the respondent.
Education	Dummy variable that represents the degree of education level for the respondent, which varies from some college courses to graduate studies.
Employment	Dummy variable that represents different types of employment status for respondents.
Income	Dummy variable that represents different ranges of income for respondents, which go from less than \$20,000 to more than \$120,000 annually.
EC	Dummy variable that represents the respondents' answers about their degree of environmental consciousness.

Table 3-8 Likelihood Ratio statistics and pseudo-R2 for the attribute models for ocean/beach location

	Animal Species	Facilities	Plant Species	Number of Visitors	Traveled Distance	Fees
LR Statistics	79.667	87.974	80.963	67.312	73.307	70.922
P-value (LR)	0.000	0.000	0.000	0.006	0.001	0.003
Pseudo R2	0.121	0.153	0.171	0.099	0.135	0.126

Table 3-9 Likelihood Ratio statistics and pseudo-R^2 for the attribute models for the rive/lake location

	Animal Species	Facilities	Plant Species	Number of Visitors	Traveled Distance	Fees
LR Statistics	142.360	74.652	129.795	63.282	75.796	95.442
P-value (LR)	0.000	0.001	0.000	0.014	0.001	0.000
Pseudo R2	0.311	0.142	0.307	0.118	0.135	0.181

Table 3-10 Likelihood Ratio statistics and pseudo R^2 for the attribute models for ocean/beach location – weighted sample

	Animal Species	Facilities	Plant Species	Number of Visitors	Traveled Distance	Fees
LR Statistics	82.344	95.745	83.792	74.757	74.499	78.182
P-value (LR)	0.000	0.000	0.000	0.001	0.001	0.000
Pseudo R2	0.160	0.354	0.192	0.102	0.140	0.188

Table 3-11 Likelihood Ratio statistics and pseudo R^2 for the attribute models for ocean/beach location – weighted sample

	Animal Species	Facilities	Plant Species	Number of Visitors	Traveled Distance	Fees
LR Statistics	117.18	79.795	134.114	61.712	82.060	110.000
P-value (LR)	0.000	0.000	0.000	0.020	0.000	0.000
Pseudo R2	0.384	0.158	0.346	0.105	0.159	0.203

Table 3-12 Tax preferences of survey respondents for improvement investments in ocean/beach and river/lake parks

	Improvement of Parks by Attributes				
Type of Park	Animal Species	Facilities	Plant Species	Number of Visitors	Fees
Ocean/Beach	28.29%	33.47%	18.73%	15.14%	4.38%
River/Lake	37.85%	28.29%	20.72%	6.77%	3.19%

		ANIMAL SPECIES		FACILITIES		PLANT SPECIES		NUMBER OF VISITORS		TRAVELED DISTANCE		FEES	
		Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Residence	Seasonally	-0.624	-1.621	0.068	0.165	-0.894	-1.564	0.136	0.340	-0.521	-1.344	-0.184	-0.427
Freq 1	Daily	-1.105	-2.105	-0.507	-0.875	0.199	0.320	0.419	0.847	1.789	3.105	0.289	0.543
Freq 2	Weekly	-0.780	-1.737	-0.561	-1.168	0.093	0.186	0.009	0.023	0.806	2.219	0.566	1.562
Freq 3	Monthly	-0.320	-0.890	0.186	0.444	0.212	0.488	0.088	0.257	0.742	2.365	0.557	1.818
Freq 4	3 months	-0.760	-1.959	0.159	0.368	-0.026	-0.057	-0.095	-0.279	0.765	2.386	0.661	2.127
Freq 5	6 months	-0.028	-0.239	-0.035	-0.143	-0.189	-0.406	-0.525	-1.271	1.063	2.677	0.624	1.898
Freq 6	Year	-0.083	-0.183	-0.040	-0.399	0.374	0.724	0.440	0.866	1.113	2.746	0.743	1.825
Time 1	less than 1 hour	-0.013	-0.323	0.109	0.223	-0.714	-1.383	0.223	0.513	-0.215	-0.653	-0.243	-0.628
Time 2	1 - 2 hours	0.465	1.152	-0.047	-0.182	-0.600	-1.267	0.070	0.195	-0.831	-2.548	-0.819	-2.432
Time 3	3 - 6 hours	0.214	0.572	-0.017	-0.144	-0.778	-1.784	-0.441	-1.366	-0.833	-2.823	-0.453	-1.592
Time 4	7 hours - one day	-0.810	-1.920	0.955	2.116	-0.745	-1.556	-0.671	-1.761	-0.613	-1.935	-0.638	-1.920
Time 5	2 - 3 days	-0.255	-0.426	0.234	0.454	-0.303	-0.564	-0.071	-0.169	-0.396	-1.041	-0.495	-1.301
Time 6	3 - 7 days	0.777	1.286	0.464	0.776	-0.643	-0.976	-0.486	-1.031	-0.864	-1.673	-0.442	-1.030
Location 1	Urban	0.054	0.163	0.329	0.967	-0.245	-0.688	0.145	0.364	-0.563	-1.721	-0.776	-2.557
Location 2	Suburban	0.053	0.156	0.134	0.397	-0.488	-1.371	0.179	0.452	-0.544	-1.673	-0.457	-1.537
Gender	Male	0.483	2.442	0.245	1.264	0.630	2.853	0.480	2.541	0.263	1.268	0.473	2.489
Age 1	18 - 25 years	0.462	0.713	-1.305	-2.094	0.614	0.880	-1.159	-1.808	0.063	0.090	-1.143	-1.637
Age 2	26 - 35 years	-0.606	-0.997	-1.118	-2.065	-0.186	-0.300	-0.544	-0.912	0.124	0.202	-0.049	-0.080
Age 3	36 - 45 years	-0.147	-0.267	-0.980	-2.122	0.044	0.086	-0.646	-1.249	0.118	0.221	-0.618	-1.291
Age 4	46 - 55 years	-0.153	-0.292	-0.773	-1.742	0.121	0.243	-0.656	-1.298	0.038	0.068	-0.492	-1.071
Age 5	56 - 65 years	-0.616	-1.189	-1.139	-2.615	0.016	0.032	-0.447	-0.924	0.404	0.739	0.081	0.183
Marital 1	Single	-0.833	-2.067	0.989	2.477	-0.190	-0.422	0.086	0.221	-0.293	-0.751	-0.039	-0.088
Marital 2	Married	-0.569	-2.164	0.352	1.308	-0.256	-0.886	-0.430	-1.718	-0.632	-2.209	-0.465	-1.662
Education 1	Some college courses	-0.521	-0.934	0.362	0.763	-0.070	-0.128	-0.269	-0.535	-1.047	-2.422	-0.373	-1.012
Education 2	Associate	-0.332	-0.526	0.342	0.599	0.568	0.931	-0.193	-0.325	-1.148	-2.418	-0.207	-0.405
Education 3	Bachelor's	-0.396	-0.750	0.743	1.638	0.133	0.264	-0.305	-0.605	-1.348	-3.405	-0.506	-1.571
Education 4	Some Graduate	-0.344	-0.598	1.213	2.404	0.446	0.800	0.164	0.306	-1.288	-2.920	-0.166	-0.444
Education 5	Graduate	-0.334	-0.640	0.604	1.348	0.104	0.208	-0.237	-0.481	-1.422	-3.583	-0.361	-1.097
Employment 1	Employed full-time	0.104	0.165	-1.779	-3.668	-1.103	-2.151	-0.745	-1.372	-0.893	-1.608	-0.714	-1.540
Employment 2	Homemaker	1.273	0.712	0.389	0.353	-1.077	-0.916	0.473	0.611	0.546	0.595	1.198	1.478
Employment 3	Student	0.104	0.143	-2.396	-3.571	-1.781	-2.421	-0.611	-0.853	-0.575	-0.767	-0.236	-0.373
Employment 4	Retired	0.444	0.665	-2.641	-4.458	-0.997	-1.640	-0.762	-1.408	-1.914	-2.576	-1.854	-3.311
Income 1	$20,000 - $39,999	0.161	0.453	-0.334	0.348	-0.151	-0.380	-0.313	-0.877	0.419	1.225	0.042	0.112
Income 2	$40,000 - $59,999	0.208	0.643	0.212	0.341	-0.157	-0.414	0.478	1.346	0.726	1.891	0.427	1.342
Income 3	$60,000 - $79,999	0.004	0.188	-0.519	0.361	0.201	0.526	0.344	0.903	0.342	0.877	0.047	0.131
Income 4	$80,000 - $99,999	0.800	2.069	-0.727	0.341	-0.086	-0.235	-0.006	-0.016	0.907	2.653	0.641	1.930
Income 5	$100,000 - $120,000	0.475	1.377	-0.029	0.144	-0.121	-0.324	0.201	0.567	0.286	0.901	0.725	1.909
Income 6	More than $120,000	0.199	0.611	-0.013	0.017	-0.241	-0.698	0.077	0.233	0.821	2.531	1.062	3.066
EC 1	Little	-0.415	-1.221	0.216	0.373	-0.749	-1.967	0.433	1.347	0.651	1.809	0.165	0.442
EC 2	Moderate	-0.461	-1.384	-0.405	0.380	-0.918	-2.350	0.492	1.602	0.781	2.131	0.138	0.385
EC 3	Very/Extremely	-0.972	-2.561	0.293	0.412	-1.409	-3.171	-0.113	-0.287	0.446	1.036	-0.172	-0.421
Threshold Values	γ1	-1.512	-4.369	-1.837	-4.499	-2.362	-5.347	-1.867	-5.186	-2.551	-7.136	-2.651	-7.415
	γ2	-0.421	-2.302	-0.400	-1.803	-0.949	-2.282	-0.506	-3.334	-0.894	-2.806	-0.951	-3.029
	γ3	0.516	1.661	0.807	2.049	0.493	1.747	0.672	1.812	0.334	3.091	0.324	1.779
	γ4	0.786	2.397	1.084	2.661	0.619	1.951	1.374	2.922	0.610	2.019	0.861	2.786

Figure 3-1 Coefficient estimates for the attribute models for ocean/beach location

VARIABLES		ANIMAL SPECIES		FACILITIES		PLANT SPECIES		NUMBER OF VISITORS		TRAVELED DISTANCE		FEES	
		Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Residence	Seasonally	-0.140	-0.307	0.319	0.828	-0.227	-0.489	0.027	0.088	0.313	0.276	0.454	1.356
Freq 1	Daily	1.210	2.019	0.671	1.152	0.818	1.202	-0.234	-0.353	-0.688	0.641	1.469	2.853
Freq 2	Weekly	-0.461	-1.006	-0.089	-0.247	0.300	0.720	-0.851	-2.243	-0.175	0.350	0.148	0.418
Freq 3	Monthly	-0.665	-1.838	-0.204	-0.639	-0.861	-2.033	-0.521	-1.609	0.030	0.313	-0.240	-0.743
Freq 4	3 months	0.077	0.221	-0.065	-0.215	0.230	0.644	-0.874	-2.892	-0.017	0.271	0.018	0.070
Freq 5	6 months	-0.004	-0.009	-0.112	-0.324	0.683	1.725	-0.553	-1.648	0.321	0.277	0.570	1.801
Freq 6	Year	0.477	1.238	-0.233	-0.696	0.256	0.659	0.001	0.002	0.239	0.263	0.456	1.656
Time 1	less than 1 hour	0.147	0.360	0.206	0.612	0.127	0.329	0.136	0.454	0.334	0.418	0.532	1.604
Time 2	1 - 2 hours	0.122	0.422	-0.185	-0.681	-0.119	-0.374	-0.433	-1.614	-0.288	0.259	-0.830	-3.136
Time 3	3 - 6 hours	-0.068	-0.236	0.137	0.572	-0.244	-0.873	-0.380	-1.655	-0.124	0.222	-0.108	-0.516
Time 4	7 hours - one day	0.031	0.090	-0.192	-0.697	-0.427	-1.288	-0.216	-0.751	-0.099	0.304	-0.098	-0.337
Time 5	2 - 3 days	1.045	1.970	0.131	0.326	0.167	0.354	-0.217	-0.528	0.427	0.375	0.335	0.816
Time 6	3 - 7 days	-0.572	-1.260	-0.471	-0.950	-0.548	-0.923	0.304	0.587	-0.102	0.359	-1.207	-2.569
Location 1	Urban	-0.706	-1.690	0.128	0.360	-0.944	-2.242	-0.073	-0.165	-1.065	0.385	-0.696	-1.860
Location 2	Suburban	-0.689	-1.599	0.213	0.596	-0.714	-1.702	-0.181	-0.396	-0.763	0.410	-0.406	-1.054
Gender	Male	0.224	0.879	0.309	1.626	0.118	0.517	0.347	1.789	0.462	0.215	0.409	1.825
Age 1	18 - 25 years	-0.200	-0.303	-0.641	-1.245	-1.356	-2.286	-0.024	-0.039	0.060	0.631	-0.354	-0.606
Age 2	26 - 35 years	-1.225	-1.890	-1.060	-2.182	-1.382	-2.588	-0.393	-0.706	0.218	0.623	0.551	1.010
Age 3	36 - 45 years	-1.433	-2.413	-0.604	-1.367	-1.271	-2.590	-0.705	-1.379	0.120	0.618	-0.569	-1.218
Age 4	46 - 55 years	-1.054	-1.730	-0.361	-0.839	-1.351	-2.810	-0.669	-1.267	0.705	0.645	-0.420	-0.881
Age 5	56 - 65 years	-2.448	-3.849	-0.641	-1.506	-1.954	-3.832	-0.384	-0.728	0.751	0.609	-0.092	-0.200
Marital 1	Single	-1.363	-2.959	0.512	1.356	-0.223	-0.499	-0.262	-0.663	0.281	0.365	-0.198	-0.448
Marital 2	Married	-1.538	-5.052	-0.168	-0.633	-0.544	-1.812	-0.246	-1.091	0.204	0.297	-0.507	-1.700
Education 1	Some college courses	0.481	0.948	-1.156	-2.587	-0.144	-0.275	0.063	0.115	-1.531	0.514	-1.452	-2.957
Education 2	Associate	1.462	2.215	-1.116	-1.814	0.947	1.449	0.060	0.093	-1.491	0.519	-1.180	-2.346
Education 3	Bachelor's	0.842	1.800	-1.010	-2.314	-0.099	-0.195	-0.428	-0.730	-2.023	0.507	-1.772	-3.768
Education 4	Some Graduate	0.797	1.450	-0.727	-1.627	0.250	0.479	-0.259	-0.458	-1.357	0.509	-1.277	-2.609
Education 5	Graduate	0.887	1.913	-0.814	-1.888	-0.099	-0.193	-0.123	-0.219	-1.841	0.481	-1.591	-3.393
Employment 1	Employed full-time	0.302	0.952	-0.108	-0.427	0.123	0.391	-0.101	-0.380	-0.090	0.309	-0.117	-0.402
Employment 2	Homemaker	0.037	0.073	1.177	1.651	-0.165	-0.178	0.739	1.305	-0.106	0.332	0.064	0.153
Employment 3	Student	-0.067	-0.234	0.440	1.664	0.061	0.199	-0.199	-0.684	0.012	0.237	0.248	0.985
Employment 4	Retired	-0.555	-1.796	0.320	0.806	-0.648	-1.190	-0.153	-0.357	0.335	0.365	-0.137	-0.377
Income 1	$20,000 - $39,999	0.103	0.311	-0.072	-0.238	-0.371	-1.021	-0.424	-1.417	0.302	0.315	-0.283	-0.854
Income 2	$40,000 - $59,999	0.134	0.359	-0.078	-0.236	-0.475	-1.197	-0.142	-0.454	0.216	0.328	-0.059	-0.174
Income 3	$60,000 - $79,999	-0.368	-0.811	-0.584	-1.577	-0.517	-1.144	0.006	0.016	0.452	0.349	0.522	1.315
Income 4	$80,000 - $99,999	0.616	1.330	-0.533	-1.478	-0.491	-1.103	0.074	0.201	0.628	0.377	0.848	2.298
Income 5	$100,000 - $120,000	0.507	1.112	0.455	1.285	0.077	0.190	0.518	1.333	-0.098	0.385	1.218	3.189
Income 6	More than $120,000	0.566	1.448	-0.205	-0.656	-0.230	-0.632	-0.014	-0.042	0.494	0.319	0.967	2.773
EC 1	Little	-0.453	-0.959	0.199	0.501	-0.184	-0.437	0.230	0.544	0.429	0.472	0.715	1.789
EC 2	Moderate	-0.755	-1.587	0.064	0.164	-0.518	-1.259	0.152	0.340	0.465	0.447	0.878	2.312
EC 3	Very/Extremely	-1.313	-2.575	0.176	0.426	-0.707	-1.586	-0.179	-0.399	0.210	0.493	0.358	0.780
Threshold Values	$\gamma 1$	-2.088	-6.693	-1.812	-5.583	-2.719	-6.637	-2.358	-8.064	-2.361	-8.991	-2.605	-8.743
	$\gamma 2$	-0.834	-3.129	-0.441	-1.435	-1.225	-3.253	-1.000	-4.003	-0.707	-3.432	-0.766	-3.165
	$\gamma 3$	0.954	3.042	1.012	3.250	0.000	0.000	0.437	1.857	0.761	3.678	0.637	2.816
	$\gamma 4$	1.185	3.092	1.198	3.688	0.952	2.442	0.992	3.610	1.263	5.216	1.007	4.030

Figure 3-2 Coefficient estimates for the attributes model for river/lake location

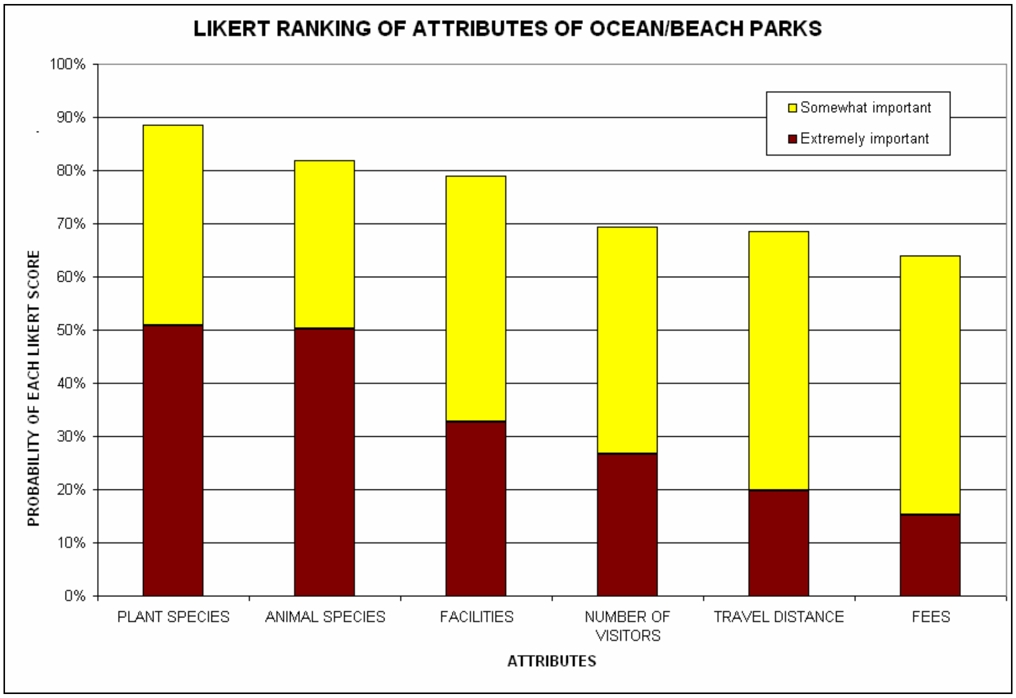

Figure 3-3 Rankings of ocean/beach park attributes based on the order probit unweighted models and the survey responses

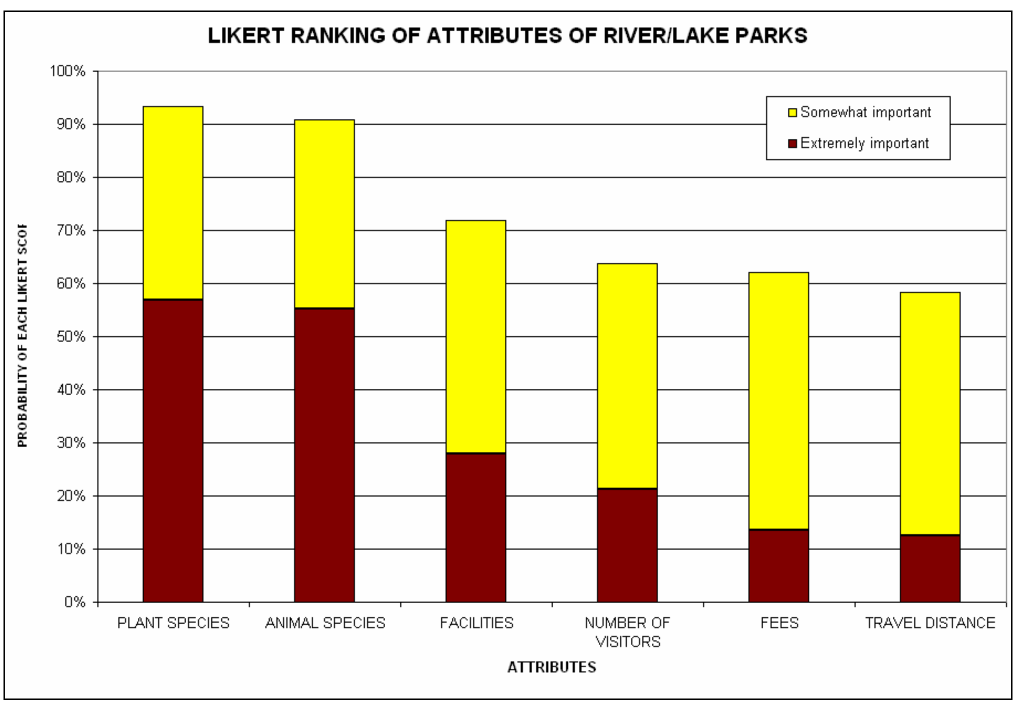

Figure 3-4 Rankings of river/lake park attributes based on the order probit unweighted models and the survey responses

		ANIMAL SPECIES		FACILITIES		PLANT SPECIES		NUMBER OF VISITORS		TRAVELED DISTANCE		FEES	
		Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Residence	Seasonally	-0.230	-1.170	-0.058	-0.310	-0.220	-1.000	0.275	1.600	0.283	1.650	0.380	2.250
Freq 1	Daily	0.907	2.610	0.493	0.910	1.015	1.730	-0.204	-0.380	0.698	1.290	0.312	0.580
Freq 2	Weekly	0.499	2.380	0.169	0.850	0.157	0.730	0.586	3.090	0.418	2.170	0.323	1.720
Freq 3	Monthly	0.311	1.580	0.011	0.060	-0.091	-0.440	-0.117	-0.700	-0.111	-0.680	-0.065	-0.400
Freq 4	3 months	-0.100	-2.550	0.130	0.810	-0.264	-1.430	-0.039	-0.260	-0.071	-0.480	0.019	0.130
Freq 5	6 months	0.200	0.900	-0.027	-0.130	0.088	0.370	-0.191	-1.980	0.030	0.150	-0.004	-0.020
Freq 6	Year	0.139	0.710	-0.070	-0.400	0.021	0.780	0.026	0.150	0.278	1.620	0.193	1.150
Time 1	less than 1 hour	-0.033	-0.180	0.057	0.320	0.029	0.140	0.189	1.060	0.206	1.140	0.174	0.990
Time 2	1 - 2 hours	-0.232	-1.420	-0.156	-1.000	-0.142	-0.780	0.232	1.580	0.333	2.280	0.290	2.030
Time 3	3 - 6 hours	-0.142	-2.190	0.161	1.280	-0.080	-0.550	0.120	0.960	-0.010	-0.130	0.131	1.070
Time 4	7 hours - one day	-0.159	-2.110	0.048	0.310	-0.109	-0.590	0.023	0.150	-0.062	-0.410	0.050	0.340
Time 5	2 - 3 days	-0.799	-2.380	-0.128	-0.530	-0.536	-2.920	-0.257	-2.130	-0.077	-0.350	-0.041	-0.180
Time 6	3 - 7 days	-0.266	-1.090	-0.082	-0.350	-0.251	-1.990	0.570	2.520	0.642	2.780	0.455	2.010
Location 1	Urban	0.106	0.570	0.208	1.130	0.478	2.150	0.204	2.170	0.345	1.980	0.457	2.640
Location 2	Suburban	-0.006	-0.030	0.130	0.680	0.334	2.260	0.049	0.270	0.284	1.560	0.366	2.010
Gender	Male	-0.111	-1.010	0.227	2.130	-0.159	-1.180	0.123	1.190	0.055	0.540	-0.017	-0.170
Age 1	18 - 25 years	0.646	2.020	-0.155	-2.570	0.079	0.250	-0.472	-2.190	-0.484	-1.840	-0.491	-1.900
Age 2	26 - 35 years	0.592	1.960	-0.035	-1.980	-0.112	-2.390	-0.310	-2.300	-0.528	-2.200	-0.541	-2.260
Age 3	36 - 45 years	0.289	1.990	-0.166	-2.140	-0.258	-0.880	-0.236	-2.050	-0.427	-1.680	-0.627	-2.460
Age 4	46 - 55 years	-0.083	-0.260	0.061	2.030	-0.722	-2.180	-0.259	-2.030	-0.406	-1.600	-0.515	-2.040
Age 5	56 - 65 years	0.097	0.330	-0.167	-2.100	-0.739	-2.410	-0.252	-2.110	-0.587	-2.540	-0.768	-3.280
Marital 1	Single	-0.590	-2.670	0.110	2.540	0.126	0.420	0.175	0.850	0.391	1.930	0.157	0.800
Marital 2	Married	-0.240	-1.510	-0.258	-1.750	0.331	1.430	0.073	0.510	0.222	1.560	0.268	1.910
Education 1	Some college courses	0.080	0.300	-0.278	-1.080	-0.028	-0.090	0.446	1.780	0.393	1.570	0.116	0.480
Education 2	Associate	-0.756	-1.300	-0.683	-1.290	-0.953	-1.480	0.572	1.180	0.395	0.800	0.027	0.060
Education 3	Bachelor's	0.097	0.310	-0.424	-1.440	-0.699	-2.040	0.260	0.890	0.164	0.560	0.071	0.250
Education 4	Some Graduate	0.153	0.580	-0.318	-1.280	-0.234	-1.820	0.229	0.940	-0.096	-0.390	-0.163	-0.690
Education 5	Graduate	-0.017	-2.070	-0.444	-1.770	-0.126	-0.440	0.178	0.720	0.243	0.980	0.046	0.190
Employment 1	Employed full-time	0.154	1.170	-0.193	-1.590	0.033	1.220	-0.053	-0.450	-0.047	-0.400	-0.011	-0.100
Employment 2	Homemaker	-0.217	-0.540	-0.083	-2.240	-0.167	-0.410	-0.592	-1.690	-0.776	-2.100	-0.369	-1.130
Employment 3	Student	0.100	0.810	0.030	2.240	-0.104	-0.720	-0.370	-3.000	-0.336	-2.730	-0.363	-2.990
Employment 4	Retired	-0.593	-1.730	0.214	0.810	-0.041	-1.140	-0.129	-0.490	0.040	0.150	-0.116	-0.460
Income 1	$20,000 - $39,999	0.164	1.140	0.183	1.340	0.155	0.930	-0.091	-0.670	-0.156	-1.190	0.028	0.220
Income 2	$40,000 - $59,999	0.203	1.330	0.205	1.400	0.289	2.130	-0.136	-0.960	-0.145	-1.040	0.080	0.600
Income 3	$60,000 - $79,999	-0.869	-1.650	0.215	2.430	-1.111	-1.940	-0.058	-2.020	-0.099	-0.210	0.101	0.210
Income 4	$80,000 - $99,999	-0.249	-0.530	0.424	1.990	-0.331	-0.660	0.420	0.960	-0.296	-0.680	-0.085	-0.200
Income 5	$100,000 - $120,000	-0.547	-1.160	-0.067	-2.150	-0.374	-0.730	0.850	1.940	0.284	0.650	0.835	1.920
Income 6	More than $120,000	-0.430	-0.670	-0.547	-1.970	-1.773	-2.470	-0.355	-0.590	0.108	0.180	0.475	0.800
EC 1	Little	-0.482	-1.560	0.164	0.630	-0.708	-2.260	-0.160	-1.330	-0.062	-0.250	0.135	0.540
EC 2	Moderate	-0.421	-1.380	0.093	2.360	-0.326	-2.130	-0.256	-2.020	-0.235	-0.960	-0.112	-0.460
EC 3	Very/Extremely	-0.417	-2.300	0.425	1.510	-0.299	-2.000	-0.373	-2.060	-0.152	-0.560	0.082	0.310
Threshold Values	$\gamma 1$	-0.911	-2.592	-0.963	-2.797	-0.791	-2.069	-0.708	-2.099	-0.810	-2.406	-0.791	-2.368
	$\gamma 2$	0.863	2.445	0.942	2.713	0.955	2.446	0.682	2.053	0.680	2.054	0.670	2.052
	$\gamma 3$	1.105	3.030	1.628	4.445	1.601	3.711	1.120	3.330	1.275	3.778	1.450	4.317
	$\gamma 4$	1.401	3.746	1.889	4.970	1.791	3.907	1.782	5.004	1.735	4.969	2.047	5.791

Figure 3-5 Coefficient estimates for the attribute models for ocean/beach location – weighted sample

		ANIMAL SPECIES		FACILITIES		PLANT SPECIES		NUMBER OF VISITORS		TRAVELED DISTANCE		FEES	
		Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Residence	Seasonally	-0.172	-0.800	0.238	0.164	-0.028	0.883	0.053	0.323	0.060	0.355	0.081	0.628
Freq 1	Daily	0.625	1.060	0.700	0.200	0.402	0.510	-0.288	-0.547	0.243	0.461	0.380	0.478
Freq 2	Weekly	-0.065	-0.220	0.321	0.098	0.474	0.048	-0.389	-2.010	-0.176	-0.958	0.197	0.287
Freq 3	Monthly	-0.071	-0.340	0.269	0.116	-0.032	0.872	-0.216	-1.343	-0.046	-0.283	-0.009	0.957
Freq 4	3 months	0.290	1.460	0.214	0.178	0.234	0.219	-0.225	-1.533	-0.021	-0.143	0.044	0.769
Freq 5	6 months	0.271	1.110	0.181	0.372	0.582	0.014	-0.364	-1.839	-0.017	-0.085	-0.089	0.658
Freq 6	Year	0.802	3.480	0.181	0.302	0.441	0.036	-0.412	-2.465	-0.158	-0.940	-0.803	0.000
Time 1	less than 1 hour	0.165	0.710	0.220	0.226	0.127	0.553	-0.052	-0.309	0.280	1.640	0.050	0.772
Time 2	1 - 2 hours	-0.047	-0.240	-0.107	0.494	-0.084	0.640	-0.038	-0.265	0.001	0.005	-0.077	0.593
Time 3	3 - 6 hours	-0.038	-0.230	0.153	0.230	-0.053	0.710	-0.476	-3.882	0.117	0.962	0.099	0.416
Time 4	7 hours - one day	0.056	0.280	0.412	0.007	-0.244	0.202	-0.141	-0.920	0.087	0.579	-0.069	0.643
Time 5	2 - 3 days	0.514	1.900	-0.033	0.887	0.153	0.548	-0.074	-0.336	0.218	0.982	0.164	0.458
Time 6	3 - 7 days	0.026	0.100	-0.412	0.081	-0.624	0.015	0.143	0.643	0.518	2.305	-0.199	0.380
Location 1	Urban	-0.458	-1.890	0.303	0.109	-0.446	0.035	0.063	0.359	-0.241	-1.389	-0.101	0.569
Location 2	Suburban	-0.455	-1.790	0.291	0.140	-0.331	0.134	0.105	0.579	-0.070	-0.384	0.101	0.587
Gender	Male	-0.034	-0.250	0.308	0.004	-0.045	0.722	0.165	1.635	0.268	2.657	0.186	0.068
Age 1	18 - 25 years	0.128	0.360	-0.120	0.647	-0.123	0.694	0.208	0.818	0.721	2.800	-0.335	0.195
Age 2	26 - 35 years	-0.502	-1.600	-0.470	0.056	-0.272	0.337	-0.168	-0.716	0.062	0.262	-0.290	0.220
Age 3	36 - 45 years	-0.668	-1.890	-0.218	0.398	-0.232	0.437	-0.060	-0.240	0.119	0.471	-0.315	0.211
Age 4	46 - 55 years	-0.233	-0.770	-0.345	0.181	-0.374	0.200	0.131	0.530	0.567	2.257	-0.170	0.494
Age 5	56 - 65 years	-1.160	-3.350	-0.300	0.203	-0.712	0.015	0.230	1.026	0.406	1.788	-0.091	0.688
Marital 1	Single	-0.592	-2.210	0.031	0.879	-0.240	0.312	-0.238	-1.199	0.034	0.176	-0.114	0.567
Marital 2	Married	-0.716	-3.840	-0.187	0.211	-0.279	0.092	-0.140	-1.000	-0.034	-0.249	-0.223	0.114
Education 1	Some college courses	0.659	1.830	-0.633	0.017	0.273	0.371	-0.107	-0.420	-0.862	-3.433	-0.673	0.007
Education 2	Associate	1.354	2.280	-0.589	0.253	1.104	0.043	-0.195	-0.399	-1.448	-2.878	-0.821	0.100
Education 3	Bachelor's	0.690	1.780	-0.463	0.120	0.532	0.121	-0.124	-0.432	-0.934	-3.213	-0.492	0.086
Education 4	Some Graduate	0.378	1.090	-0.601	0.016	0.247	0.401	0.056	0.234	-0.574	-2.417	-0.223	0.342
Education 5	Graduate	0.651	1.780	-0.578	0.023	0.196	0.530	0.264	1.079	-0.536	-2.220	-0.189	0.428
Employment 1	Employed full-time	0.083	0.480	-0.080	0.504	0.901	0.000	-0.067	-0.574	0.039	0.341	0.031	0.786
Employment 2	Homemaker	0.221	0.580	0.693	0.035	0.213	0.566	0.080	0.249	-0.149	-0.457	0.931	0.004
Employment 3	Student	-0.066	-0.460	0.150	0.222	0.074	0.588	-0.161	-1.296	0.129	1.088	0.065	0.590
Employment 4	Retired	0.088	0.300	0.693	0.008	0.416	0.159	0.296	1.181	0.409	1.614	0.371	0.143
Income 1	$20,000 - $39,999	-0.157	-0.860	0.210	0.122	-0.256	0.125	-0.809	-6.222	0.107	0.833	0.011	0.935
Income 2	$40,000 - $59,999	-0.211	-0.446	0.117	0.424	-0.150	0.403	0.159	1.171	0.155	1.138	0.185	0.183
Income 3	$60,000 - $79,999	-1.157	-1.800	0.209	0.677	-1.170	0.047	-0.961	-2.027	0.814	1.711	-0.407	0.395
Income 4	$80,000 - $99,999	-0.216	-0.410	-0.069	0.884	-1.006	0.060	-0.652	-1.491	0.704	1.614	-0.254	0.561
Income 5	$100,000 - $120,000	-0.094	-0.180	1.102	0.017	-0.481	0.346	-0.447	-1.021	-0.085	-0.193	0.473	0.287
Income 6	More than $120,000	-0.369	-0.500	0.719	0.261	-1.167	0.102	-1.247	-2.057	-0.561	-0.924	-0.357	0.558
EC 1	Little	0.296	1.010	0.387	0.146	0.368	0.199	-0.496	-1.962	0.170	0.674	0.490	0.052
EC 2	Moderate	0.172	0.590	0.445	0.087	0.192	0.492	-0.691	-2.782	0.101	0.407	0.641	0.009
EC 3	Very/Extremely	-0.300	-0.900	0.577	0.045	-0.090	0.774	-0.510	-1.859	-0.125	-0.462	0.525	0.053
Threshold Values	γ_1	-0.860	-2.064	-0.842	-2.409	-0.820	-2.118	-1.930	-5.496	-1.910	-5.431	-1.994	-9.479
	γ_2	1.046	2.457	1.446	4.025	1.146	2.863	-0.719	-2.165	-0.961	-2.897	-0.380	-3.677
	γ_3	1.945	4.288	2.524	6.448	0.000	0.000	0.606	1.843	0.740	2.228	0.627	2.771
	γ_4	2.164	4.615	2.738	6.769	2.032	0.458	0.821	2.392	1.224	3.579	0.967	4.133

Figure 3-6 Coefficient estimates for the attribute models for river/lake location – weighted sample

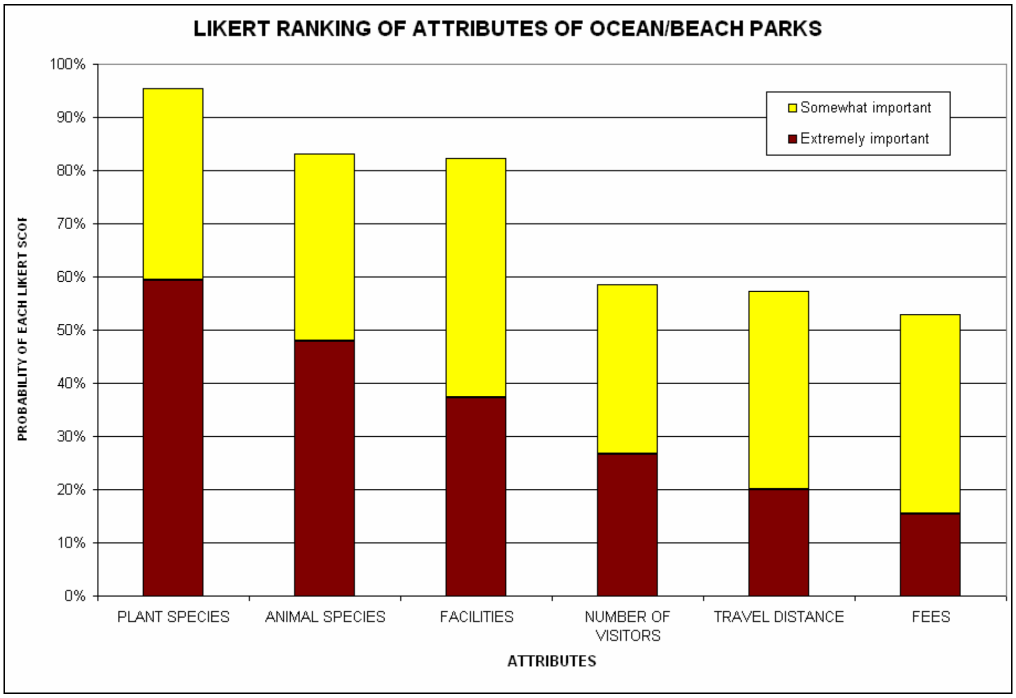

Figure 3-7 Rankings of ocean/beach park attributes based on the order probit weighted models and the survey responses

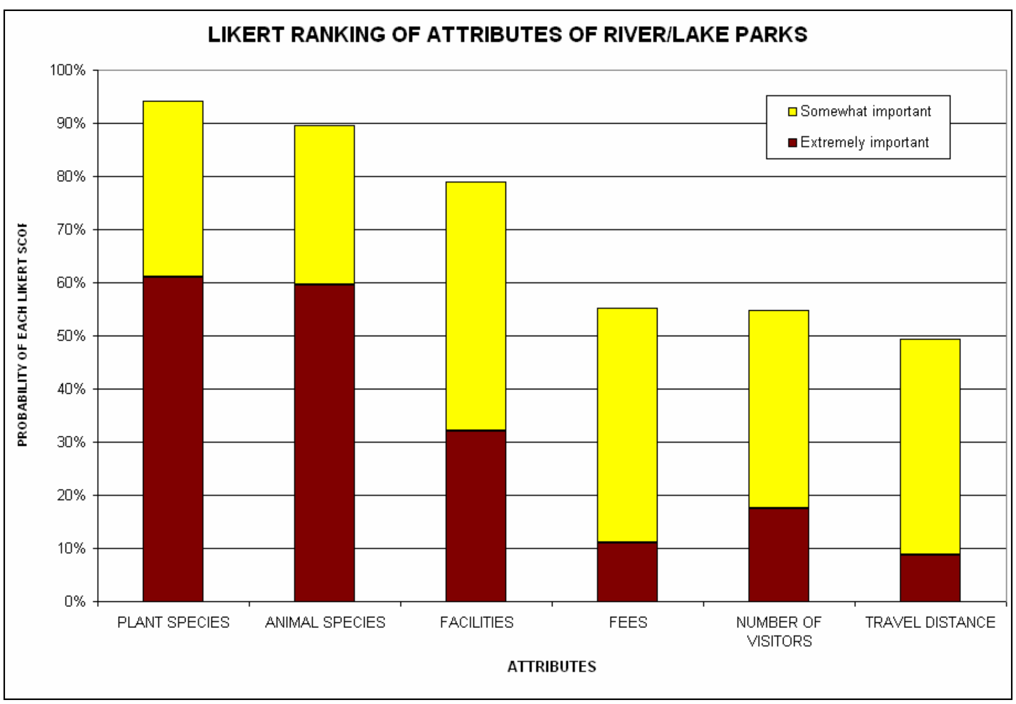

Figure 3-8 Rankings of river/lake park attributes based on the order probit weighted models and the survey responses

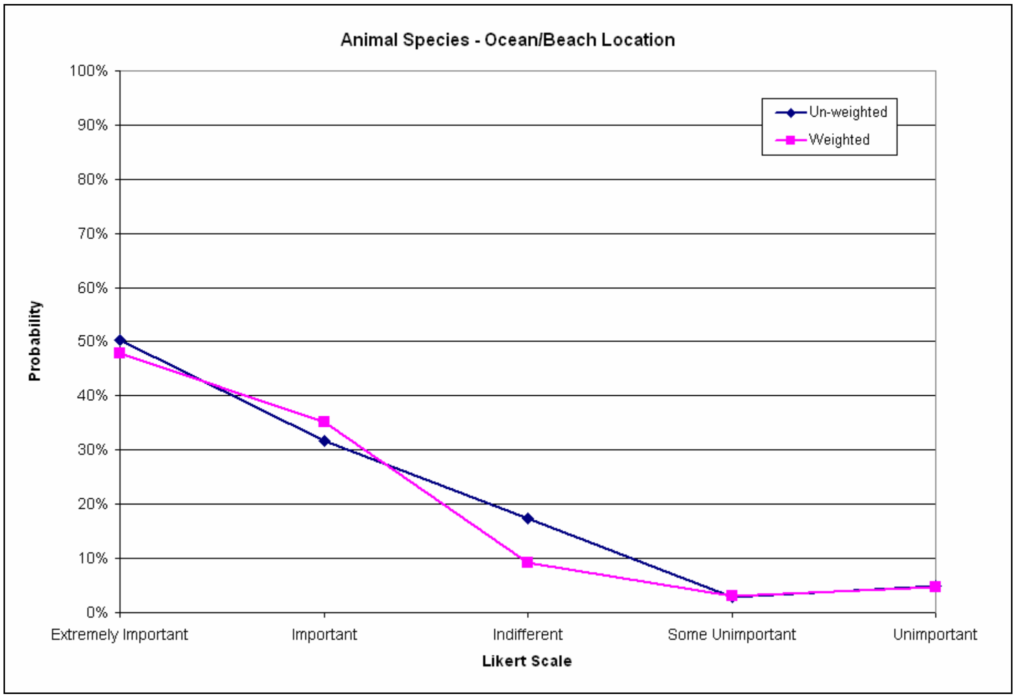

Figure 3-9 Likert ranking of animal species attribute for ocean/beach location for unweighted and weighted models

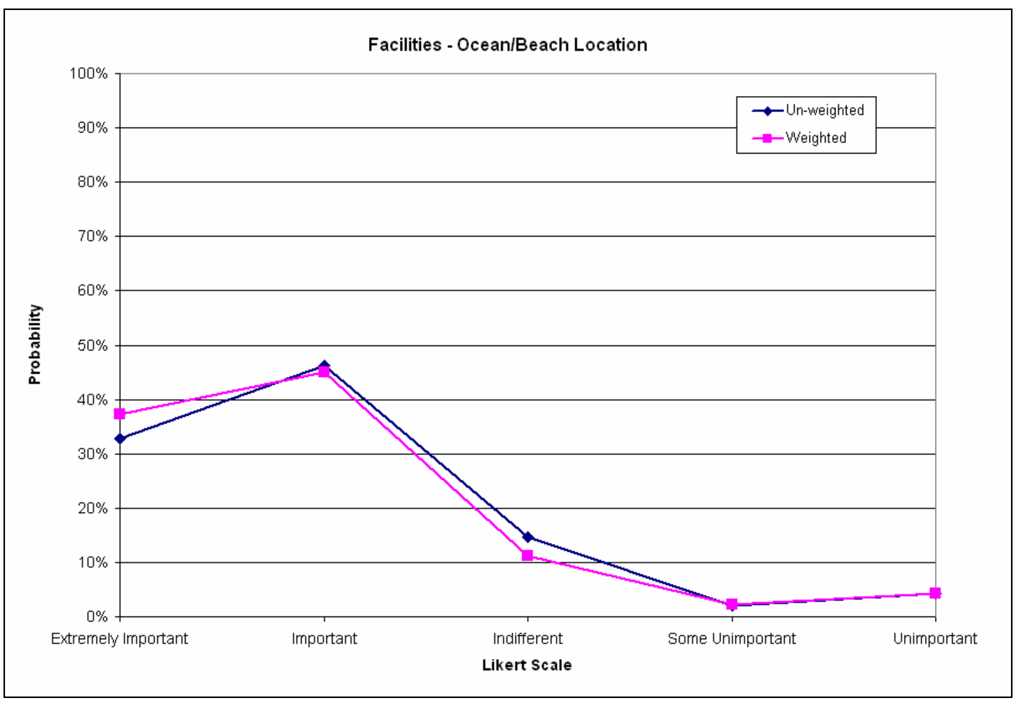

Figure 3-10 Likert ranking of facilities attribute for ocean/beach location for unweighted and weighted models

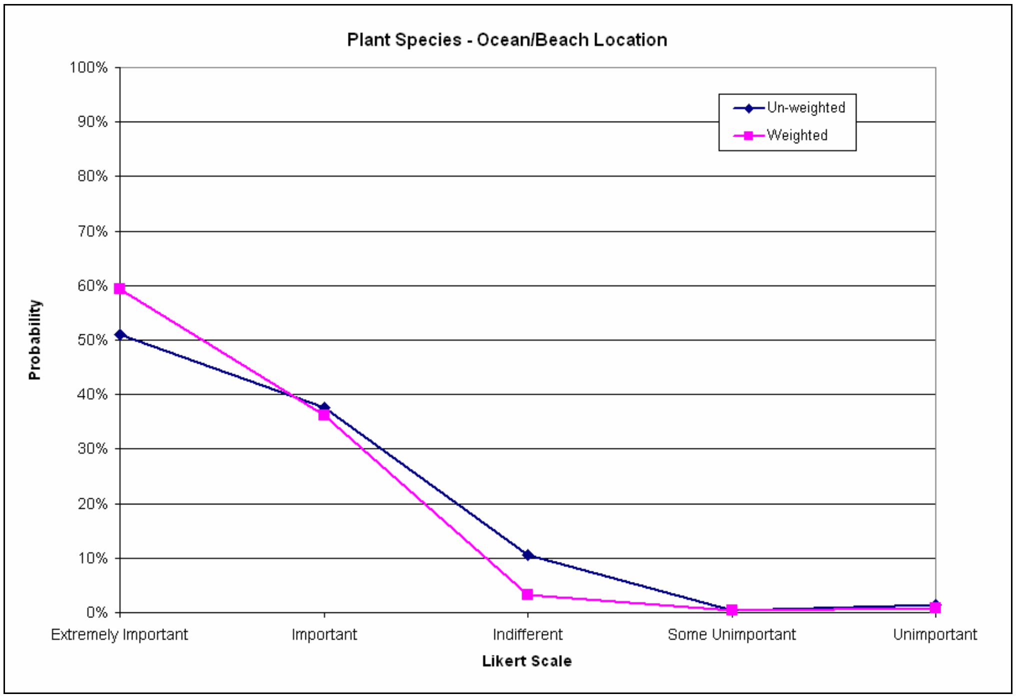

Figure 3-11 Likert ranking of plant species attribute for ocean/beach location for unweighted and weighted models

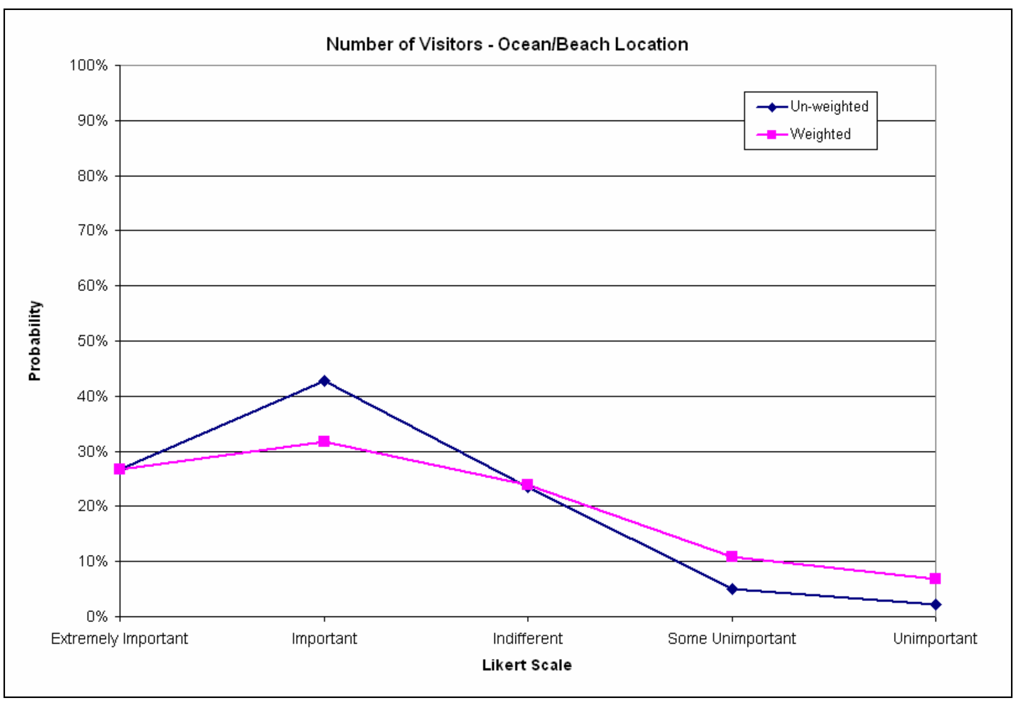

Figure 3-12 Likert ranking of number of visitors attribute for ocean/beach location for unweighted and weighted models

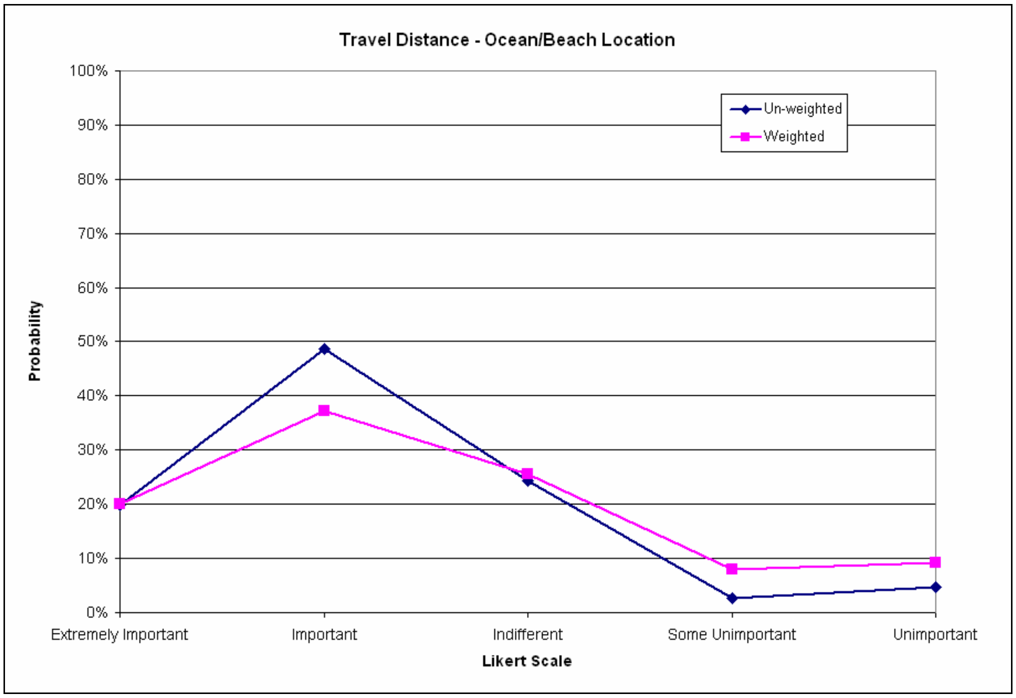

Figure 3-13 Likert ranking of travel distance attribute for ocean/beach location for unweighted and weighted models

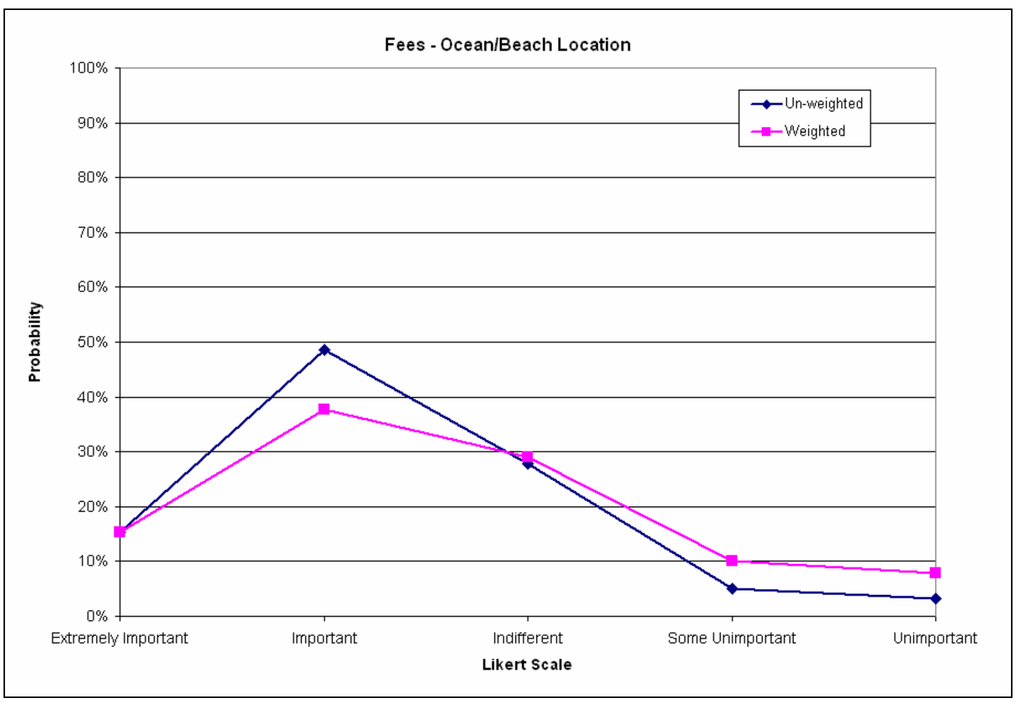

Figure 3-14 Likert ranking of fees attribute for ocean/beach location for unweighted and weighted models

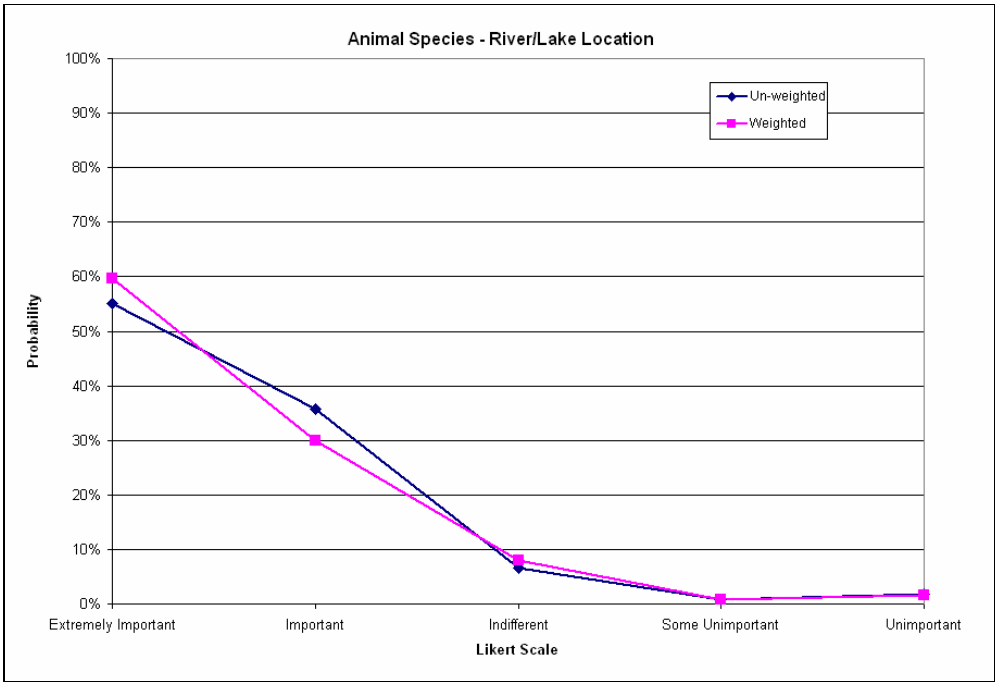

Figure 3-15 Likert ranking of animal species attribute for river/lake location for unweighted and weighted models

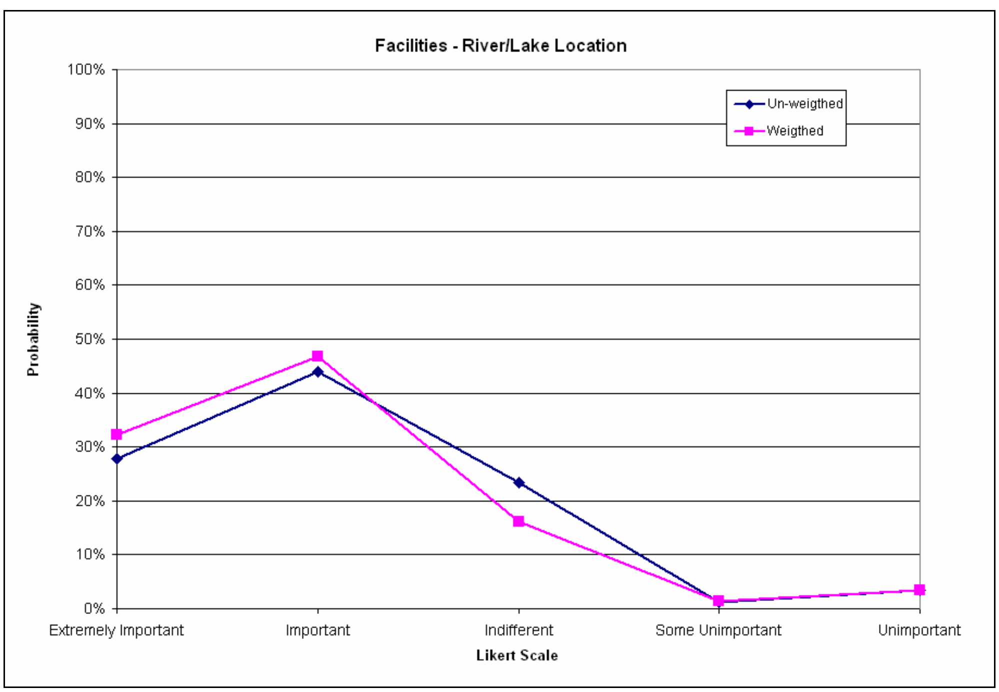

Figure 3-16 Likert ranking of facilities attribute for river/lake location for unweighted and weighted models

Figure 3-17 Likert ranking of plant species attribute for river/lake location for unweighted and weighted models

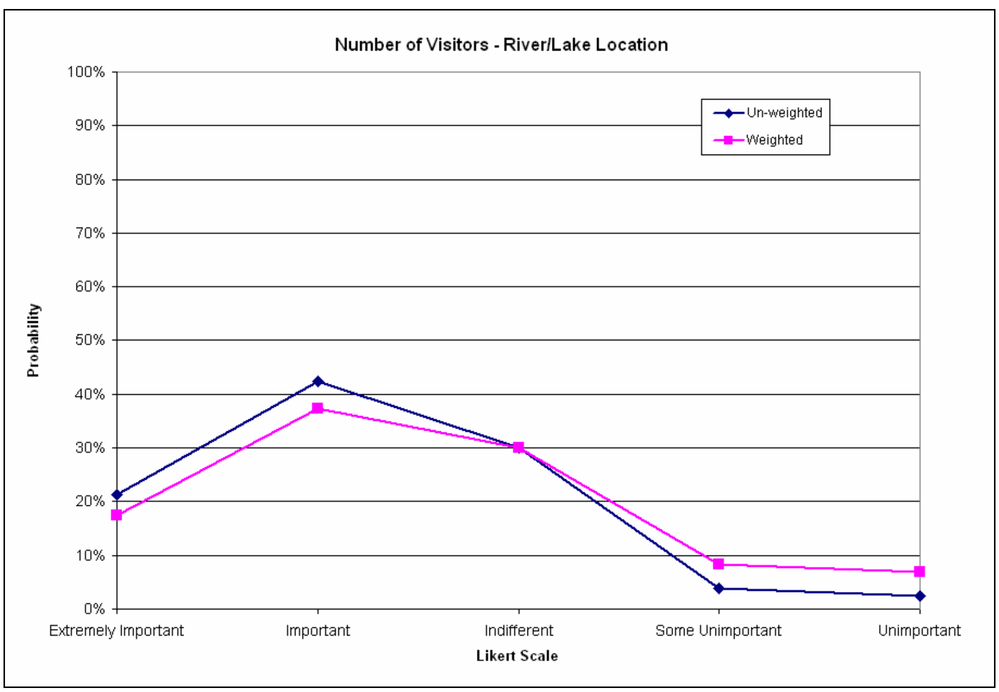

Figure 3-18 Likert ranking of number of visitors attribute for river/lake location for un-weighted and weighted models

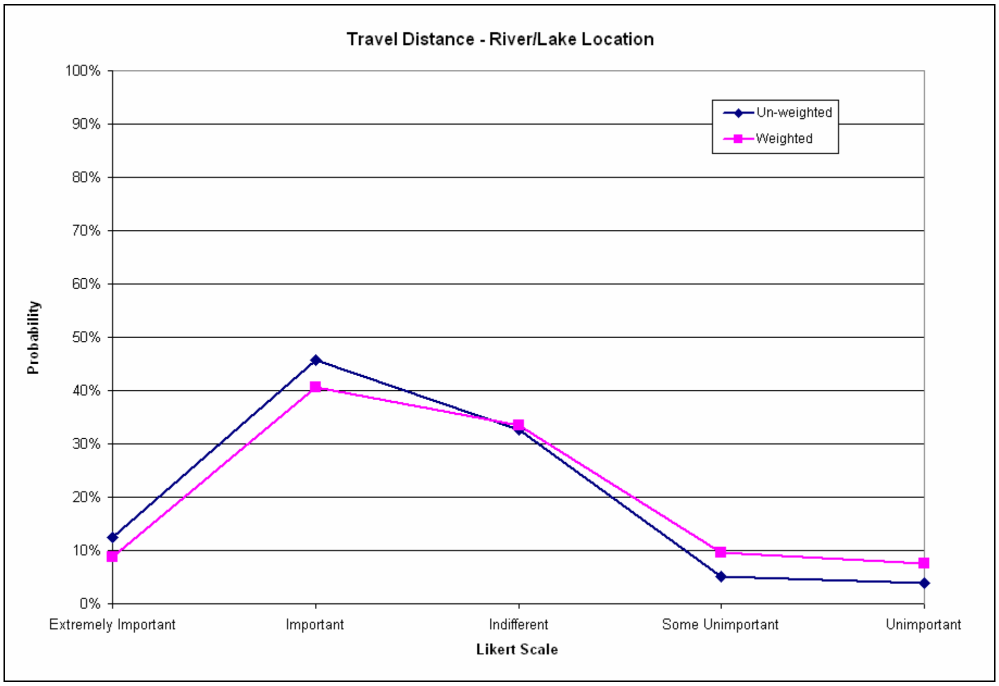

Figure 3-19 Likert ranking of travel distance attribute for river/lake location for unweighted and weighted model

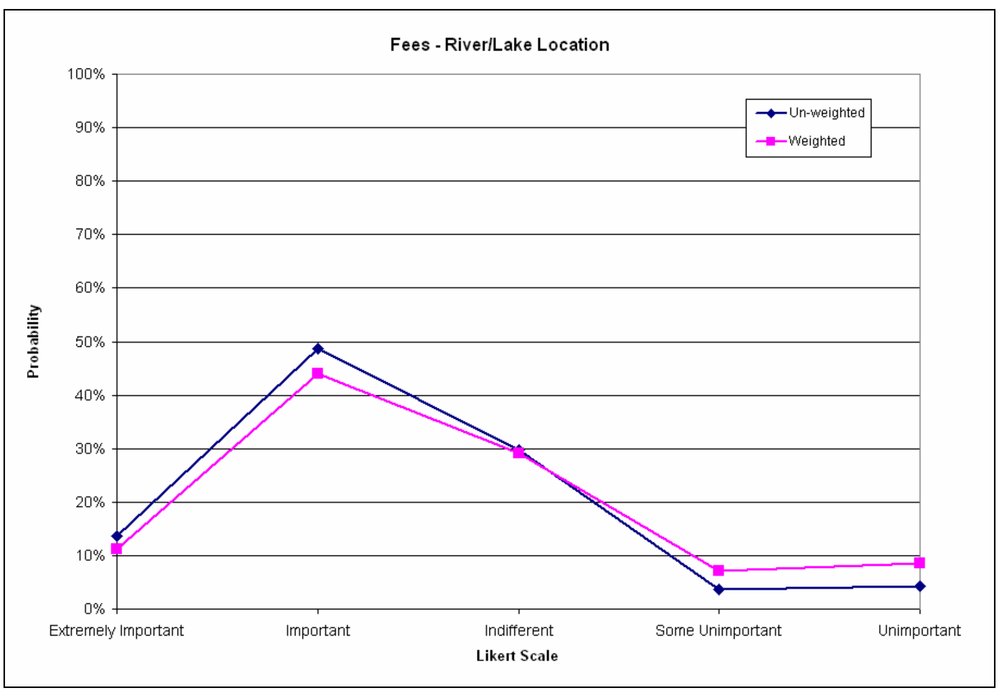

Figure 3-20 Likert ranking of fees attribute for river/lake location for unweighted and weighted models

CHAPTER 4
MULTIATTRIBUTE ANALYSIS FOR AQUATIC AREAS IN FLORIDA

Introduction

In chapters two and three we determined: 1) the attributes that people value the most when they visit aquatic areas in Florida and 2) the extent of Florida residents' knowledge of invasive plants. Therefore the three most important attributes of aquatic parks (ocean/beach and river/lake) for Floridians are: plant species, animal species, and facilities. In addition, approximately between 30 and 40 percent of Florida's population have at least moderate knowledge about invasive plants.

These two conclusions are the foundations of the following Multi-attribute Analysis (MA), in which the main objective is to appraise the value that Florida's population assign to the problem of invasive plants. This was done through the determination of a functional relationship between the public's utility—derived from participation on nature-based recreational activities—and the presence of invasive plants in aquatic areas in Florida.

This chapter is divided into five parts: 1) Determination of attributes' levels and pair-wise choice design; 2) Survey design and respondents profile; 3) Statistical Analysis; 4) Estimation of annual marginal willingness to pay (MWTP); and 5) Conclusions.

Attribute's Levels and Pair-wise Choice Design

In chapter three we determined that the most important attributes of aquatic parks for Florida's residents are: animal species, plant species and facilities. Along with these three attributes it was already determined two additional attributes as fixed. These two attributes are "presence of invasive plant species" and "fees." A more detailed definition of these five attributes, which were used in the MA, is given next[11]:

- Park Facilities Condition: State of the facilities available in the park which include parking lots, boat docks, boat ramps, picnic tables, restrooms, showers, among others.
- Diversity of Native Plant Species: Variety of the native or indigenous plants present in the park.
- Diversity of Animal Species: Variety of all those animals living in the wild, as well as wild birds and all fish found in inland and coastal areas.
- Presence of Invasive plant species: Incidence of non-native plants (known to disrupt ecosystem processes) in the park.
- Fees: Include fees for admission, parking, camping among others

The next stage was to determine the levels in which each attribute would vary. These levels must satisfy the following requirements:

- Levels within each attribute should be mutually exclusive.
- Attribute levels should cover the full range of possibilities for existing goods as well as goods that may not yet exist, but that it is required to investigate.
- The number of levels among attributes must be balanced in a fixed number, since all else equal, attributes defined with more levels tend to get more importance. This is called the "*Number-of-Levels Effect"*.
- The number of levels on each attribute must be limited. It is suggested to not include more than five levels to describe attributes.

In our specific case it was determined to limit the number of levels to three. This number was the same for each attribute in order to avoid the Number-of-Levels effect. Additionally it was decided to define each level as simple as possible; in order to avoid fatigue, reduce the decision time and increase response rates.

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[11] This succinct definition of the five attributes was also provided to respondents in the survey so that they fully understand their meaning.

For the process of determining the level of each attribute we used the results obtained from the preliminary survey conducted to park managers (referred in chapter 3). This survey was conducted to determine the attributes that park managers thought that visitors value the most; however it also helped us to determine the level of each of the five chosen attributes.

In addition a group of experts[12] were consulted in order to depurate the preliminary set of attributes' levels and comply with the requirements of conciseness and explicitness. Thus the levels' range for each attribute was established in the way that is summarized in Table 4-1.

One of the most discussed attributes was the fee attribute which gathers all the costs of using aquatic State Parks in Florida, such as fees for admission, parking, and camping. Initially its levels were established in a range from \$5 to \$35. However it was necessary to establish a range closer to the current situation of State Parks in Florida.

Then after several analyses (using the park manager's survey as a main source) it was decided to employ "free" as a minimum and a value of \$20, somewhat above from the current average of fees in aquatic parks (\$8.5 according to the park managers' opinion) as a maximum. Hence this new range (from free to \$20) is both closer to the existing situation and satisfies the requirement of being beyond the average situation. This would permit us to obtain a better measure of respondent's sensitivity to the fees variations as well as the level changes of the other attributes.

The five attributes previously defined as well as their levels were used in a set of pair-wise choices for each of the two aquatic areas analyzed (ocean/beach and river/lake parks). Nevertheless since two of the five attributes (plant species and animal species) by definition have a high level of correlation between them, we decide to divide the initial set of attributes in two

[12] The experts that collaborated with important opinion and suggestion for the cleansing of these levels were: Dr. Donna Lee, Dr. Alan Hodges, Dr. Janaki Alavalapaty, Dr. Sherry Larkin and Dr. Randall Stocker.

different combinations of four attributes. The first combination included the animal species attribute and the other three attributes: facilities, invasive plant species and fees. The second combination included all else equal to the first combination except for the inclusion of the plant species attribute as a substitution of the animal species attribute. Each combination (Plant Species Combination and Animal Species Combination) was conducted in a different survey. Therefore four different surveys (one for each combination and for each location) were designed.

An example of a pair-wise choice question with the "animal species" combination is presented in Figure 4 -1. The same process of describing the attribute levels for each pair of possible parks was followed in the surveys using the "plant species" combination (Figure 4-2). Thus as it can be observed in Figure 4-1 and Figure 4-2 respondents were asked to express their preference for two fictitious parks in each pair-wise question but under the following assumptions:

- These two parks are the only alternatives available,
- The two parks are on the same distance from the respondent's home, and
- Both parks offer the same "number and type" of facilities and recreational activities. These facilities only differ in their "quality level" or "condition".

It is important to emphasize that is optimal to present no more than ten set of pair-wise choices to respondents due to their limitations in time, resources and attentiveness. In our case a full factorial experiment was not feasible since four attributes with three levels each resulted in 81 (3^4) possible attribute-level combinations, and 3^4 x 3^4, possible combinations in a paired choice design. For that reason a fractional factorial design was employed to reduce the number of pair-wise combinations and to create a balanced sample of possible attribute alternatives, in order to satisfy both the cognitive and time limitations but maintaining the consistency of the responses.

SAS "FACTEX" (SAS Institute) procedure was applied obtaining a set of 20 optimal combinations paired in a block of ten. Then we ruled out alternatives that were obviously dominated by others[13]. After that, we established seven definitive pair-wise choices (fourteen attribute-level combinations) used in the survey. This design provides significant savings in time and research costs but still allows a robust estimation of all main effects. The seven choices sets used in both attributes combinations (plant species and animal species) for both aquatic parks (river/lake and ocean/beach) are shown in Table 4-2 and Table 4-3.

Another characteristic of our pair-wise choice design is the non inclusion of a status quo or "do-nothing" alternative. Even though in most cases a status quo option is included, there are some situations where it cannot be considered as a feasible choice. One of those situations is when it is impossible to standardize a state of reality. In our specific case, Florida has over 1.5 million acres of lakes and rivers, including 7,700 lakes and ponds and 1,400 rivers and streams. Florida also has over 1,197 miles of coastline and over 663 miles of beaches. For that reason it would be impossible to generalize all the river/lake and/or ocean/beach parks of Florida in a homogenous set of characteristics; hence a status quo option is not reasonable (Morey, 2001).

Additionally, it is necessary to note that this study sought to measure preferences for park features and not specific policy options. Then a study of how to allocate efficiently resources from programs of control and management of invasive plants is more adequate [14](Longo, 2007). Consequently an experimental design without a status quo option is more appropriate since such method allows us to determine the "trade-off among the relevant parks' attributes" impacting in people's preferences and not necessarily in their actual choices. In addition with this approach

[13] For example, if park A and B were compared, and the levels of all attributes were identical, but B was more expensive, A would be, clearly, a dominating choice and it is necessary to rule it out.

[14] This is even more reasonable when public agencies have already determined a budget to allocate to these programs.

we will be able to measure not only people's use value but also their non-use value of the non-market good, in this case aquatic parks.

It is also necessary to recall that for respondents the process of answering a number of choice questions can produce fatigue and indifference. This effect is increased when the analysis is broad and outside of a particular spectrum or state. Respondents can become frustrated if they dislike all of the available alternatives, and they may have little incentive for sufficient introspection to determine their preferred alternative. Hence if a status quo option is included there can be a bias towards it, and the respondent might ignore his constraints behaving strategically. Then since our analysis is not about a park or region in particular but about all the aquatic parks in Florida to include a status quo option in the survey would have been extremely prejudicial since it had increased significantly the exposition to a status quo bias.

To summarize, given the objectives and characteristics of our study (generic per se), a status quo or "do-nothing" option is not appropriate by any means.

Survey Design and Respondents Profile

Survey Design

The information required for this MA analysis was collected through Web surveys[15]. For this purpose "four" different surveys were designed. One for each specific aquatic location (rive/lake or ocean/beach parks) and for each specific attribute combination (animal species or plant species combination), which were labeled as following:

- Ocean and Beach Parks – Animal Species Combinations (OBAS)
- Ocean and Beach Parks – Plant Species Combinations (OBPS)
- River and Lake Parks – Animal Species Combinations (RLAS)

[15] The MAU survey draft underwent several revisions and was extensively pre-tested using experts (Dr. Donna Lee, Dr. Alan Hodges, Dr. Janaki Alavalapati, Dr. Sherry Larkin) as well as a group of undergraduate students (242) of the Food and Resource Economics Department in the University of Florida from the classes of Dr. Donna Lee, Dr. Damian Adams and Allison Lutz.

- River and Lake Parks – Plant Species Combinations (RLPS)

These surveys were obtained from a randomly selected sample of Florida residents. Zoomerang Email Marketing was selected to perform the e-mail broadcast by early May, 2007 through a cover letter (Appendix F). This letter contained an invitation to take the survey (Appendix G) as well as a link to the Web address containing the survey (found on www.SurveyMonkey.com). The survey was also streamlined so it could be completed in about six minutes. It is important to emphasize that for these surveys respondents who successfully completed the surveys were provided with 50 "Zoom points." Zoomerang survey panel participants collect points that can be redeemed for merchandise. The approximate value of 50 Zoom points is $0.65.

In order to obtain a higher rate of response and to avoid confusion and tiredness, the surveys were designed following the methodology specified by Dillman, Tortura and Bowker (1998) who recommended:

- Introduce the questionnaire with a welcome screen that "is motivational, emphasizes the ease of responding, and instructs respondents on the action needed for proceeding to the next page."
- Choose an initial question that is likely to be interesting to most respondents, easy to answer, and fully visible on the screen.
- Present each question in a format similar to that found in paper surveys.
- Avoid differences in graphical appearance between questions.
- Provide specific instructions.
- Provide to respondents a sense of their nearness to completing the survey.
- Avoid questions known to have measurement problems, such as open-ended questions or check all that apply options.

Hence respondents, who participated in the Web survey, initially were told in the cover letter that the objective of the study was to determine the impact of invasive plants on recreation activities in Florida's aquatic parks. Each survey was divided in three parts. In the first part respondents were asked to provide different valuations about a specific natural area and a second one of their choice, which was optional. In the second part respondents were asked to give their opinion about what effects invasive plant species have had in their decision of which location to attend and enjoyment when engaging in outdoor recreational activities in aquatic parks. Finally, in the third part respondents were asked to give some socio-economic information for the analysis.

In chapter two it was determined the importance of respondents having an adequate background of knowledge in order to fully discern the impact of invasive plant species on their satisfaction with outdoor recreational activities. It was also found that between 30 and 40 percent of Florida's population approximately has a moderate knowledge about invasive plant species. These results indicated the necessity of providing an adequate level of information about invasive plants in the multi-attribute survey. This information would allow us to obtain more accurate valuation about the impact of these species on people's utility and at the same time it would reduce the bias due to the unawareness effect. Consequently along with the full questionnaire we included in the survey a brief description of the study, background information about invasive plants and photos depicting invasive plants in natural areas.

Respondents' Profiles

The total numbers of valid responses obtained from each of the four Web surveys conducted to Florida residents are shown in Table 4-4. The main demographic characteristics of these respondents as well as comparable figures for the state population, obtained from the U.S. Census Bureau, are summarized in Table 4-5.

From Table 4-5 it can be verified that there are a group of characteristics (income and education) that matched to a high degree with the proportions of the Florida population. On the other hand, there are other categories such as gender and age in which the sample showed an important difference from the composition of Florida population. That situation compelled us to be extremely careful in the conclusions and the applied methodology. A process of weighting the sample was employed in order to correct the problem of imbalance of the sample, in special for those set of categories that present a higher level of discrepancy with respect to the population. At the end, with this weighting process it was possible to increase the representation in the adjusted sample of the strata that are underrepresented and in turn to obtain a sample that mirrors the population.

Statistical Analysis

Econometric Modeling of Pair-wise Choices

It was already stated that the MA analysis survey consisted of a set of choice questions in which respondents express their preference among two hypothetical parks with a limited set of attributes that vary. With each choice, respondents face a tradeoff between attribute levels, and select the park whose attributes mix maximize their utility. As they make their choices between the two parks, the utility associated with changes in the levels of specific attributes can be specified.

The MA analysis will permit to determine the respondents' tradeoff for the park's attributes as long as each attribute: 1) reflect an independent dimension of the good, 2) be measurable and 3) be easy to understand.

Assume a set of alternatives of a good (in our specific case aquatic parks) in which the utility derived from their consumption can be expressed by a linear combination of four relevant attributes as follow:

$$
\begin{aligned}
& U_i = \alpha + \beta_1 x_1^i + \beta_2 x_2^i + \beta_3 x_3^i + \beta_4 x_4^i + \varepsilon_i = \\
(4\text{-}1) \qquad & U_i = X^i + \varepsilon_i = \\
& U(X^i)
\end{aligned}
$$

where X_i is a set of four attributes for alternative i and ε_i is a random error term.

Then assume that in a MA setting respondents compare alternatives A and B by their attributes-mix and select the alternative that provides a higher level of utility (e.g. alternative A):

$$
(4\text{-}2) \qquad U\left(X^A\right) > U\left(X^B\right)
$$

where U(.) represents a respondent's utility function and X^A and X^B represent the set of attributes for alternatives A and B. Utility can be also expressed as the sum of a systematic component ϕ (.), determined by the attributes, and a random component (ε_i) :

$$
(4\text{-}3) \qquad U_i = \phi\,(X^i) + \varepsilon_i
$$

The error term ε represents researches uncertainty about the choice since the choice behavior is deterministic from the perspective of the individual but from the researcher perspective this behavior is random.

Furthermore the probability that the respondent will choose alternative A over B depends on the probability that the difference between the systematic component of A and B be greater than the difference between the random components, such that the probability of choosing A is:

$$
\begin{aligned}
(4\text{-}4) \qquad & \mathrm{P(A)} = \mathrm{P}[\phi(X^A) - \phi(X^B) > (\varepsilon_B - \varepsilon_A)] = \\
& \mathrm{P(A)} = \mathrm{P}[\Delta U > \delta]
\end{aligned}
$$

Thus for this analysis, econometric techniques parallel to the theory of rational and probabilistic choice will be applied. These types of models are called discrete-choice models and the most representative is the McFadden's conditional *Logit* (1974), which allows us to determine the effects of explanatory variables on a subject's choice of one of a discrete set of options.

It is important to specify that the main characteristic of these models is that for a given subject an explanatory variable x takes different values. For instance for a subject λ and response choice i, $x_{\lambda i} = (x_{\lambda i1}, \ldots, x_{\lambda ik})$ denote the values of the k explanatory variables conditional on the set C_λ which represents all of the alternatives in the choice set of response choices for subject λ. An econometrical specification of these concepts is given in equation 4-5.

$$(4\text{-}5) \qquad \pi_i = \frac{e^{(\beta' x_{\lambda i})}}{\sum_{h \in C_\lambda} e^{(\beta' x_{\lambda h})}}$$

where β is the vector of coefficients (weights) for the attributes used in the analysis. In addition for each pair of alternatives "a" and "b" the model (4-5) has the following *Logit* form (Domencich and McFadden, 1975):

$$(4\text{-}6) \qquad \log\left[\frac{\pi_a(x_{\lambda a})}{\pi_b(x_{\lambda b})}\right] = \beta'(x_{\lambda a} - x_{\lambda b})$$

Thus conditional on a subject's choice between "a" or "b", the influence of an explanatory variable depends on the distance between the person's valuation of that variable for those alternatives. If the values are the same, we can say that the variable has no influence on the choice between "a" or "b". In our specific case, the explanatory variables will be the relevant park attributes which vary around a specific range of levels.

Statistical Results for the Multi-Attribute Model

In this section, following the prescribed methodology of McFadden (1974); and Domencich and McFadden (1975), a logistic regression will be used in order to estimate the relative importance of each attribute on the respondents' utility. We will establish a set of four explanatory variables that represent each park attribute and a binary variable Y representing the dependent variable, which takes the value of 1 if a respondent chose alternative A, and 0 otherwise. In our model, the explanatory variables (attributes) have been considered as quantitative; for that reason a set of scores have been assigned to them[16]. The reason for this is that in our experimental design the status quo is not present and therefore it would not be possible to estimate the welfare change from a baseline (natural of a model with qualitative variables as dummies where the omitted dummy is the status quo/baseline). On the contrary, an experimental design like ours (without status quo) requires estimating the trade-off and weight of the attributes in average, as a form to describe the relative importance of the components in the moment of the decision (Longo, 2007). The predictors of the model and their scores[17] are given in Table 4-6.

It is necessary to specified that in order to correct the problem of imbalance of the sample a weighting procedure was applied. The procedure used the sample proportions and the population proportions and with those a set of possible combinations of feasible weights[18] were determined. These weights were estimated for each observation and then applied to the sample.

The models for each attribute combination are defined as follows:

Animal Species Combination:

(4-7)
$$Logit[P_{AB}] = Log\left(\frac{\pi(X^A)}{\pi(X^B)}\right) =$$
$$= \beta_{fa}(Fa^A - Fa^B) + \beta_{as}(As^A - As^B) + \beta_{is}(Is^A - Is^B) + \beta_{fe}(Fe^A - Fe^B)$$

[16] This is also possible given the natural order of intensity of each attribute level.

[17] According to Agresti (1996), the choice of scores has little effect on the results; then any concern about misspecification due to the score selection is not justified as long as we have a large sample, which is our case.

[18] See chapter 3, equation 3-6.

Plant Species Combination:

$$\text{(4-8)} \quad Logit[P_{AB}] = Log\left(\frac{\pi(X^A)}{\pi(X^B)}\right) = $$
$$= \beta_{fa}(Fa^A - Fa^B) + \beta_{ps}(Ps^A - Ps^B) + \beta_{is}(Is^A - Is^B) + \beta_{fe}(Fe^A - Fe^B)$$

The discrete choice models proposed in 4-7 and 4-8 follows the structure of McFadden (1974) which in turn follows Bradley and Terry (1952). Therefore P_{AB} denotes the probability that respondents prefer A over B (given their attributes-mix) since alternative A provides a higher utility.

Tables 4-7 to 4-10 present the estimation results for the multi-attribute models for different location/attributes combination. In all these models the coefficients of the four chosen attributes are significant. Hence it can be concluded that on each of these models all attributes (given the specific location/attributes combination) are relevant for respondents' utility. Consequently they form their preferences based on the utilities derived from the mix of all the four relevant attributes of each alternative.

In the specific case of the "facilities" (FA) and "animal/plant species" (AS/PS) estimators, they were positive and significant in all the models. That means that respondents preferred parks with both "facilities of higher quality" and "higher diversity of animal/plant species". In contrast the "fees"[19] (FE) and "invasive plant species" (IS) estimators were negative and statistically significant indicating that respondents preferred parks with "lower fees" and "less presence of invasive plant species". These statistical results indicate that higher level of animal/plant diversity, higher quality on the facilities, lower fees and less presence of invasive plant species increased the likelihood that respondents would prefer a park over another.

[19] $\partial U / \partial FE$ and in consequence β_{fee} gathers the change in utility associated with a marginal decrease in wealth; thus it is expected that the sign of β_{fee} be negative

In Table 4-11 a global test for each model (RLAS, OBAS, RLPS, OBPS) was conducted. In this test the null hypothesis that all the estimators of these models are not significant ($\beta = 0$) was contrasted. Thus it can be verified from Table 4-11, that the null hypothesis that all the estimators are not significant (or equal to zero) is rejected for all the models. Then all the four models can be considered statistically significant at 5% and 1% confidence level.

The multi-attribute utility (MAU) parameters for each location/attributes combination can be compared through the use of standardized estimators[20]. From Table 4-12 it can be observed that respondents gave a positive weight to the FA and AS/PS attributes. These results reinforce the conclusion that respondents preferred aquatic parks with facilities in excellent conditions and with a high diversity of either plant or animal species. On the other hand the other two attributes: IS and FE, were negatively weighted. That means that parks with high fees and large presence of invasive plant species are less preferred by respondents.

An important thing to note from Table 4-12 is that in all the location/attributes combinations the two attributes that have more weight on the utility and in turn on the respondents preferences are FE and IS, in that order. Thus given their negative weight these attributes in high levels not only would reduce but also would null the positive impact of the other two attributes namely FA and AS/PS. This imposes the necessity of controlling and keeping in acceptable levels both the fees and the presence of invasive plant species in all the aquatic parks in Florida to avoid any impact on the population's welfare.

[20] This is obtained by the following formula $\hat{\beta} = \beta \frac{\sigma_x}{\sigma_y}$, where $\hat{\beta}$ is the standardized estimator, β is the original estimator, σ_x is the standard deviation of the explanatory variable and σ_y is the standard deviation of the dependent variable.

In third place of importance appears, in some combinations FA and in others AS/PS. However from Table 4-13 we can verify that the relative importance of these two attributes is not statistically different. We applied a Wald test in Table 4-13 and in this test the null hypotheses that, Ho: $\beta_{FA} = \beta_{AS}$ or Ho: $\beta_{FA} = \beta_{PS}$ (given the specific location/attributes combination) were contrasted. In other words we tested that the estimators for FA and AS/PS were equal. Then it can be concluded, from Table 4-13, that for all the location/attributes combinations the null hypothesis can not be rejected at 5% and 1% confidence level. Therefore the effect of the "condition of facilities" and "diversity of plant/animal species" attributes on the respondents' utility are statistically the same.

In Tables 4-14 to 4-16 it was also contrasted other three hypotheses; to be precise:

- Ho: $\beta_{IS} = \beta_{FA}$;
- Ho: $\beta_{IS} = \beta_{AS}$ or Ho: $\beta_{IS} = \beta_{PS}$; and
- Ho: $\beta_{IS} = \beta_{FE}$.

In all the three cases we reject, at the 5% and 1% confidence level, the null hypothesis of identical effect of these attributes on respondents' utility. Thus the ranking of the attributes according to their effect on the respondents' utility and their specific location/attributes combination is established in the way that is showed in Table 4-17.

Furthermore if we compare the relevance of the presence of invasive species in each location we find the following. First, with the combination animal species; the importance of the IS attribute for the respondents' utility is similar for both locations (river/lake and ocean/beach). In other words when people imply that the invasive plant species will affect animal species in aquatic areas, the importance of this effect on the respondents' utility will be the same either this location is a river/lake (RL) park or an ocean/beach (OB) park. On the contrary with the combination plant species; the importance of the IS attribute is different for both locations. In this specific case the weight or relative importance of this attribute to the respondent's utility is larger for the RL parks than for the OB parks. This effect could be due to the small importance that visitors give to the presence of plant species in OB parks[21]. In other words people do not hold a high value for the presence of native plants in OB parks and as a consequence when people imply that the invasive plant species will affect native plants in this type of park, the importance of this effect will be small but still negative; (even more it is the lowest from all the location/attributes combinations). In contrast when we analyze the RLPS combination the importance or absolute weight of the IS attribute on the respondents' utility is the highest one (-1.311). This is because people value in a high degree the environmental and aesthetical benefits provided by native plants in these locations. Hence if it is implied that the invasive plant species will affect native plant species in a RL park, the importance of this effect will be high, at the point of being the highest one from all the combinations (Table 4-12).

A further approach to measure the relative importance of each attribute on the respondents' utility is through a monetary measure called "marginal willingness to pay" (MWTP)[22]. This measure gathers the monetary impact (on respondents) for changes in a non-monetary attribute of a good (in this case an aquatic park). However, it is necessary to emphasize that in this specific case the estimated willingness to pay not only will gather the use value that respondents provide to a specific attribute and/or alternative but also the non use value or

[21] A proof of that is that the standardized estimator of PS for OB locations (PS=0.67) is the smallest one from all the other estimators in all the location/attributes combinations.

[22] The willingness to pay can also be defined as the quantity of money needed to equate the original level of utility with the level associated with an improvement of a non-market good. In other words is the amount of money that an individual or group could pay, along with a change in a non-market good, without being made worse off. It is therefore a monetary measure of the benefit to them of the improvement. If negative, it measures its cost.

existence value[23] of the good. For that reason it can be stated that in this study the estimated willingness to pay represent the average valuation of the non-market good based on people's preference system instead on their actual choices like in the case of an experimental design with the status quo option.

Thus once models 4-7 and 4-8 are estimated, the rate of tradeoff between any two attributes is the ratio of their respective β coefficients. The marginal value of each attribute is computed as the negative of the coefficient on that attribute (i), divided by the coefficient on the price or cost variable (FE). Then the Willingness to pay for an attribute is computed as:

$$(4\text{-}9) \qquad MWTP(i) = -\frac{\partial U / \partial i}{\partial U / \partial FE}$$

where MWTP (i) is the marginal willingness to pay for changes in attribute i, $\partial U / \partial i$ is the marginal utility derived form changes in attribute i, and $\partial U / \partial FE$ is the marginal utility coefficient of the monetary attribute of the model.

The full effects of respondents preferences for each park attribute across the sample are reflected in the MWTP values presented in Tables 4-18 and 4-19. In the animal species combinations the AS attribute had the highest "positive" WTP for both locations; indicating that respondents derived the most satisfaction from an increase in this attribute. However the IS attribute shows the highest WTP in absolute in all the location of this first combination (animal species). That means that the IS attribute presents the highest level of impact on the respondent's utility compared to the others. Even more since the sign for this attribute is negative; this large

[23] Non-use value is the value that people derive from goods (especially natural resources) independent of any use (present or future) that people might make of those goods. The simple availability of the good provides some value to the individual in the sense that s/he may eventually be in a position to use the good. In other words the utility is not only derived from the direct use of the resource but also from knowing that the resource exists (Chen, 2003).

negative number associated to this attribute indicates a strong aversion of respondents to the presence of invasive plants. The fact that this negative effect is higher (in absolute value) than the positive effects of the other attributes (facilities and animal species) implies that is not sufficient an enhancement in the other attributes (pure tradeoff effect) to reduce the harmful impact (on the people's utility) from the presence of invasive species. On the contrary it is necessary to take direct actions to control and attack this problem. The situation is similar for the plant species combinations where the attribute that presents the highest willingness to pay in absolute value in all the locations is the IS attribute. This value, like in the animal species combinations, is negative and larger than the others, which reflect the serious impact of the presence of invasive species on the people's utility when participating in recreational activities in aquatic areas.

One thing that is important to highlight is the fact that in all the location/attributes combinations the MWTP for the IS attribute are similar, (with an average value of -$6.21), except for the case of the OBPS combination which presents the lowest value (-$5.41). This is because people give a small importance to the presence of plant species in OB parks; and as a consequence when people relate the main impact of invasive species over the native plants in this location a small MWTP (lower than those in the other three combinations: RLAS, OBAS and RLPS) is obtained.

At this point it is necessary to analyze how these attributes influence the respondents' decision toward one park over another. For that purpose the odds ratios and the likelihood of preferences of a hypothetical park A over another park B (for each location/attributes combination) were estimated. The results of these analyses are provided from Table 4-20 to Table 4-35.

From Tables 4-20 and 4-22 it can be examined that the probability that a person prefers a RL park with facilities in adequate condition is between 32.65% and 40.76% higher than the probability that this person prefers another RL park but with facilities in minimal condition. Moreover the probability that a person prefers a RL park with facilities in excellent condition is between 75.96% and 98.13% higher than the probability that s/he prefers a RL park with facilities in minimal condition.

The situation follows the same pattern for OB parks (Tables 4-21 and 4-23); that is, the probability that a person prefers an OB park with facilities in adequate condition is between 23.00% and 33.76% higher than the probability that this person prefers another OB park but with facilities in minimal condition. Furthermore the probability that a person prefers an OB park with facilities in excellent conditions is between 51.29% and 78.93% higher than the probability that s/he prefers an OB park with facilities in minimal conditions. It can also be concluded that the relative importance of the facilities condition for the respondents' decision and preferences is higher for RL parks than for OB parks.

In the specific case of the AS attribute the impact for the RL parks is given in Table 4-24. Thus it can be examined that the likelihood that a person prefers a RL park with moderate diversity of animal species is 39.10% higher than the likelihood that this person prefers another RL park but with low diversity of animal species. In addition the probability that a person prefers a RL park with high diversity of animal species is 93.50% higher than the probability that s/he prefers a RL park with low diversity of animal species. On the other hand in the case of OB parks (Table 4-25) the probability that a person prefers an OB park with moderate diversity of animal species is 37.78% higher than the probability that this person prefers another OB park but with low diversity of animal species. Additionally the likelihood that a person prefers an OB park with high diversity of animal species is 89.83% higher than the likelihood that s/he prefers an OB park with low diversity of animal species. It can be observed that the impact of the diversity of animal species in both aquatic locations is almost the same. Then we can conclude that the AS attribute has the same effect on the people's utility derived form recreational activities in both RL and OB parks.

The impact of the PS attribute on the people's utility derived from engaging in recreational activities in aquatic areas is provided in Tables 4-26 and 4-27. Hence the likelihood that a person prefers a RL park with moderate diversity of plant species is 33.92% higher than the likelihood that this person prefers another RL park but with low diversity of plant species. In addition the likelihood that a person prefers a RL park with high diversity of plant species is 79.35% higher than the likelihood that s/he prefers a RL park with low diversity of plant species. In contrast in the case of OB parks the likelihood that a person prefers an OB park with moderate diversity of plant species is 24.68% higher than the likelihood that this person prefers another OB park but with low diversity of plant species. In addition the probability that a person prefers an OB park with high diversity of plant species is 55.44% higher than the probability that s/he prefers an OB park with low diversity of plant species. It can be observed that the impact of PS diversity in OB parks is less than the registered on RL parks. Even more the impact of PS in OB parks is significantly small compared with the other attributes in both locations, which reflects the low importance of this attribute (PS) for people when visiting any OB location.

As it was previously determined the IS attribute is the second most important attribute that impact on people's utility when engaging in recreational activities in aquatic parks in Florida. For that reason it was found (Tables 4-28 and 4-30) that the probability that a person prefers a RL park with a presence of few and dispersed invasive species is between 49.57% and 59.59%

higher than the probability than s/he prefers a park with a numerous presence of invasive species. Furthermore the probability that a person prefers a RL park with none invasive species is between 123.73% and 154.70% higher than the probability than s/he prefers a park with a numerous presence of invasive species.

On the other hand in the case of OB parks the preferences are expressed in the following way (Tables 4-29 and 4-31): the probability that a person prefers an OB park with a presence of few and dispersed invasive species is between 43.31% and 52.47% higher than the probability than s/he prefers an OB park with a numerous presence of invasive species. Moreover the probability that a person prefers an OB park with none invasive species is between 105.37% and 132.48% higher than the probability than s/he prefers an OB park with a numerous presence of invasive species. Again the sensitivity of respondents to the presence of invasive species is stronger for the case of the RL location. However the individual impact of this attribute (IS) on respondents' preferences for both locations is higher than the impact of all the positive park attributes (FA, AS and PS), which indicates an impossibility of a full tradeoff from enhancement on these attributes.

Finally the impact of the fees over the respondent's utility is the most important among all the other attributes. As a consequence in RL parks (Tables 4-32 and 4-34) the probability that a person prefers a RL park with fees in a level of $10 is between 93.44% and 112.50% higher than the probability that s/he prefers a RL park with fees in $20. Additionally the probability that a person prefers a free RL park is between 274.20% and 351.57% higher than the probability that s/he prefers a park with fees in $20. These differences on probability are impressive compared with the values obtained for the other attributes which indicates the great importance of this attribute (FE) on people's preference (as high as the FA and AS/PS effects combined).

Furthermore in the case of OB parks (Tables 4-33 and 4-35) the probability that a person prefers a park with fees in a level of $10 is between 94.40% and 94.82% higher than the probability that s/he prefers an OB park with fees in $20. Additionally the probability that a person prefers a free OB park is between 277.93% and 279.56% higher than the probability that s/he prefers an OB park with fees in $20. Also in this type of aquatic park, the FE attribute is the most important of all producing the highest level of impact on people's preferences. Thus it can be concluded that people's preference on RL and OB locations are driven mainly by the level of fees and second by the presence of invasive species.

Ranking, Net Willingness to Pay and Likelihood of Preference Measures for Multi-Attribute Models.

In this section we proceed to evaluate how respondents would answer to hypothetical combinations of the attributes using the utility function estimations showed from Table 4-7 to 4-10. We will apply three different procedures that can be summarized as follows: 1) ranking based on the overall utility of each alternative; 2) estimation of the net willingness to pay of each alternative, and 3) assessment of the likelihood of preference of each alternative.

The ranking evaluation of alternatives will be obtained from equation 4-7 and 4-8. The net score (S) for the jth alternative would be computed as:

Animal Species Combination

(4-10) $$S = \beta_{fa} Fa^{A} + \beta_{as} As^{A} + \beta_{is} Is^{A} + \beta_{fe} Fe^{A}$$

Plant Species Combination

(4-11) $$S = \beta_{fa} Fa^{A} + \beta_{ps} Ps^{A} + \beta_{is} Is^{A} + \beta_{fe} Fe^{A}$$

where the β's are the estimated coefficients obtained from Tables 4-7 to 4-10; and Fa^A, As^A, Is^A and Fe^A are the attributes at the level of the alternative A. This net score will be applied to the 81 feasible alternatives that corresponding to the full fractional experiment of each location/attributes combination. Once all the 81 net scores have been calculated, the alternatives will be ordered so as to obtain an ordinal ranking of all the feasible alternatives. For the willingness to pay approach, first it would be necessary to determine the alternative that provides a zero utility in order to use it as a baseline. This alternative will be determined using the net score procedure previously explained. Then the net willingness to pay can be defined as:

Animal Species combination

(4-12) $$NetWTP_A = -\frac{\beta_{fa}}{\beta_{fe}}(Fa^A - Fa^{Base}) - \frac{\beta_{as}}{\beta_{fe}}(As^A - As^{Base}) - \frac{\beta_{is}}{\beta_{fe}}(Is^A - Is^{Base}) - (Fe^A - Fe^{Base})$$

Plant Species Combination:

(4-13) $$NetWTP_A = -\frac{\beta_{fa}}{\beta_{fe}}(Fa^A - Fa^{Base}) - \frac{\beta_{ps}}{\beta_{fe}}(Ps^A - Ps^{Base}) - \frac{\beta_{is}}{\beta_{fe}}(Is^A - Is^{Base}) - (Fe^A - Fe^{Base})$$

where the β's are the estimated coefficients obtained from Tables 4-7 to 4-10; Fa^A, As^A, Is^A and Fe^A are the attributes at the level of the alternative A; and Fa^{Base}, As^{Base}, Is^{Base} and Fe^{Base} are the attributes at the level of the baseline alternative (defined as the alternative that generates zero utility). This procedure will also be applied to the 81 feasible alternatives providing us some indication of the intensity of preferences for each alternative.Finally the probability that respondents prefer alternative A instead of the baseline alternative will be also estimated. For this purpose we will apply the following equations:

Animal Species Combination

(4-14) $$P_{A.vs.Base} = \frac{e^{\beta_{fa}(Fa^A - Fa^{Base}) + \beta_{as}(As^A - As^{Base}) + \beta_{is}(Is^A - Is^{Base}) + \beta_{fe}(Fe^A - Fe^{Base})}}{1 + e^{\beta_{fa}(Fa^A - Fa^{Base}) + \beta_{as}(As^A - As^{Base}) + \beta_{is}(Is^A - Is^{Base}) + \beta_{fe}(Fe^A - Fe^{Base})}}$$

Plant Species Combination

(4-15) $$P_{A.vs.Base} = \frac{e^{\beta_{fa}(Fa^A - Fa^{Base}) + \beta_{ps}(Ps^A - Ps^{Base}) + \beta_{is}(Is^A - Is^{Base}) + \beta_{fe}(Fe^A - Fe^{Base})}}{1 + e^{\beta_{fa}(Fa^A - Fa^{Base}) + \beta_{ps}(Ps^A - Ps^{Base}) + \beta_{is}(Is^A - Is^{Base}) + \beta_{fe}(Fe^A - Fe^{Base})}}$$

where the β's are the estimated coefficients obtained from Tables 4-7 to 4-10; Fa^A, As^A, Is^A and Fe^A are the attributes at the level of the alternative A; and Fa^{Base}, As^{Base}, Is^{Base} and Fe^{Base} are the attributes at the level of the baseline alternative.

The evaluations of the 81 possible alternatives for each location/attributes combination are presented from Figures 4-3 to 4-6. First, it is necessary to specify that in all the location/attributes combinations the park that was specified as the baseline (BL) was that which had the following attribute mix: FA= minimal, AS/PS= low, IS= none and FE= free. This BL park offers the minimal level in their entire positive attributes (FA and AS/PS), but in turn it offers the minimal levels for their negative attributes (FE and IS). This produces an absolute compensation that generates an expected utility of zero for all the locations/attributes combinations.

Figures 4-3 and 4-4 show the evaluation for alternatives in the RL location. Then the park alternative which ranked first for the two attributes combination (AS and PS) of the RL location was that which had the following attributes mix: FA= excellent, AS/PS= high, IS= none and FE= free. This plan can be considered as the full benefits park (FBP). Therefore among 77% and 78% of respondents would prefer this FBP to the baseline park with a WTP that is between \$16.82 and \$18.57. It is important to note that between 26% and 28% of the 81 possible alternatives can be considered feasible[24]. From this group of feasible parks, approximately 80% of them are free, and the other 20% has a fee level of \$10. This reflects the high impact of the fees on the utility of respondents who provide a large weight to this attribute in comparison to the others.

[24] An alternative is considered feasible if generates a utility greater or equal than zero.

On the other hand in the case of OB parks, Figures 4-5 and 4.-6 show the evaluation for all the possible alternatives. Again the highest ranked park is the FBP for both OB combinations. In this specific case among 70% and 77% of respondents would prefer this FBP to the baseline park with a WTP that ranges between $12.86 and $18.34. The minimum of this range is lower than that in the RL case since as we previously stated people provide a small value to the presence of native plants in OB parks. Thus the valuation for the combination OBPS is undervalued due to the effect on the people's perception of the PS attribute. It is important to emphasize (like in the RL case) that between 21% and 27% of the 81 possible OB alternatives can be considered feasible. However the proportion of feasible OB parks with fees equal to zero is higher than that of RL parks, and ranges from 82% to 94%. The other 6% and 18% of feasible parks have a fee level of $10. This reflects again the high importance that people provide to the fee attribute and how the utility and preferences of respondents are skewed to alternatives that offer an adequate or maximum (minimum) level of "positive" ("negative") attributes but at no cost.

Effects of Socioeconomic and Experiential Characteristics on Preferences for Aquatic Parks Alternatives

In equations 4-5 and 4-6 the econometrical specification of the multi-attribute model was determined. It is important to identify respondents' weighting of different parks attributes but it is also useful to evaluate whether socioeconomic characteristics (gender, region, age, education and income), as well as experiential features (extent of declared knowledge, real knowledge and benefits perceived from invasive species) have any effect over the attributes importance on respondents' utility.

For that purpose, explanatory variables that are characteristics of the chooser can be incorporated to the conditional Logit models (equations 4-7 and 4-8) as interaction with the attribute variables (Swallow et al. 1994). In this analysis, we have two types of dummies variables, those that represents socioeconomic characteristics of the respondents (Table 4-36) and those that represent a set of variables (Table 4-37) related with the extent of experience and knowledge that respondents have regarding to invasive species. These two types of variables come into the model interacting with the parks attributes; which can be expressed as.

$$\text{(4-16)} \quad Logit[P_{AB}] = Log\left(\frac{\pi(X^A)}{\pi(X^B)}\right) = \sum_{i=1}^{4} \beta_i (X_i^A - X_i^B) + \sum_{i=1}^{4}\sum_{j=1}^{n} \alpha_{ij}\delta_j (X_i^A - X_i^B)$$

where X_i denotes the ith attribute, β_i are the coefficients for the main effects of each attribute, α_{ij} are the coefficients for the interactive variables of the attributes with the socioeconomic and experiential dummies represented by δ_j.

It is important to note that there is a probability that the socioeconomic interactions create multicolinearity in the model. Therefore it was determined to apply a procedure that allows us to overcome this potential problem. This method is the principal component analysis (PCA), which can be defined as a mathematical procedure that transforms a number of (possibly) correlated variables into a (smaller) number of uncorrelated variables called as "principal components". The objectives of a PCA are usually interrelationship modeling, score replacement, or both. In our specific case we are interested in a "score replacement"; that is, the substitution of an original set of variables (socioeconomic variables) with new variables or scores that summarize the data parsimoniously. In other words, the objective of this analysis is to take our nine socioeconomic variables $X_1, X_2, \ldots, X_9$ and find combinations of these to produce a new set of variables (indices) $SC_1, SC_2, \ldots, SC_q$ that are uncorrelated. For this purpose we started finding for each location/attributes combination (RLAS, OBAS, RLPS and OBPS) the eigenvalues $\lambda_1, \lambda_2, \ldots, \lambda_9$ (Tables 4-38 to 4-41) of their socioeconomic variables. Then the number of factors to retain is determined according to the Kaiser criterion which recommends to keep only the factors with eigenvalues greater than 1. Hence the corresponding principal components selected for each location/attributes combination are presented from Tables 4-42 to 4-45. It is important to emphasize that it is possible to determine as many principal components as there are original variables. However it is advisable to choose few of them, which will be mutually uncorrelated. Thus the objective of parsimony and independence can be attained.

A rotation process (Varimax) was also applied (Tables 4-46 to 4-49). This is a method of altering the initial factors in order to achieve more interpretability through a simpler structure. A factor structure is considered to be simple if each of the original variables relates highly to only one factor and each factor can be identified as represented what is common to a relatively small number of variables. Therefore a structure is considered simple if for each factor the weights for most variables are near to zero and the remaining ones are relatively large. Then the factor can be considered as depicting the variation shared in common by the subset of variables highly related (large weights) and not to the others.

Finally, factor scores for each set of variables of every attribute/location combination were estimated. A factor score is a specific value of a factor calculated for a particular sampling unit (observation) and is formed as a weighted sum of the variables for that sampling unit. These factor scores are particularly useful when one wants to perform further analyses like in our case a regression analysis. Thus the factors associated with the components obtained via rotation and used for the estimation of the score variables (SCi) of each location/attribute combination are given as following:

$$(4\text{-}17)\quad RLAS-Factors=\begin{cases} SC_1=0.076G_1-0.927ED_1+0.927ED_2+0.092AG_1+0.089AG_2-0.139IN_1-0.057IN_2-0.003REG_1+0.045REG_2 \\ SC_2=0.022G_1-0.069ED_1+0.009ED_2-0.012AG_1+0.057AG_2-0.925IN_1+0.935IN_2+0.002REG_1+0.022REG_2 \\ SC_3=0.002G_1+0.035ED_1-0.009ED_2+0.012AG_1+0.047AG_2+0.015IN_1-0.004IN_2+0.893REG_1-0.896REG_2 \\ SC_4=0.001G_1-0.022ED_1-0.010ED_2+0.829AG_1-0.786AG_2+0.040IN_1-0.009IN_2-0.053REG_1-0.029REG_2 \\ SC_5=0.950G_1-0.076ED_1+0.013ED_2-0.226AG_1-0.287AG_2-0.017IN_1+0.009IN_2+0.075REG_1+0.075REG_2 \end{cases}$$

$$(4\text{-}18)\quad OBAS-Factors=\begin{cases} SC_1=-0.196G_1+0.503ED_1-0.486ED2+0.119AG_1+0.015AG_2+0.072IN_1+0.059IN_2-0.021REG_1+0.003REG_2 \\ SC_2=-0.050G_1+0.009ED_1+0.007ED2-0.075AG_1-0.011AG_2+0.533IN_1-0.538IN_2-0.013REG_1+0.017REG_2 \\ SC_3=0.050G_1-0.012ED_1+0.002ED2-0.028AG_1-0.015AG_2-0.005IN_1+0.028IN_2+0.558REG_1-0.553REG_2 \\ SC_4=0.236G_1+0.038ED_1-0.080ED2+0.594AG_1-0.570AG_2-0.028IN_1+0.083IN_2-0.008REG_1-0.006REG_2 \end{cases}$$

$$(4\text{-}19)\quad RLPS-Factors=\begin{cases} SC_1=-0.043G_1+0.015ED_1-0.041ED2+0.040AG_1+0.022AG_2-0.527IN_1+0.546IN_2+0.023REG_1+0.000REG_2 \\ SC_2=0.072G_1-0.007ED_1+0.002ED2+0.007AG_1+0.020AG_2-0.012IN_1+0.012IN_2+0.555REG_1-0.549REG_2 \\ SC_3=0.197G_1-0.525ED_1+0.514ED2-0.076AG_1-0.017AG_2-0.009IN_1-0.077IN_2+0.028REG_1+0.012REG_2 \\ SC_4=0.154G_1+0.006ED_1-0.052ED2+0.584AG_1-0.617AG_2+0.000IN_1+0.011IN_2-0.010REG_1+0.002REG_2 \end{cases}$$

$$(4\text{-}20)\quad OBPS-Factors=\begin{cases} SC_1=-0.045G_1-0.018ED_1+0.013ED2+0.129AG_1+0.049AG_2-0.523IN_1+0.526IN_2+0.035REG_1-0.008REG_2 \\ SC_2=0.157G_1-0.518ED_1+0.516ED2-0.134AG_1-0.011AG_2-0.068IN_1-0.038IN_2+0.004REG_1-0.020REG_2 \\ SC_3=0.027G_1-0.010ED_1+0.008ED2-0.020AG_1-0.017AG_2-0.016IN_1+0.028IN_2+0.548REG_1-0.546REG_2 \\ SC_4=0.184G_1+0.043ED_1-0.121ED2+0.654AG_1-0.547AG_2-0.050IN_1+0.083IN_2+0.004REG_1+0.004REG_2 \end{cases}$$

To sum up, starting from the interaction model proposed in equation 4-16 we replaced the socioeconomic variables by five scores variables (SC_i) for the RLAS case and by four scores variables for the other cases (RLPS, OBAS, OBPS). This will allow us to obtain more parsimonious models that are not affected by multicolinearity. This will reduce the likelihood of wrong interpretations and conclusions since the multicolinearity problem could influence erroneously on the significance and value of the estimated parameters.

On the other hand in the case of experiential variables it is important to specify that the variable K represents the declared knowledge or the knowledge that people state that they have. As we found in chapter two there is a discrepancy between this “declared knowledge” and the “real knowledge” that people have. Both are not equal and only the real knowledge has a real effect in people’s satisfaction when confronting to the presence of invasive plants. In this specific case we have a proxy variable that mimics the effect of the “real knowledge” this is the AF variable which represents any declaration of respondents about if s/he has been affected (in any form) by invasive plant species when visiting aquatic parks.

In Tables 2-6 and 2-7 we found a strong association among the real (or observed) knowledge of a respondent and his/her satisfaction expressed by their complaints of being affected somehow for these species. Then as a proxy of the real level of knowledge of respondents we will use the variable AF for the interaction models.

The maximum likelihood estimates for the proposed logistic regression model for each location/attribute combinations are given from Tables 4-50 to 4-53. We also presented a global test for each model. In this test the null hypothesis that all the estimators of these models are not significant ($\beta = 0$) was contrasted. Thus from Table 4-54 it can be concluded that all the four interactions models are statistically significant at 5% and 1% level of confidence; that is, the null hypothesis is rejected for all the models.

In the case of RL parks (Tables 4-50 and 4-52) the interaction effects of the socioeconomic variables (represented by the SC_i factors) with the IS attribute are not statistically significant. As a consequence the socioeconomic characteristics do not have any statistical significant effect on the negative weight that people perceived from IS attribute when attending RL parks. In the case of the experiential variables it was found that AF interactions are significant at 0.05 and 0.01 level of confidence; and BE at 0.05 level of confidence only. Consequently it can be concluded that the extent of people's real knowledge (AF) and the benefits (BE) that they perceived from these species do have an important effect in their preferences and utility for RL parks. However the effect of BE is weaker for the PS combination, which indicates a less importance on the perception of perceived benefits from invasive species when their impact is related to the natural scenario derived from the presence of native plants in RL parks.

It was also concluded that a person who has at least a moderate level of knowledge about invasive species is between 27.71% and 51.56% more likely to prefer parks with less presence of invasive species than those who have no knowledge about these species. Furthermore people who perceived a benefit from invasive plants are between 13.40% and 35.34% less likely to prefer parks with less presence of these species than those who does not perceived any benefit. In addition the effect of the stated or hypothetical knowledge (K) was not statistically significant. This reinforces our previous conclusion that the hypothetical knowledge (or the knowledge that people state that they have) does not have any statistical significant impact on people's discernment of the effect of invasive plants on their utility. To sum up in this location (RL) we found the following results: all the socioeconomic characteristics of the respondents have not any statistical significant impact on the negative weights that they provide to the effect of the IS on their utility. Although both the real knowledge (AF) and benefits (BE) perceived by the people have an effect on the perception about the negative effect of IS. In addition the K variable does not have any statistical significant effect on respondent's utility when we talked of RL parks. This is consistent with the results obtained in chapter two, in which it was found that the stated or hypothetical knowledge does not have a statistical significant impact on people's perception of the invasive species problem.

On the other hand from the results presented in Tables 4-51 and 4-53 it can be concluded that the interaction of the socioeconomic variables (represented by the score variables SC_i) with the IS attribute are not statistically significant for any OB parks models. As a consequence it can be concluded that people's socioeconomic characteristics do not have any statistical significant impact on the negative weight (perception) that people provide to the IS attribute when attending OB parks.

On the contrary if the impact of the experiential variables are examined, it can be found that both AF and BE variables are significant at 0.05 and 0.01 level, but the K variable is not. Therefore the extent of people's real knowledge (AF) and the benefits (BE) that they perceived from these species do have an important effect in their preferences and utility. Thus a person who has at least a moderate level of knowledge about invasive species is between 25.62% and 34.74% more likely to prefer parks with less presence of invasive species than those who have no knowledge about these species. Moreover people who perceived a benefit from these plants are between 12.97% and 31.57% less likely to prefer parks with less presence of these species than those who does not perceived any benefit. In addition the stated or hypothetical knowledge (K) does not have any influence on respondents' valuation of the impact of invasive species on their utility, which confirms the findings obtained in chapter two about the irrelevance of the stated knowledge.

Another effect derived from the inclusion of socioeconomic variables in the utility model was a discrepancy in the MWTP related to the IS attribute for different group of people. In other words, people who have at least a moderate level of knowledge about invasive plant species show larger negative MWTP for the IS attribute than people who have little or no knowledge. This is because the former are more affected on their utility by the presence of these plants due to their enhanced discernment.

In other words in Tables 4-18 and 4-19 it was determined that the average MWTP for the IS attribute in RL parks range from -$6.10 to -$6.20. However if we consider a difference in the level of knowledge (about these plants) among respondents, we found profound divergences among their MWTP as well as over their perception of the impact of invasive plants in their utility. Thus for people who have at least a moderate level of knowledge about invasive species their MWTP derived from the presence of these plants in RL parks range from -$7.08 to -$10.90. This impact in absolute value is higher than the average MWTP (derived from the IS attribute), which was estimated for all the respondents without categorizing them by knowledge background. Moreover for people who lack this type of knowledge, their MWTP for the IS attribute range from -$3.89 to -$5.06; less than the average obtained from the initial utility functions. This reinforces our conclusion about the influence of the knowledge on the perception of the impact of invasive plants on the people utility, which it is translated in a larger negative MWTP and as a consequence a higher disposition to avoid this problem.

The situation is similar for the OB location in which the average MWTP derived from the presence of invasive plants was estimated in Tables 4-18 and 4-19 and ranged from -$5.41 to

-\$6.32. These values were obtained without considering the differences in the level of knowledge about invasive species. Thus if we take into account the difference of knowledge among respondents we found that the MWTP derived from the IS attribute for people who have at least a moderate level of knowledge range from -\$7.94 to -\$9.95. This range is larger than the average range obtained from the original utility function (without the inclusion of socioeconomic and experiential variables). On the contrary analyzing the group of people with limited or no knowledge about invasive species, it was found that their MWTP for the IS attribute range from -\$4.72 to -\$5.71.

These results confirm our conclusion that asserts that people who have at least a moderate level of knowledge about invasive species are more able to discern the impact of these plants on their utility and as a consequence they present a larger (negative) willingness to pay than people who do not have this extent of knowledge. In other words this group of well-informed people is more sensitive to the presence of invasive plants than the rest; therefore any action tending to eradicate these plants it is going to be more valued by this group of knowledgeable people.

Estimation of Annual Marginal Willingness to Pay (MWTP)

In this section we will estimate the annual willingness to pay or benefits derived from a reduction in the presence of invasive species in Florida's aquatic areas. For that purpose, firstly, we will proceed to model -through an ordered probit- the frequency of visit to two types of aquatic parks (OB and RL) in Florida. We will apply the ordered response model of Aitchison and Silvey (1957). In this model, the dependent variable represents ordered or ranked categories that characterize people's frequency of visit to aquatic parks in Florida. The seven-point Likert scale (in descendent order) used in this analysis is the following:

- Daily;
- Weekly;

- Monthly;
- Once every 2 to 3 months;
- Once every 4 to 6 months;
- Once every 7 to 12 months
- Not at all

The data for this analysis were obtained through the following question in the survey: "How frequently have you participated in nature related outdoor activities at each of the following locations during the past 12 months?."

The applied model is defined as follow: the dependent variable model y_i^* that possesses more than two levels (in our case, seven levels) represents the frequency of visit of respondents to aquatic parks and will depend linearly on the explanatory variables (in our case demographic variables):

(4-21) $y_i^* = x_i^{'}\beta + \varepsilon_i$

where x_i and ε_i are independent and identically distributed random variables. The observed y_i is determined from y_i^* using the rule:

$$(4\text{-}22) \quad y_i = \begin{cases} 1 & if \quad y_i^* \le \gamma_1 \\ 2 & if \quad \gamma_1 < y_i^* \le \gamma_2 \\ 3 & if \quad \gamma_2 < y_i^* \le \gamma_3 \\ 4 & if \quad \gamma_3 < y_i^* \le \gamma_4 \\ 5 & if \quad \gamma_4 < y_i^* \le \gamma_5 \\ 6 & if \quad \gamma_5 < y_i^* \le \gamma_6 \\ 7 & if \quad \gamma_6 \le y_i^* \end{cases}$$

It is worth noting that the actual values chosen to represent the categories in "y" are completely arbitrary. All the ordered specification required is for ordering to be preserved so that $y_i^* < y_j^*$ implies that $y_i < y_j$. It follows that the probabilities of observing each value of "y" are given by system 4-22.

$$
(4\text{-}23) \quad P(y_i) = \begin{cases} \Pr(y_i = 1|x_i, \beta, \gamma) = F(\gamma_1 - x_i^{'}\beta) \\ \Pr(y_i = 2|x_i, \beta, \gamma) = F(\gamma_2 - x_i^{'}\beta) - F(\gamma_1 - x_i^{'}\beta) \\ \Pr(y_i = 3|x_i, \beta, \gamma) = F(\gamma_3 - x_i^{'}\beta) - F(\gamma_2 - x_i^{'}\beta) \\ \Pr(y_i = 4|x_i, \beta, \gamma) = F(\gamma_4 - x_i^{'}\beta) - F(\gamma_3 - x_i^{'}\beta) \\ \Pr(y_i = 5|x_i, \beta, \gamma) = F(\gamma_5 - x_i^{'}\beta) - F(\gamma_4 - x_i^{'}\beta) \\ \Pr(y_i = 6|x_i, \beta, \gamma) = F(\gamma_6 - x_i^{'}\beta) - F(\gamma_5 - x_i^{'}\beta) \\ \Pr(y_i = 7|x_i, \beta, \gamma) = 1 - F(\gamma_6 - x_i^{'}\beta) \end{cases}
$$

where F is the cumulative distribution function of ε.

The threshold values γ are estimated along with the β coefficients by maximizing the log likelihood function:

$$
(4\text{-}24) \quad \ln[L(\beta, \gamma)] = \sum_{i=1}^{N} \sum_{j=0}^{M} \log\left(\Pr(y_i = j|x_i, \beta, \gamma)\right)\delta(y_i = j)
$$

Where δ is an indicator function that takes the value 1 if the argument is true and 0 if the argument is false. The explanatory variables that will be used in the model are presented in Table 4-36 with the only difference that the education category has been divided in three dummies (high school or less, associate or some college courses, and bachelor's degree) instead of the two that originally was separated. The sample sizes of each of the two locations are shown in Table 4-55.

The maximum likelihood estimates for the ordered probit models proposed for the two aquatic parks are given in Table 4-56. It is necessary to emphasize that for this estimation a weighting procedure was also applied.

It can be observed in Table 4-57 that the models showed large chi-square statistics (and small p-values), thus the null hypothesis that all slope coefficients (except the constant) are zero can be rejected in both models. As a consequence, it can be stated that the OB and RL models are statistical significant; that is, that all their estimators are different from zero.

Using the ordered probit estimators from Table 4-56, we were able to calculate the probability of each score for the respondents (Likert scale). If we recall that the scores represent different frequencies of visit we can build a probability distribution of this variable for each location. The results are showed in Table 4-58 and Figure 4-7.

From Table 4-58 it can be determined that, on average, respondents visit OB parks thirteen times per year (12.97 times); and for the case of RL parks respondents go twelve times (11.59 times) per year. That means a frequency of visit of at least once per month for both types of locations. These high frequencies of visit reflect the importance of these locations for the welfare of the Florida's population since they seem to be essential components of the leisure time of Floridians and in turn of their quality of life.

At this point the results obtained on Table 4-58 can be used to estimate the annual willingness to pay for respondents. This measure will allow us to determine a more accurate measure of the MWTP value derived from the invasive species problem. The reason is because this value uses both the average MWTP per visit and the people's frequency of visit as a weight measure of the importance of each location (OB and RL parks) for respondents. For example we can see in Figure 4-7 that the frequency of visit is larger for OB parks than for RL parks; this is a proxy of the importance that people provide to the former location compared to the latter.

In Table 4-59 we can note that the average MWTP for the IS attribute is higher in absolute value for the OB location than for the RL parks. In other words a significant reduction in the presence of invasive species in OB parks generates an annual increment of the population's surplus in \$76.47 and in the case of RL parks the impact is lower; that is, \$71.26 approximately. These measures gather both the effect of the impact of invasive plants in respondents' utility and the preferences for the type of park reflected in their frequency of visits. Hence it can be observed that the effect of the preferences for the type of park which is larger for OB parks results in this location presenting the highest average MWTP for the IS attribute per year. This indicates us that welfare of the Florida's population derived from leisure activities are skewed to this type of location.

In addition if we take into account the level of knowledge of respondents about invasive plants the results differ from the average case. Hence it can be verified that the MWTP derived from a significant reduction in the presence of invasive plants for people who have a least a moderate level of knowledge presents an increment of approximately $36 per year comparing to the average. In other words, for OB parks a significant reduction of the presence of invasive plants generates an increment of the surplus for the "well-informed people" in $115.95 per year and in the case of RL parks the impact for the same group of people is about $104.19 per year.

In contrast in the case of the people who have limited or no knowledge about invasive species the impact of the presence of these plants on their utility is smaller in $14.12 per year comparing to the average case. In other words for OB parks a significant reduction of the presence of invasive plants generates an increment of the surplus of the people (with little or no knowledge) in only $67.63 per year and in the case of RL parks the impact for the same group of people is $51.86 per year.

Extrapolating these results for the Florida's adult population it can be inferred that the potential average impact on the people utility of the presence of invasive plants in aquatic areas is substantial. This impact is estimated in an amount[25] (per year) of -$1,065,516,700 for OB parks and -$992,595,790 for RL parks approximately. However this potential impact would be

[25] For this estimation the 2006 projection of the Florida's adult (older than 18) population provided in the 2000 Census is applied.

even higher if the population will be well-informed. Therefore the impact would be in an amount (per year) of -$1,615,092,363 for OB parks and -$1,451,284,807 for RL parks approximately.

Then any action to reduce the presence of invasive plants in these natural areas in Florida is justified because of the sizeable potential impact of these species on the welfare and quality of life of Floridians. Moreover it is necessary to emphasize that educational campaigns about these problems would produce better results since will increase the WTP of the population due to an enhancement of their awareness and discernment about the benefits of any control and management program of these plants.

Therefore this study has demonstrated that an important and necessary action is not only to develop control and management programs but also to design and to implement educational programs that facilitate the public's participation and their willingness to collaborate[26] through an enhancement of their awareness of the problem and the benefits of these programs. This can be proved through the higher level of aversion to the presence of invasive plants (reflected in larger negative WTP) for informed respondents compared to those who do not have an adequate level of knowledge.

Conclusions

In this chapter we determined the utility function of respondents when participating in nature-based recreational activities in OB and RL parks. We found in these functions that the presence of invasive plants has a negative impact on the people's utility in a magnitude superior to the effect of the positive attributes such as: facilities, animal species and plant species. This large negative number associated to the IS attribute indicates; first, a strong aversion of respondents to the presence of invasive plants and second, that an enhancement of the other

[26] That can be raised through indirect taxes as a compensation measure for providing aquatic areas free of these noxious plants.

positive attributes is not sufficient in order to compensate for a high presence of these plants. On the contrary, it is necessary to attack directly this problem through effective management and control programs that must be accompanied by educational programs as well. In addition the most important attribute that impacts people's utility when visiting these aquatic parks is the level of fees. In other words, people are very sensitive to the fee levels hence they not only demand parks with a small presence of invasive species but also with low fees.

Furthermore, using rankings we corroborated the conclusion that people provide a high importance to the fee attribute. Hence, the utility and preferences of respondents are skewed to alternatives that offer an adequate or maximum (minimum) level of "positive" ("negative") attributes but at no or low cost.

An analysis with interaction terms was also conducted, using both demographics and experiential variables. For OB and RL parks no socioeconomic variable (gender, age, education, income and region) were statistically significant. Hence, people's socioeconomic characteristics do not have any impact on the negative weight that people provide to the IS attribute when attending OB and RL parks.

In the case of the experiential variables the findings were also the same for both locations. That is, both the extent of people's real knowledge (AF) and the benefits (BE) that they perceived from invasive plants do have an important effect in people's preferences and utility but the stated knowledge (K) does not. These results support two ideas: first, the necessity of educational programs as an effective approach to attack the invasive plant species problem in aquatic areas in Florida; and second, that the stated knowledge (or the knowledge that people state that they have) does not have any statistical significant impact on people's discernment of the effect of invasive plants on his/her utility.

Finally the importance of control and management program along Florida is justified by the potential impact of the presence of these species on the population's welfare, which reaches to -$1,065,516,700 for OB parks and -$992,595,790 for RL parks. However it is recommended that this type of programs should be implemented along with educational projects that would increase the public's awareness and knowledge of invasive species. This can be verified in the larger impact of this problem if the population would be adequate informed. This impact reaches to -$1,615,092,363 for OB parks and -$1,451,284,807 for RL parks; that is, approximately $500 millions additionally in each location. Therefore any type of strategy of control and management implemented along with educational programs would increase people's willingness to pay to eradicate the invasive plant species problem[27] and in turn will increase the public's collaboration facilitating the eradication of these plants in Florida.

[27] Since a person with at least a moderate level of knowledge is more able to fully discern what the real impact of invasive plants is in his/her utility

Table 4-1 Summary of attributes and attributes levels

Attributes	Levels
a) Park facilities condition	1. Minimal 2. Adequate 3. Excellent
b) Diversity of Plant Species	1. Low 2. Moderate 3. High
c) Diversity of Animal Species	1. Low 2. Moderate 3. High
d) Presence of Invasive plant species	1. None 2. Few and dispersed 3. Numerous and dense
e) Fees	1. Free 2. $10 3. $20

Table 4-2 Pair-wise choice sets for the plant species combination survey

Pair-wise Choice	Park	Attributes			
		Facilities Condition	Native Plant Diversity	Presence of Invasive plant species	Fees
1	A	Minimal	Moderate	Few and dispersed	$10
	B	Adequate	High	Numerous and dense	$20
2	A	Minimal	Low	None	Free
	B	Excellent	High	Few and dispersed	$20
3	A	Excellent	High	None	$20
	B	Adequate	Low	Numerous and dense	Free
4	A	Minimal	High	Few and dispersed	$10
	B	Excellent	Moderate	None	$20
5	A	Adequate	Moderate	None	$10
	B	Excellent	High	Numerous and dense	Free
6	A	Excellent	Moderate	Few and dispersed	$10
	B	Minimal	High	Numerous and dense	Free
7	A	Excellent	High	Numerous and dense	$20
	B	Minimal	Low	None	$10

Table 4-3 Pair-wise choice sets for the animal species combination survey

Pair-wise Choice	Park	Attributes			
		Facilities Condition	Native Plant Diversity	Presence of Invasive plant species	Fees
1	A	Minimal	Moderate	Few and dispersed	$10
	B	Adequate	High	Numerous and dense	$20
2	A	Minimal	Low	None	Free
	B	Excellent	High	Few and dispersed	$20
3	A	Excellent	High	None	$20
	B	Adequate	Low	Numerous and dense	Free
4	A	Minimal	High	Few and dispersed	$10
	B	Excellent	Moderate	None	$20
5	A	Adequate	Moderate	None	$10
	B	Excellent	High	Numerous and dense	Free
6	A	Excellent	Moderate	Few and dispersed	$10
	B	Minimal	High	Numerous and dense	Free
7	A	Excellent	High	Numerous and dense	$20
	B	Minimal	Low	None	$10

Table 4-4 Total valid response rates for each survey

	RLAS	OBAS	RLPS	OBPS
Total Valid Responses	681	890	618	911
Total Observations for the Models*	4767	6230	4326	6377

*This is equal to the total of valid responses multiplied by seven that is the number of pair-wise choices in each survey

Table 4-5 Socioeconomic characteristics for the survey sample and comparisons with the Florida population.

Categories	RLAS	RLPS	OBAS	OBPS	Florida
Urban	25.8%	30.2%	27.1%	31.3%	47.0%
Suburban	58.0%	53.7%	57.5%	54.4%	44.0%
Rural	16.3%	16.2%	15.4%	14.2%	9.0%
Male	36.2%	36.7%	34.6%	36.5%	48.8%
Female	63.8%	63.3%	65.4%	63.5%	51.2%
18 - 25 years	1.9%	1.5%	2.4%	1.1%	7.8%
26 - 35 years	8.7%	9.3%	8.5%	9.9%	16.9%
36 - 45 years	20.5%	22.3%	21.6%	19.4%	20.1%
46 - 55 years	24.6%	23.8%	23.7%	25.5%	16.8%
56 - 65 years	28.8%	25.4%	27.1%	26.5%	12.6%
More than 65 years	15.5%	17.6%	16.8%	17.7%	25.9%
High School or less	36.6%	40.3%	33.8%	36.6%	48.9%
Associate or some college	25.9%	25.1%	26.3%	25.7%	28.8%
Bachelor's degree	24.6%	19.1%	24.7%	21.5%	14.3%
Advanced degree beyond bachelor's	12.9%	15.5%	15.2%	16.2%	8.0%
Less than $14,999	4.8%	5.1%	3.9%	5.0%	16.3%
$15,000 - $34,999	20.9%	23.0%	21.3%	21.3%	28.7%
$35,000 - $59,999	29.1%	28.5%	28.1%	32.7%	24.8%
$60,000 - $74,999	16.7%	15.7%	17.3%	14.5%	11.1%
$75,000 - $99,999	15.0%	14.5%	15.0%	13.5%	8.7%
$100,000 - $149,999	9.7%	10.4%	10.8%	9.0%	6.3%
More than $150,000	3.7%	2.8%	3.6%	4.0%	4.1%

Source: U.S. Census Bureau 2000

Table 4-6 Predictors for multi-attribute utility model (MAUM)

Variable	Description
Facilities (FA)	Variable that indicates the condition of facilities in a park. This variable takes value of: 0 when minimal, 1 when adequate and 2 when excellent.
Animal Species (AS)	Variable that denotes the level of diversity of wildlife in a park. This variable takes value of: 0 when low, 1 when moderate and 2 when high.
Plant Species (PS)	Variable that denotes the level of diversity of native plant species in a park. This variable takes value of: 0 when low, 1 when moderate and 2 when high.
Invasive plant species (IS)	Variable that denotes the degree of presence of invasive plant species in a park. This variable takes value of: 0 when none, 1 when few and dispersed and 2 when numerous and dense.
Fees (FE)	Variable that denotes the degree of presence of invasive plant species in a park. This variable takes value of: 0 when none, 1 when few and dispersed and 2 when numerous and dense.

Table 4-7 Coefficient estimates for the river and lake/animal species combination (RLAS)

Var.	Estimates	Std. Err.	z	P>|z|	95% C.I	
FA	0.283	0.0389	7.260	0.000	0.206	0.359
AS	0.330	0.0387	8.540	0.000	0.254	0.406
IS	-0.403	0.0394	-10.220	0.000	-0.480	-0.325
FE	-0.066	0.0064	-10.250	0.000	-0.079	-0.053

Table 4-8 Coefficient estimates for the ocean and beach/animal species combination (OBAS)

Var.	Estimates	Std. Err.	z	P>|z|	95% C.I	
FA	0.291	0.0338	8.610	0.000	0.225	0.357
AS	0.320	0.0341	9.380	0.000	0.254	0.387
IS	-0.422	0.0345	-12.240	0.000	-0.489	-0.354
FE	-0.067	0.0056	-12.000	0.000	-0.078	-0.056

Table 4-9 Coefficient estimates for the river and lake/plant species combination (RLPS)

Var.	Estimates	Std. Err.	z	P>|z|	95% C.I	
FA	0.342	0.0410	8.330	0.000	0.261	0.422
PS	0.292	0.0406	7.190	0.000	0.212	0.372
IS	-0.467	0.0412	-11.360	0.000	-0.548	-0.387
FE	-0.075	0.0068	-11.150	0.000	-0.089	-0.062

Table 4-10 Coefficient estimates for the ocean and beach/animal species combination (OBPS)

Var.	Estimates	Std. Err.	z	P>|z|	95% C.I	
FA	0.207	0.0331	6.260	0.000	0.142	0.272
PS	0.221	0.0327	6.740	0.000	0.156	0.285
IS	-0.360	0.0335	-10.740	0.000	-0.425	-0.294
FE	-0.066	0.0055	-12.060	0.000	-0.077	-0.056

Table 4-11 Global test of significance of estimators

Global Null Hypothesis Beta = 0			
MODEL	df	χ^2	p-value
RLAS	4	122.61	0.0000
OBAS	4	176.89	0.0000
RLPS	4	166.12	0.0000
OBPS	4	255.72	0.0000

Table 4-12 Standardized estimators for each location/attributes combination model

	Location/Attributes Combinations			
Attribute	RLAS	OBAS	RLPS	OBPS
FA	0.929	0.954	1.124	0.680
AS	0.999	0.972	NA	NA
PS	NA	NA	0.885	0.669
IS	-1.129	-1.178	-1.311	-1.007
FE	-1.762	-1.819	-2.046	-1.808

Table 4-13 Wald Test for facilities and plant/animal species attributes for each location/attributes combination model

	RLAS	OBAS	RLPS	OBPS
Wald (FA vs. AS/PS)	1.39	0.72	1.40	0.16
P-value	0.24	0.40	0.24	0.69

Table 4-14 Wald Test for weight equivalence of facilities and invasive plant species attributes for each location/attributes combination model

	RLAS	OBAS	RLPS	OBPS
Wald (FA vs. IS)	92.56	131.62	116.83	87.15
P-value	0.00	0.00	0.00	0.00

Table 4-15 Wald Test for weight equivalence of animal/plant species and invasive plant species attributes for each location/attributes combination model

	RLAS	OBAS	RLPS	OBPS
Wald (AS/PS vs. IS)	99.82	131.92	97.76	87.07
P-value	0.00	0.00	0.00	0.00

Table 4-16 Wald Test for weight equivalence of fees and invasive plant species attributes for each location/attributes combination model

	RLAS	OBAS	RLPS	OBPS
Wald (FE vs. IS)	95.51	138.33	118.95	100.69
P-value	0.00	0.00	0.00	0.00

Table 4-17 Ranking on the relative importance of each attribute on the respondents' utility for each location/attributes combination

Ranking	RLAS	OBAS	RLPS	OBPS
1st Place	FE	FE	FE	FE
2nd Place	IS	IS	IS	IS
3rd Place	FA and AS*	FA and AS*	FA and PS*	FA and PS*

* It was proved in table 4.13 that the importance of these two attributes was statistically the same

Table 4-18 Marginal willingness to pay (MWTP) for each attribute in models with “animal species” attribute combinations.

Attributes	River and Lake			Ocean and Beach		
	MWTP	Lower Limit	Upper Limit	MWTP	Lower Limit	Upper Limit
FA	$ 4.282	$ 2.625	$ 6.723	$ 4.362	$ 2.896	$ 6.400
AS	$ 5.002	$ 3.235	$ 7.604	$ 4.805	$ 3.268	$ 6.943
IS	$ (6.102)	$ (6.105)	$ (6.098)	$ (6.325)	$ (6.350)	$ (6.307)

Table 4-19 Marginal willingness to pay (MWTP) for each attribute in models with “plant species” attribute combinations.

Attributes	River and Lake			Ocean and Beach		
	MWTP	Lower Limit	Upper Limit	MWTP	Lower Limit	Upper Limit
FA	$ 4.535	$ 2.950	$ 6.797	$ 3.114	$ 1.840	$ 4.884
PS	$ 3.874	$ 2.397	$ 5.983	$ 3.318	$ 2.024	$ 5.114
IS	$ (6.201)	$ (6.226)	$ (6.185)	$ (5.413)	$ (5.506)	$ (5.283)

Table 4-20 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of facilities condition for the combination RLAS.

		Park A		
		Minimal	Adequate	Excellent
Park B	Minimal	1.0000	1.3265	1.7596
		0.00%	+32.65%	+75.96%
	Adequate	0.7539	1.0000	1.3265
		-24.61%	0.00%	+32.65%
	Excellent	0.5683	0.7539	1.0000
		-43.17%	-24.61%	0.00%

Table 4-21 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of facilities condition for the combination OBAS.

		Park A		
		Minimal	Adequate	Excellent
Park B	Minimal	1.0000	1.3376	1.7893
		0.00%	+33.76%	+78.93%
	Adequate	0.7476	1.0000	1.3376
		-25.24%	0.00%	+33.76%
	Excellent	0.5589	0.7476	1.0000
		-44.11%	-25.24%	0.00%

Table 4-22 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of facilities condition for the combination RLPS.

		Park A		
		Minimal	Adequate	Excellent
Park B	Minimal	1.0000 0.00%	1.4076 +40.76%	1.9813 +98.13%
	Adequate	0.7104 -28.96%	1.0000 0.00%	1.4076 +40.76%
	Excellent	0.5047 -49.53%	0.7104 -28.96%	1.0000 0.00%

Table 4-23 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of facilities condition for the combination OBPS.

		Park A		
		Minimal	Adequate	Excellent
Park B	Minimal	1.0000 0.00%	1.2300 +23.00%	1.5129 +51.29%
	Adequate	0.8130 -18.70%	1.0000 0.00%	1.2300 +23.00%
	Excellent	0.6610 -33.90%	0.8130 -18.70%	1.0000 0.00%

Table 4-24 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of diversity of animal species for the combination RLAS.

		Park A		
		Low	Moderate	High
Park B	Low	1.0000 0.00%	1.3910 +39.10%	1.9350 +93.50%
	Moderate	0.7189 -28.11%	1.0000 0.00%	1.3910 +39.10%
	High	0.5168 -48.32%	0.7189 -28.11%	1.0000 0.00%

Table 4-25 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of diversity of animal species for the combination OBAS.

		Park A		
		Low	Moderate	High
Park B	Low	1.0000 0.00%	1.3778 +37.78%	1.8983 +89.83%
	Moderate	0.7258 -27.42%	1.0000 0.00%	1.3778 +37.78%
	High	0.5268 -47.32%	0.7258 -27.42%	1.0000 0.00%

Table 4-26 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of diversity of plant species for the combination RLPS.

		Park A		
		Low	Moderate	High
Park B	Low	1.0000 0.00%	1.3392 +33.92%	1.7935 +79.35%
	Moderate	0.7467 -25.33%	1.0000 0.00%	1.3392 +33.92%
	High	0.5576 -44.24%	0.7467 -25.33%	1.0000 0.00%

Table 4-27 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of diversity of plant species for the combination OBPS.

		Park A		
		Low	Moderate	High
Park B	Low	1.0000 0.00%	1.2468 +24.68%	1.5544 +55.44%
	Moderate	0.8021 -19.79%	1.0000 0.00%	1.2468 +24.68%
	High	0.6433 -35.67%	0.8021 -19.79%	1.0000 0.00%

Table 4-28 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of presence of invasive plant species for the combination RLAS.

		Park A		
		None	Few	Numerous
Park B	None	1.0000 0.00%	0.6686 -33.14%	0.4470 -55.30%
	Few	1.4957 +49.57%	1.0000 0.00%	0.6686 -33.14%
	Numerous	2.2373 +123.73%	1.4957 +49.57%	1.0000 0.00%

Table 4-29 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of presence of invasive plant species for the combination OBAS.

		Park A		
		None	Few	Numerous
Park B	None	1.0000 0.00%	0.6558 -34.42%	0.4301 -56.99%
	Few	1.5247 +52.47%	1.0000 0.00%	0.6558 -34.42%
	Numerous	2.3248 +132.48%	1.5247 +52.47%	1.0000 0.00%

Table 4-30 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of presence of invasive plant species for the combination RLPS.

		Park A		
		None	Few	Numerous
Park B	None	1.0000	0.6266	0.3926
		0.00%	-37.34%	-60.74%
	Few	1.5959	1.0000	0.6266
		+59.59%	0.00%	-37.34%
	Numerous	2.5470	1.5959	1.0000
		+154.70%	+59.59%	0.00%

Table 4-31 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of presence of invasive plant species for the combination OBPS.

		Park A		
		None	Few	Numerous
Park B	None	1.0000	0.6978	0.4869
		0.00%	-30.22%	-51.31%
	Few	1.4331	1.0000	0.6978
		+43.31%	0.00%	-30.22%
	Numerous	2.0537	1.4331	1.0000
		+105.37%	+43.31%	0.00%

Table 4-32 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of fees for the combination RLAS.

		Park A		
		Free	$10	$20
Park B	Free	1.0000	0.5169	0.2672
		0.00%	-48.31%	-73.28%
	$10	1.9344	1.0000	0.5169
		+93.44%	0.00%	-48.31%
	$20	3.7420	1.9344	1.0000
		+274.20%	+93.44%	0.00%

Table 4-33 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of fees for the combination OBAS.

		Park A		
		Free	$10	$20
Park B	Free	1.0000	0.5133	0.2635
		0.00%	-48.67%	-73.65%
	$10	1.9482	1.0000	0.5133
		+94.82%	0.00%	-48.67%
	$20	3.7956	1.9482	1.0000
		+279.56%	+94.82%	0.00%

Table 4-34 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of fees for the combination RLPS.

		Park A		
		Free	$10	$20
Park B	Free	1.0000	0.4706	0.2214
		0.00%	-52.94%	-77.86%
	$10	2.1250	1.0000	0.4706
		+112.50%	0.00%	-52.94%
	$20	4.5157	2.1250	1.0000
		+351.57%	+112.50%	0.00%

Table 4-35 Odds ratio and likelihood of preference of Park A (row) over Park B (columns) given different levels of fees species for the combination OBPS.

		Park A		
		Free	$10	$20
Park B	Free	1.0000	0.5144	0.2646
		0.00%	-48.56%	-73.54%
	$10	1.9440	1.0000	0.5144
		+94.40%	0.00%	-48.56%
	$20	3.7793	1.9440	1.0000
		+277.93%	+94.40%	0.00%

Table 4-36 Socioeconomic variables for multi-attribute utility model (MAUM) with interactions

Variable	Definition
REG	Dummy variables that indicate the region in which the respondents' residence is located. This category is divided in two dummies: reg1 = people who live in central Florida and reg2 = people who live in south Florida.
G	Dummy variable that indicates the respondent's gender. The variable g1 represents male respondents.
ED	Dummy variables that represent respondents' level of education. This category is divided in three dummies: ed1 = people with a level of education between high school (or less) and either an associate degree or some college courses and ed2= people who have a bachelor's degree.
AG	Dummy variables that represent different age ranges for respondents. It is divided in two dummies: ag1 = people from 18 to 34 years old and ag2 = people from 35 to 54 years old.
IN	Dummy variables that represent different ranges of income for respondents. It is divided in two dummies in1 = people with income that ranges from less than $14,999 to $34,999 (low); and in2= people with income that ranges from $35,000 to $99,999 (intermediate)

Table 4-37 Experiential variables for multi-attribute utility model (MAUM) with interactions

Variable	Definition
K	Dummy variable that represents if respondents have at least a moderate level of knowledge about invasive species (K=1).
AF	Dummy variable that represents if respondents have been affected by invasive plants on either their enjoyment of outdoor recreation activities or their frequency of visit to aquatic parks (AF = 1).
BE	Dummy variable that represents if respondents perceived any benefit from the presence of invasive plants in aquatic parks in Florida (B=1).

Table 4-38 Eigenvalues for the socioeconomics variable for the animal species/river and lake combination (RLAS)

Factor	Eigenvalue	Proportion	Cumulative
1	1.9440	0.2160	0.2160
2	1.6517	0.1835	0.3995
3	1.5648	0.1739	0.5734
4	1.2823	0.1425	0.7159
5	1.0302	0.1145	0.8303
6	0.6496	0.0722	0.9025
7	0.3885	0.0432	0.9457
8	0.3012	0.0335	0.9791
9	0.1878	0.0209	1.0000

Table 4-39 Eigenvalues for the socioeconomics variable for the animal species/ocean and beach combination (OBAS)

Factor	Eigenvalue	Proportion	Cumulative
1	2.0387	0.2265	0.2265
2	1.8380	0.2042	0.4307
3	1.5402	0.1711	0.6019
4	1.2190	0.1354	0.7373
5	0.9362	0.1040	0.8413
6	0.5733	0.0637	0.9050
7	0.3712	0.0412	0.9463
8	0.3077	0.0342	0.9805
9	0.1757	0.0195	1.0000

Table 4-40 Eigenvalues for the socioeconomics variable for the plant species/river and lake combination (RLPS)

Factor	Eigenvalue	Proportion	Cumulative
1	2.0078	0.2231	0.2231
2	1.5989	0.1777	0.4007
3	1.5287	0.1699	0.5706
4	1.3150	0.1461	0.7167
5	0.9909	0.1101	0.8268
6	0.6268	0.0696	0.8965
7	0.3769	0.0419	0.9383
8	0.3545	0.0394	0.9777
9	0.2005	0.0223	1.0000

Table 4-41 Eigenvalues for the socioeconomics variable for the plant species/ocean and beach combination (OBPS)

Factor	Eigenvalue	Proportion	Cumulative
1	2.1299	0.2367	0.2367
2	1.8481	0.2053	0.4420
3	1.5514	0.1724	0.6144
4	1.1236	0.1248	0.7392
5	0.9683	0.1076	0.8468
6	0.5489	0.0610	0.9078
7	0.3280	0.0364	0.9442
8	0.3086	0.0343	0.9785
9	0.1932	0.0215	1.0000

Table 4-42 Factor loadings for the socioeconomics variable for the animal species/river and lake combination (RLAS)

Variables	1	2	3	4	5	Uniqueness
g1	0.1843	-0.0822	0.0960	0.1108	0.9196	0.0921
ed1	-0.7306	0.3751	-0.4356	0.0525	0.0621	0.1291
ed2	0.6817	-0.3874	0.4709	-0.1015	-0.1177	0.1393
ag1	-0.0216	-0.2655	0.0450	0.7477	-0.3394	0.2527
ag2	0.1016	0.2741	0.0483	-0.7666	-0.1968	0.2858
in1	-0.6945	-0.5607	0.2241	-0.1697	0.0354	0.1230
in2	0.5537	0.6468	-0.3203	0.2220	-0.0194	0.1227
reg1	-0.1995	0.4927	0.7132	0.0939	0.0775	0.1940
reg2	0.2684	-0.4827	-0.6916	-0.1527	0.0730	0.1879

Table 4-43 Factor loadings for the socioeconomics variable for the animal species/ocean and beach combination (OBAS)

Variables	1	2	3	4	Uniqueness
g1	-0.4189	-0.1819	0.1743	0.2262	0.7099
ed1	0.6327	0.5551	-0.3312	0.1778	0.1502
ed2	-0.5907	-0.5348	0.3068	-0.2264	0.2197
ag1	-0.2972	0.1220	-0.1620	0.7068	0.3709
ag2	0.5592	-0.1095	0.0639	-0.6033	0.3072
in1	-0.5255	0.6623	-0.3162	-0.2763	0.1089
in2	0.6596	-0.4945	0.2604	0.3766	0.1107
reg1	0.0208	0.4938	0.7537	0.0271	0.1870
reg2	-0.0358	-0.5069	-0.7347	-0.0493	0.1995

Table 4-44 Factor loadings for the socioeconomics variable for the plant species/river and lake combination (RLPS)

Variables	1	2	3	4	Uniqueness
g1	0.1824	0.1607	0.3247	0.1039	0.8247
ed1	-0.6788	-0.1432	-0.5496	0.2049	0.1747
ed2	0.6260	0.1189	0.5426	-0.2637	0.2300
ag1	0.0162	0.0570	0.1714	0.7603	0.3891
ag2	-0.0743	-0.0208	-0.3453	-0.7544	0.3057
in1	-0.7330	-0.2102	0.5293	-0.1175	0.1246
in2	0.6436	0.1949	-0.6306	0.1672	0.1223
reg1	-0.2430	0.8663	0.0196	-0.0520	0.1875
reg2	0.3251	-0.8380	-0.0057	0.0325	0.1910

Table 4-45 Factor loadings for the socioeconomics variable for the plant species/ocean and beach combination (OBPS)

Variables	1	2	3	4	Uniqueness
g1	-0.4593	0.0976	0.1027	0.0965	0.7597
ed1	0.6099	-0.5167	-0.3736	0.2576	0.1551
ed2	-0.5320	0.5050	0.3662	-0.3349	0.2157
ag1	-0.3391	0.0832	-0.0144	0.7415	0.3281
ag2	0.6542	0.0037	0.0079	-0.5125	0.3094
in1	-0.5427	-0.5695	-0.4596	-0.2049	0.1279
in2	0.6498	0.4559	0.4040	0.2844	0.1258
reg1	-0.0151	-0.6191	0.6742	0.0226	0.1614
reg2	0.0633	0.6278	-0.6617	0.0009	0.1640

Table 4-46 Rotated factor loadings for the socioeconomics variable for the animal species/river and lake combination (RLAS)

Variables	1	2	3	4	5	Uniqueness
g1	0.0761	0.0220	0.0022	0.0009	0.9495	0.0921
ed1	-0.9266	-0.0687	0.0352	-0.0225	-0.0763	0.1291
ed2	0.9275	0.0091	-0.0094	-0.0103	0.0132	0.1393
ag1	0.0918	-0.0118	0.0122	0.8291	-0.2260	0.2527
ag2	0.0888	0.0565	0.0468	-0.7865	-0.2869	0.2858
in1	-0.1385	-0.9250	0.0149	0.0397	-0.0166	0.1230
in2	-0.0571	0.9348	-0.0041	-0.0086	0.0092	0.1227
reg1	-0.0030	0.0016	0.8930	-0.0533	0.0750	0.1940
reg2	0.0445	0.0220	-0.8962	-0.0286	0.0748	0.1879

Table 4-47 Rotated factor loadings for the socioeconomics variable for the animal species/ocean and beach combination (OBAS)

Variables	1	2	3	4	Uniqueness
g1	-0.4015	-0.0100	0.0563	0.3544	0.7099
ed1	0.9203	-0.0054	0.0297	-0.0444	0.1502
ed2	-0.8820	0.0205	-0.0414	-0.0131	0.2197
ag1	0.1035	0.0154	-0.0448	0.7849	0.3709
ag2	0.1398	-0.1744	-0.0211	-0.8015	0.3072
in1	0.1067	0.9325	0.0483	0.0888	0.1089
in2	0.1269	-0.9336	-0.0004	-0.0397	0.1107
reg1	0.0166	0.0282	0.9010	-0.0137	0.1870
reg2	-0.0469	-0.0243	-0.8931	-0.0022	0.1995

Table 4-48 Rotated factor loadings for the socioeconomics variable for the plant species/river and lake combination (RLPS)

Variables	1	2	3	4	Uniqueness
g1	-0.0373	0.1056	0.3364	0.2226	0.8247
ed1	-0.0953	0.0299	-0.9024	-0.0318	0.1747
ed2	0.0480	-0.0358	0.8749	-0.0302	0.2300
ag1	0.0426	0.0180	-0.0783	0.7763	0.3891
ag2	0.0429	0.0287	-0.0725	-0.8285	0.3057
in1	-0.9252	0.0208	-0.1374	0.0075	0.1246
in2	0.9367	-0.0152	-0.0065	0.0005	0.1223
reg1	0.0055	0.9013	0.0080	-0.0085	0.1875
reg2	0.0446	-0.8959	0.0663	0.0008	0.1910

Table 4-49 Rotated factor loadings for the socioeconomics variable for the plant species/ocean and beach combination (OBPS)

Variables	1	2	3	4	Uniqueness
g1	-0.1504	0.3420	0.0360	0.3154	0.7597
ed1	-0.0006	-0.9127	0.0291	-0.1049	0.1551
ed2	0.0143	0.8849	-0.0316	-0.0013	0.2157
ag1	0.0623	-0.0365	-0.0397	0.8156	0.3281
ag2	0.2472	-0.2002	-0.0323	-0.7671	0.3094
in1	-0.9263	-0.0948	0.0420	0.0579	0.1279
in2	0.9297	-0.0866	-0.0140	-0.0478	0.1258
reg1	-0.0047	-0.0410	0.9148	-0.0053	0.1614
reg2	0.0525	0.0126	-0.9127	0.0024	0.1640

Table 4-50 Coefficient estimates for the interaction model for the river and lake/animal species combination (RLAS)

Variable	Coef.	Std. Err.	Z	P>|z|	95% C.I.	
FA	0.3245	0.0387	8.386	0.0000	0.2487	0.4004
AS	0.3565	0.0390	9.139	0.0000	0.2800	0.4329
IS	-0.3609	0.0541	-6.674	0.0000	-0.4668	-0.2549
FE	-0.0712	0.0064	-11.101	0.0000	-0.0838	-0.0587
K*IS	-0.0317	0.0475	-0.668	0.5042	-0.1249	0.0614
AF*IS	-0.4158	0.0466	-8.923	0.0000	-0.5071	-0.3245
BE*IS	0.4360	0.0576	7.574	0.0000	0.3232	0.5488
SC_1*FA	0.0486	0.0398	1.222	0.2215	-0.0293	0.1265
SC_1*AS	0.0098	0.0393	0.250	0.8026	-0.0673	0.0869
SC_1*IS	-0.0032	0.0403	-0.080	0.9366	-0.0822	0.0758
SC_1*FE	-0.0065	0.0066	-0.980	0.3273	-0.0194	0.0065
SC_2*FA	0.1007	0.0382	2.636	0.0084	0.0258	0.1756
SC_2*AS	0.0245	0.0381	0.643	0.5201	-0.0502	0.0993
SC_2*IS	-0.0232	0.0391	-0.592	0.5537	-0.0998	0.0535
SC_2*FE	-0.0008	0.0064	-0.125	0.9004	-0.0133	0.0117
SC_3*FA	-0.0240	0.0394	-0.608	0.5433	-0.1012	0.0533
SC_3*AS	0.0191	0.0405	0.472	0.6368	-0.0603	0.0986
SC_3*IS	0.0089	0.0414	0.214	0.8304	-0.0723	0.0900
SC_3*FE	-0.0024	0.0065	-0.375	0.7075	-0.0152	0.0103
SC_4*FA	-0.0462	0.0376	-1.228	0.2196	-0.1199	0.0276
SC_4*AS	-0.0094	0.0380	-0.248	0.8041	-0.0838	0.0650
SC_4*IS	0.0371	0.0388	0.957	0.3388	-0.0389	0.1131
SC_4*FE	0.0056	0.0062	0.896	0.3701	-0.0066	0.0178
SC_5*FA	-0.0155	0.0384	-0.403	0.6866	-0.0907	0.0597
SC_5*AS	0.0051	0.0386	0.131	0.8958	-0.0706	0.0807
SC_5*IS	0.0238	0.0395	0.602	0.5471	-0.0536	0.1012
SC_5*FE	0.0028	0.0064	0.438	0.6611	-0.0097	0.0153

Table 4-51 Coefficient estimates for the interaction model for the ocean and beach/animal species combination (OBAS)

Variable	Coef.	Std. Err.	Z	P>|z|	95% C.I.	
FA	0.3125	0.0351	8.90	0.0000	0.2437	0.3813
AS	0.3723	0.0366	10.17	0.0000	0.3005	0.4440
IS	-0.4013	0.0490	-8.19	0.0000	-0.4973	-0.3053
FE	-0.0703	0.0057	-12.25	0.0000	-0.0815	-0.0590
K*IS	-0.0673	0.0504	-1.33	0.1822	-0.1661	0.0316
AF*IS	-0.2982	0.0428	-6.97	0.0000	-0.3820	-0.2144
BE*IS	0.3794	0.0488	7.78	0.0000	0.2838	0.4749
SC_1*FA	0.0263	0.0378	0.70	0.4869	-0.0478	0.1003
SC_1*AS	0.0375	0.0359	1.04	0.2962	-0.0328	0.1078
SC_1*IS	-0.0475	0.0339	-1.40	0.1609	-0.1140	0.0189
SC_1*FE	-0.0078	0.0059	-1.31	0.1898	-0.0194	0.0039
SC_2*FA	-0.0543	0.0359	-1.51	0.1304	-0.1246	0.0160
SC_2*AS	-0.0399	0.0342	-1.17	0.2435	-0.1068	0.0271
SC_2*IS	0.0063	0.0330	0.19	0.8489	-0.0584	0.0710
SC_2*FE	0.0013	0.0057	0.23	0.8194	-0.0099	0.0125
SC_3*FA	-0.0831	0.0344	-2.42	0.0157	-0.1505	-0.0157
SC_3*AS	-0.0096	0.0353	-0.27	0.7859	-0.0789	0.0597
SC_3*IS	0.0399	0.0357	1.12	0.2643	-0.0301	0.1099
SC_3*FE	0.0058	0.0057	1.03	0.3024	-0.0053	0.0170
SC_4*FA	-0.0586	0.0357	-1.64	0.1005	-0.1285	0.0113
SC_4*AS	-0.0433	0.0341	-1.27	0.2041	-0.1102	0.0236
SC_4*IS	0.0494	0.0330	1.50	0.1342	-0.0153	0.1142
SC_4*FE	0.0054	0.0057	0.96	0.3374	-0.0057	0.0166

Table 4-52 Coefficient estimates for the interaction model for the river and lake/plant species combination (RLPS)

Variable	Coef.	Std. Err.	Z	P>|z|	95% C.I.	
FA	0.3578	0.0406	8.807	0.0000	0.2782	0.4374
AS	0.3002	0.0404	7.430	0.0000	0.2210	0.3795
IS	-0.2983	0.0509	-5.865	0.0000	-0.3980	-0.1986
K*IS	-0.0767	0.0067	-11.445	0.0000	-0.0898	-0.0635
AF*IS	-0.0829	0.0539	-1.538	0.1240	-0.1886	0.0227
BE*IS	-0.2446	0.0563	-4.342	0.0000	-0.3550	-0.1342
BENIS	0.1439	0.0686	2.097	0.0360	0.0094	0.2784
SC_1*FA	0.0098	0.0401	0.243	0.8081	-0.0689	0.0884
SC_1*AS	0.0070	0.0399	0.176	0.8605	-0.0712	0.0853
SC_1*IS	0.0571	0.0407	1.403	0.1605	-0.0226	0.1368
SC_1*FE	-0.0002	0.0066	-0.036	0.9713	-0.0132	0.0128
SC_2*FA	-0.0469	0.0410	-1.144	0.2525	-0.1273	0.0334
SC_2*AS	-0.0224	0.0409	-0.548	0.5837	-0.1025	0.0577
SC_2*IS	0.0277	0.0417	0.663	0.5071	-0.0541	0.1094
SC_2*FE	0.0014	0.0068	0.213	0.8316	-0.0119	0.0147
SC_3*FA	0.0179	0.0416	0.430	0.6673	-0.0637	0.0995
SC_3*AS	-0.0215	0.0410	-0.525	0.5996	-0.1018	0.0588
SC_3*IS	0.0146	0.0414	0.352	0.7247	-0.0666	0.0958
SC_3*FE	0.0034	0.0069	0.495	0.6206	-0.0100	0.0168
SC_4*FA	-0.0282	0.0404	-0.699	0.4849	-0.1074	0.0510
SC_4*AS	0.0100	0.0402	0.249	0.8033	-0.0687	0.0887
SC_4*IS	0.0538	0.0410	1.311	0.1898	-0.0266	0.1342
SC_4*FE	-0.0026	0.0067	-0.382	0.7027	-0.0156	0.0105

Table 4-53 Coefficient estimates for the interaction model for the ocean and beach/plant species combination (OBPS)

Variable	Coef.	Std. Err.	Z	P>|z|	95% C.I.	
FA	0.2348	0.0347	6.770	0.0000	0.1668	0.3028
AS	0.2481	0.0347	7.145	0.0000	0.1800	0.3161
IS	-0.3350	0.0460	-7.288	0.0000	-0.4251	-0.2449
FE	-0.0709	0.0057	-12.354	0.0000	-0.0822	-0.0597
K*IS	-0.0119	0.0485	-0.246	0.8059	-0.1070	0.0831
AF*IS	-0.2281	0.0427	-5.336	0.0000	-0.3118	-0.1443
BE*IS	0.1390	0.0522	2.661	0.0078	0.0366	0.2413
SC_1*FA	0.0174	0.0354	0.490	0.6238	-0.0520	0.0868
SC_1*AS	-0.0038	0.0331	-0.115	0.9084	-0.0686	0.0610
SC_1*IS	-0.0016	0.0319	-0.050	0.9601	-0.0641	0.0609
SC_1*FE	0.0023	0.0057	0.403	0.6867	-0.0088	0.0134
SC_2*FA	0.0412	0.0372	1.105	0.2692	-0.0318	0.1142
SC_2*AS	-0.0033	0.0343	-0.097	0.9230	-0.0706	0.0640
SC_2*IS	0.0198	0.0326	0.606	0.5446	-0.0442	0.0838
SC_2*FE	-0.0006	0.0059	-0.096	0.9232	-0.0120	0.0109
SC_3*FA	-0.0140	0.0331	-0.422	0.6728	-0.0789	0.0509
SC_3*AS	-0.0274	0.0330	-0.830	0.4067	-0.0920	0.0373
SC_3*IS	-0.0094	0.0339	-0.279	0.7804	-0.0758	0.0569
SC_3*FE	0.0037	0.0055	0.668	0.5043	-0.0072	0.0146
SC_4*FA	0.0330	0.0373	0.884	0.3765	-0.0401	0.1061
SC_4*AS	0.0072	0.0338	0.214	0.8307	-0.0591	0.0736
SC_4*IS	0.0323	0.0315	1.028	0.3042	-0.0293	0.0940
SC_4*FE	-0.0025	0.0058	-0.439	0.6610	-0.0139	0.0088

Table 4-54 Global test of significance of estimators of interaction models

Global Null Hypothesis Beta = 0			
MODEL	df	χ^2	p-value
RLAS	27	301.56	0.0000
OBAS	23	250.46	0.0000
RLPS	23	318.80	0.0000
OBPS	23	310.71	0.0000

Table 4-55 Total valid response rates for each survey

	River and Lake	Ocean and Beach
Total Valid Responses	1,299	1,801

Table 4-56 Coefficient estimates for the frequency models for river/lake and ocean/beach locations

		RIVER AND LAKE			OCEAN AND BEACH		
Variable	Description	Coef.	z	P-value	Coef.	z	P-value
g1	Male	-0.165	-2.36	0.018	-0.076	-1.29	0.197
ag1	18 - 34 years	-0.414	-4.02	0.000	-0.429	-4.84	0.000
ag2	35 - 54 years	-0.225	-3.14	0.002	-0.284	-4.77	0.000
ed1	High school and less	0.385	3.21	0.001	0.398	4.56	0.000
ed2	Associate or some college courses	0.196	1.61	0.107	0.234	2.64	0.008
ed3	Bachelor's degree	0.171	1.40	0.163	0.236	2.73	0.006
in1	Less than \$14,999 - \$34,999	0.079	0.66	0.511	0.341	3.66	0.000
in2	\$35,000 - \$99,999	-0.038	-0.35	0.725	-0.008	-0.11	0.915
reg1	Central Region	0.081	1.00	0.319	0.038	0.54	0.588
reg2	South Region	0.271	2.69	0.007	-0.020	-0.25	0.799
$\gamma 1$	Threshold Values	-1.781	-10.59	0.000	-1.867	-14.11	0.000
$\gamma 2$		-1.141	-7.22	0.000	-0.881	-7.28	0.000
$\gamma 3$		-0.640	-4.14	0.000	-0.315	-2.65	0.008
$\gamma 4$		-0.283	-1.83	0.067	0.180	1.52	0.128
$\gamma 5$		0.020	0.13	0.897	0.517	4.36	0.000
$\gamma 6$		0.430	2.77	0.006	0.949	8.00	0.000

Table 4-57 Global test of significance of estimators of frequency models

Global Null Hypothesis Beta = 0			
MODEL	df	χ^2	p-value
River and Lake	10	53.92	0.0000
Ocean and Beach	10	106.11	0.0000

Table 4-58 Estimated probabilities for frequency of visit to OB and RL parks

Frequency	River and Lake	Ocean and Beach
Daily	3.22%	2.40%
Weekly	7.88%	13.19%
Monthly	11.99%	16.71%
Once every 2 to 3 months	11.73%	18.47%
Once every 4 to 6 months	11.37%	12.62%
Once every 7 to 12 months	15.73%	14.01%
Not at all	38.08%	22.62%

Table 4-59 Marginal willingness to pay (MWTP) per year for the invasive species (IS) attribute

Type of Park	Average MWTP	Knowledge Background	
		Yes	No
River and Lake	$ (71.26)	$ (104.19)	$ (51.86)
Ocean and Beach	$ (76.47)	$ (115.95)	$ (67.63)

	PARK A	PARK B
Facilities condition	Minimal	Adequate
Animal species diversity	Moderate	High
Presence of invasive species	Few and dispersed	Numerous and dense
Fees	$10	$20

Which of the two parks do you prefer?

Park A Park B

Figure 4-1 Example of a pair-wise question – animal species combinations

	PARK A	PARK B
Facilities condition	Adequate	Excellent
Native plant diversity	Moderate	High
Presence of invasive species	None	Numerous and dense
Fees	$10	Free

Which of the two parks do you prefer?

Park A Park B

Figure 4-2 Example of a pair-wise question – plant species combinations

FA	AS	IS	FE	Utility	Ranking	WTP	P%$_{A\ vs\ Base}$
Excellent	High	None	Free	1.225	1	$ 18.57	77.30%
Adequate	High	None	Free	0.943	2	$ 14.29	71.96%
Excellent	Moderate	None	Free	0.895	3	$ 13.57	70.99%
Excellent	High	Few and dispersed	Free	0.823	4	$ 12.47	69.48%
Minimal	High	None	Free	0.660	5	$ 10.00	65.93%
Adequate	Moderate	None	Free	0.613	6	$ 9.28	64.85%
Excellent	High	None	$ 10	0.565	7	$ 8.57	63.77%
Excellent	Low	None	Free	0.565	8	$ 8.56	63.76%
Adequate	High	Few and dispersed	Free	0.540	9	$ 8.18	63.18%
Excellent	Moderate	Few and dispersed	Free	0.493	10	$ 7.46	62.07%
Excellent	High	Numerous and dense	Free	0.420	11	$ 6.36	60.35%
Minimal	Moderate	None	Free	0.330	12	$ 5.00	58.18%
Adequate	High	None	$ 10	0.283	13	$ 4.29	57.02%
Adequate	Low	None	Free	0.283	14	$ 4.28	57.02%
Excellent	Moderate	None	$ 10	0.235	15	$ 3.57	55.86%
Minimal	High	Few and dispersed	Free	0.257	16	$ 3.90	56.40%
Adequate	Moderate	Few and dispersed	Free	0.210	17	$ 3.18	55.23%
Excellent	High	Few and dispersed	$ 10	0.163	18	$ 2.47	54.06%
Excellent	Low	Few and dispersed	Free	0.162	19	$ 2.46	54.05%
Adequate	High	Numerous and dense	Free	0.137	20	$ 2.08	53.43%
Excellent	Moderate	Numerous and dense	Free	0.090	21	$ 1.36	52.25%
Minimal	High	None	$ 10	0.000	22	$ 0.00	50.01%
Minimal	*Low*	*None*	*Free*	*0.000*	*23*	*NA*	*50.00%*
Adequate	Moderate	None	$ 10	-0.047	24	$ (0.72)	48.82%
Excellent	High	None	$ 20	-0.094	25	$ (1.43)	47.64%
Excellent	Low	None	$ 10	-0.095	26	$ (1.44)	47.63%
Minimal	Moderate	Few and dispersed	Free	-0.073	27	$ (1.10)	48.19%
Adequate	High	Few and dispersed	$ 10	-0.120	28	$ (1.82)	47.01%
Adequate	Low	Few and dispersed	Free	-0.120	29	$ (1.82)	47.00%
Excellent	Moderate	Few and dispersed	$ 10	-0.167	30	$ (2.54)	45.83%
Minimal	High	Numerous and dense	Free	-0.145	31	$ (2.20)	46.38%
Adequate	Moderate	Numerous and dense	Free	-0.193	32	$ (2.92)	45.20%
Excellent	High	Numerous and dense	$ 10	-0.240	33	$ (3.64)	44.03%
Excellent	Low	Numerous and dense	Free	-0.240	34	$ (3.64)	44.02%
Minimal	Moderate	None	$ 10	-0.330	35	$ (5.00)	41.83%
Adequate	High	None	$ 20	-0.377	36	$ (5.71)	40.69%
Adequate	Low	None	$ 10	-0.377	37	$ (5.72)	40.68%
Excellent	Moderate	None	$ 20	-0.424	38	$ (6.43)	39.54%
Minimal	High	Few and dispersed	$ 10	-0.402	39	$ (6.10)	40.07%
Minimal	Low	Few and dispersed	Free	-0.403	40	$ (6.10)	40.07%
Adequate	Moderate	Few and dispersed	$ 10	-0.450	41	$ (6.82)	38.94%
Excellent	High	Few and dispersed	$ 20	-0.497	42	$ (7.53)	37.82%
Excellent	Low	Few and dispersed	$ 10	-0.497	43	$ (7.54)	37.82%
Minimal	Moderate	Numerous and dense	Free	-0.475	44	$ (7.20)	38.34%
Adequate	High	Numerous and dense	$ 10	-0.522	45	$ (7.92)	37.23%
Adequate	Low	Numerous and dense	Free	-0.523	46	$ (7.92)	37.22%
Excellent	Moderate	Numerous and dense	$ 10	-0.570	47	$ (8.64)	36.13%
Minimal	High	None	$ 20	-0.660	48	$ (10.00)	34.08%
Minimal	Low	None	$ 10	-0.660	49	$ (10.00)	34.08%
Adequate	Moderate	None	$ 20	-0.707	50	$ (10.72)	33.03%
Excellent	Low	None	$ 20	-0.755	51	$ (11.44)	31.98%
Minimal	Moderate	Few and dispersed	$ 10	-0.732	52	$ (11.10)	32.47%
Adequate	High	Few and dispersed	$ 20	-0.780	53	$ (11.82)	31.44%
Adequate	Low	Few and dispersed	$ 10	-0.780	54	$ (11.82)	31.43%
Excellent	Moderate	Few and dispersed	$ 20	-0.827	55	$ (12.54)	30.43%
Minimal	High	Numerous and dense	$ 10	-0.805	56	$ (12.20)	30.90%
Minimal	Low	Numerous and dense	Free	-0.805	57	$ (12.20)	30.89%
Adequate	Moderate	Numerous and dense	$ 10	-0.852	58	$ (12.92)	29.89%
Excellent	High	Numerous and dense	$ 20	-0.900	59	$ (13.64)	28.91%
Excellent	Low	Numerous and dense	$ 10	-0.900	60	$ (13.64)	28.91%
Minimal	Moderate	None	$ 20	-0.990	61	$ (15.00)	27.10%
Adequate	Low	None	$ 20	-1.037	62	$ (15.72)	26.17%
Minimal	High	Few and dispersed	$ 20	-1.062	63	$ (16.10)	25.69%
Minimal	Low	Few and dispersed	$ 10	-1.062	64	$ (16.10)	25.68%
Adequate	Moderate	Few and dispersed	$ 20	-1.110	65	$ (16.82)	24.79%
Excellent	Low	Few and dispersed	$ 20	-1.157	66	$ (17.54)	23.92%
Minimal	Moderate	Numerous and dense	$ 10	-1.135	67	$ (17.20)	24.32%
Adequate	High	Numerous and dense	$ 20	-1.182	68	$ (17.92)	23.46%
Adequate	Low	Numerous and dense	$ 10	-1.183	69	$ (17.92)	23.46%
Excellent	Moderate	Numerous and dense	$ 20	-1.230	70	$ (18.64)	22.62%
Minimal	Low	None	$ 20	-1.320	71	$ (20.00)	21.09%
Minimal	Moderate	Few and dispersed	$ 20	-1.392	72	$ (21.10)	19.91%
Adequate	Low	Few and dispersed	$ 20	-1.440	73	$ (21.82)	19.16%
Minimal	High	Numerous and dense	$ 20	-1.465	74	$ (22.20)	18.77%
Minimal	Low	Numerous and dense	$ 10	-1.465	75	$ (22.20)	18.77%
Adequate	Moderate	Numerous and dense	$ 20	-1.512	76	$ (22.92)	18.06%
Excellent	Low	Numerous and dense	$ 20	-1.560	77	$ (23.64)	17.37%
Minimal	Low	Few and dispersed	$ 20	-1.722	78	$ (26.10)	15.16%
Minimal	Moderate	Numerous and dense	$ 20	-1.795	79	$ (27.20)	14.25%
Adequate	Low	Numerous and dense	$ 20	-1.842	80	$ (27.92)	13.68%
Minimal	Low	Numerous and dense	$ 20	-2.125	81	$ (32.20)	10.67%

Figure 4-3 Evaluation of alternatives for the animal species combination – river and lake parks (RLAS)

FA	PS	IS	FE	Utility	Ranking	WTP	P%$_{A\ vs\ Base}$
Excellent	High	None	Free	1.268	1	$ 16.82	78.04%
Excellent	Moderate	None	Free	0.976	2	$ 12.95	72.63%
Adequate	High	None	Free	0.926	3	$ 12.29	71.63%
Excellent	High	Few and dispersed	Free	0.800	4	$ 10.62	69.01%
Excellent	Low	None	Free	0.684	5	$ 9.07	66.46%
Adequate	Moderate	None	Free	0.634	6	$ 8.41	65.34%
Minimal	High	None	Free	0.584	7	$ 7.75	64.20%
Excellent	High	None	$ 10	0.514	8	$ 6.82	62.58%
Excellent	Moderate	Few and dispersed	Free	0.508	9	$ 6.74	62.44%
Adequate	High	Few and dispersed	Free	0.459	10	$ 6.08	61.27%
Adequate	Low	None	Free	0.342	11	$ 4.54	58.46%
Excellent	High	Numerous and dense	Free	0.333	12	$ 4.42	58.25%
Minimal	Moderate	None	Free	0.292	13	$ 3.87	57.25%
Excellent	Moderate	None	$ 10	0.222	14	$ 2.95	55.53%
Adequate	High	None	$ 10	0.172	15	$ 2.29	54.30%
Excellent	Low	Few and dispersed	Free	0.216	16	$ 2.87	55.39%
Adequate	Moderate	Few and dispersed	Free	0.166	17	$ 2.21	54.15%
Minimal	High	Few and dispersed	Free	0.117	18	$ 1.55	52.91%
Excellent	High	Few and dispersed	$ 10	0.047	19	$ 0.62	51.17%
Excellent	Moderate	Numerous and dense	Free	0.041	20	$ 0.54	51.02%
Minimal	*Low*	*None*	*Free*	*0.000*	*21*	*NA*	*50.00%*
Excellent	Low	None	$ 10	-0.070	22	$ (0.93)	48.25%
Adequate	High	Numerous and dense	Free	-0.009	23	$ (0.12)	49.78%
Adequate	Moderate	None	$ 10	-0.120	24	$ (1.59)	47.01%
Minimal	High	None	$ 10	-0.170	25	$ (2.25)	45.77%
Adequate	Low	Few and dispersed	Free	-0.126	26	$ (1.67)	46.86%
Excellent	High	None	$ 20	-0.240	27	$ (3.18)	44.04%
Minimal	Moderate	Few and dispersed	Free	-0.175	28	$ (2.33)	45.63%
Excellent	Moderate	Few and dispersed	$ 10	-0.245	29	$ (3.26)	43.89%
Adequate	High	Few and dispersed	$ 10	-0.295	30	$ (3.92)	42.67%
Excellent	Low	Numerous and dense	Free	-0.251	31	$ (3.33)	43.75%
Adequate	Moderate	Numerous and dense	Free	-0.301	32	$ (3.99)	42.53%
Adequate	Low	None	$ 10	-0.412	33	$ (5.46)	39.85%
Minimal	High	Numerous and dense	Free	-0.351	34	$ (4.65)	41.32%
Excellent	High	Numerous and dense	$ 10	-0.421	35	$ (5.58)	39.63%
Minimal	Moderate	None	$ 10	-0.462	36	$ (6.13)	38.66%
Excellent	Moderate	None	$ 20	-0.532	37	$ (7.05)	37.01%
Minimal	Low	Few and dispersed	Free	-0.467	38	$ (6.20)	38.52%
Adequate	High	None	$ 20	-0.582	39	$ (7.71)	35.86%
Excellent	Low	Few and dispersed	$ 10	-0.538	40	$ (7.13)	36.88%
Adequate	Moderate	Few and dispersed	$ 10	-0.587	41	$ (7.79)	35.73%
Minimal	High	Few and dispersed	$ 10	-0.637	42	$ (8.45)	34.59%
Adequate	Low	Numerous and dense	Free	-0.593	43	$ (7.87)	35.59%
Excellent	High	Few and dispersed	$ 20	-0.707	44	$ (9.38)	33.02%
Minimal	Moderate	Numerous and dense	Free	-0.643	45	$ (8.53)	34.46%
Excellent	Moderate	Numerous and dense	$ 10	-0.713	46	$ (9.46)	32.90%
Minimal	Low	None	$ 10	-0.754	47	$ (10.00)	32.00%
Excellent	Low	None	$ 20	-0.824	48	$ (10.93)	30.49%
Adequate	High	Numerous and dense	$ 10	-0.763	49	$ (10.12)	31.81%
Adequate	Moderate	None	$ 20	-0.874	50	$ (11.59)	29.45%
Minimal	High	None	$ 20	-0.923	51	$ (12.25)	28.43%
Adequate	Low	Few and dispersed	$ 10	-0.879	52	$ (11.67)	29.33%
Minimal	Moderate	Few and dispersed	$ 10	-0.929	53	$ (12.33)	28.31%
Excellent	Moderate	Few and dispersed	$ 20	-0.999	54	$ (13.26)	26.91%
Minimal	Low	Numerous and dense	Free	-0.935	55	$ (12.40)	28.19%
Adequate	High	Few and dispersed	$ 20	-1.049	56	$ (13.92)	25.94%
Excellent	Low	Numerous and dense	$ 10	-1.005	57	$ (13.33)	26.80%
Adequate	Moderate	Numerous and dense	$ 10	-1.055	58	$ (13.99)	25.83%
Adequate	Low	None	$ 20	-1.166	59	$ (15.46)	23.76%
Minimal	High	Numerous and dense	$ 10	-1.105	60	$ (14.65)	24.89%
Excellent	High	Numerous and dense	$ 20	-1.175	61	$ (15.58)	23.60%
Minimal	Moderate	None	$ 20	-1.215	62	$ (16.13)	22.87%
Minimal	Low	Few and dispersed	$ 10	-1.221	63	$ (16.20)	22.77%
Excellent	Low	Few and dispersed	$ 20	-1.291	64	$ (17.13)	21.56%
Adequate	Moderate	Few and dispersed	$ 20	-1.341	65	$ (17.79)	20.73%
Minimal	High	Few and dispersed	$ 20	-1.391	66	$ (18.45)	19.93%
Adequate	Low	Numerous and dense	$ 10	-1.347	67	$ (17.87)	20.64%
Minimal	Moderate	Numerous and dense	$ 10	-1.397	68	$ (18.53)	19.84%
Excellent	Moderate	Numerous and dense	$ 20	-1.467	69	$ (19.46)	18.74%
Minimal	Low	None	$ 20	-1.508	70	$ (20.00)	18.13%
Adequate	High	Numerous and dense	$ 20	-1.516	71	$ (20.12)	18.00%
Adequate	Low	Few and dispersed	$ 20	-1.633	72	$ (21.67)	16.34%
Minimal	Moderate	Few and dispersed	$ 20	-1.683	73	$ (22.33)	15.67%
Minimal	Low	Numerous and dense	$ 10	-1.689	74	$ (22.40)	15.59%
Excellent	Low	Numerous and dense	$ 20	-1.759	75	$ (23.33)	14.69%
Adequate	Moderate	Numerous and dense	$ 20	-1.809	76	$ (23.99)	14.08%
Minimal	High	Numerous and dense	$ 20	-1.858	77	$ (24.65)	13.49%
Minimal	Low	Few and dispersed	$ 20	-1.975	78	$ (26.20)	12.18%
Adequate	Low	Numerous and dense	$ 20	-2.101	79	$ (27.87)	10.90%
Minimal	Moderate	Numerous and dense	$ 20	-2.150	80	$ (28.53)	10.43%
Minimal	Low	Numerous and dense	$ 20	-2.442	81	$ (32.40)	8.00%

Figure 4-4 Evaluation of alternatives for the plant species combination – river and lake parks (RLPS)

FA	AS	IS	FE	Utility	Ranking	WTP	$P\%_{A\ vs\ Base}$
Excellent	High	None	Free	1.223	1	$ 18.33	77.25%
Adequate	High	None	Free	0.932	2	$ 13.97	71.74%
Excellent	Moderate	None	Free	0.902	3	$ 13.53	71.14%
Excellent	High	Few and dispersed	Free	0.801	4	$ 12.01	69.02%
Minimal	High	None	Free	0.641	5	$ 9.61	65.50%
Adequate	Moderate	None	Free	0.611	6	$ 9.17	64.83%
Excellent	Low	None	Free	0.582	8	$ 8.72	64.15%
Excellent	High	None	$ 10	0.556	7	$ 8.33	63.55%
Adequate	High	Few and dispersed	Free	0.510	9	$ 7.65	62.48%
Excellent	Moderate	Few and dispersed	Free	0.480	10	$ 7.20	61.79%
Excellent	High	Numerous and dense	Free	0.379	11	$ 5.68	59.37%
Minimal	Moderate	None	Free	0.320	12	$ 4.81	57.94%
Adequate	Low	None	Free	0.291	14	$ 4.36	57.22%
Adequate	High	None	$ 10	0.265	13	$ 3.97	56.58%
Excellent	Moderate	None	$ 10	0.235	15	$ 3.53	55.86%
Minimal	High	Few and dispersed	Free	0.219	16	$ 3.29	55.46%
Adequate	Moderate	Few and dispersed	Free	0.190	17	$ 2.84	54.72%
Excellent	Low	Few and dispersed	Free	0.160	19	$ 2.40	53.99%
Excellent	High	Few and dispersed	$ 10	0.134	18	$ 2.01	53.35%
Adequate	High	Numerous and dense	Free	0.088	20	$ 1.32	52.20%
Excellent	Moderate	Numerous and dense	Free	0.059	21	$ 0.88	51.47%
Minimal	*Low*	*None*	*Free*	*0.000*	*22*	*NA*	*50.00%*
Minimal	High	None	$ 10	-0.026	23	$ (0.39)	49.35%
Adequate	Moderate	None	$ 10	-0.056	24	$ (0.83)	48.61%
Excellent	Low	None	$ 10	-0.085	25	$ (1.28)	47.87%
Minimal	Moderate	Few and dispersed	Free	-0.101	26	$ (1.52)	47.47%
Excellent	High	None	$ 20	-0.111	27	$ (1.67)	47.23%
Adequate	Low	Few and dispersed	Free	-0.131	28	$ (1.96)	46.73%
Adequate	High	Few and dispersed	$ 10	-0.157	29	$ (2.35)	46.09%
Excellent	Moderate	Few and dispersed	$ 10	-0.186	30	$ (2.80)	45.35%
Minimal	High	Numerous and dense	Free	-0.203	31	$ (3.04)	44.95%
Adequate	Moderate	Numerous and dense	Free	-0.232	32	$ (3.48)	44.22%
Excellent	Low	Numerous and dense	Free	-0.262	33	$ (3.93)	43.49%
Excellent	High	Numerous and dense	$ 10	-0.288	34	$ (4.32)	42.85%
Minimal	Moderate	None	$ 10	-0.346	35	$ (5.19)	41.42%
Adequate	Low	None	$ 10	-0.376	36	$ (5.64)	40.71%
Adequate	High	None	$ 20	-0.402	37	$ (6.03)	40.08%
Minimal	Low	Few and dispersed	Free	-0.422	38	$ (6.32)	39.61%
Excellent	Moderate	None	$ 20	-0.432	39	$ (6.47)	39.38%
Minimal	High	Few and dispersed	$ 10	-0.448	40	$ (6.71)	38.99%
Adequate	Moderate	Few and dispersed	$ 10	-0.477	41	$ (7.16)	38.29%
Excellent	Low	Few and dispersed	$ 10	-0.507	42	$ (7.60)	37.59%
Minimal	Moderate	Numerous and dense	Free	-0.523	43	$ (7.84)	37.21%
Excellent	High	Few and dispersed	$ 20	-0.533	44	$ (7.99)	36.98%
Adequate	Low	Numerous and dense	Free	-0.553	45	$ (8.29)	36.52%
Adequate	High	Numerous and dense	$ 10	-0.579	46	$ (8.68)	35.92%
Excellent	Moderate	Numerous and dense	$ 10	-0.608	47	$ (9.12)	35.25%
Minimal	Low	None	$ 10	-0.667	48	$ (10.00)	33.92%
Minimal	High	None	$ 20	-0.693	49	$ (10.39)	33.34%
Adequate	Moderate	None	$ 20	-0.722	50	$ (10.83)	32.69%
Excellent	Low	None	$ 20	-0.752	51	$ (11.28)	32.04%
Minimal	Moderate	Few and dispersed	$ 10	-0.768	52	$ (11.52)	31.69%
Adequate	Low	Few and dispersed	$ 10	-0.798	53	$ (11.96)	31.05%
Adequate	High	Few and dispersed	$ 20	-0.824	54	$ (12.35)	30.50%
Minimal	Low	Numerous and dense	Free	-0.844	55	$ (12.65)	30.08%
Excellent	Moderate	Few and dispersed	$ 20	-0.853	56	$ (12.80)	29.87%
Minimal	High	Numerous and dense	$ 10	-0.870	57	$ (13.04)	29.53%
Adequate	Moderate	Numerous and dense	$ 10	-0.899	58	$ (13.48)	28.92%
Excellent	Low	Numerous and dense	$ 10	-0.929	59	$ (13.93)	28.32%
Excellent	High	Numerous and dense	$ 20	-0.955	60	$ (14.32)	27.79%
Minimal	Moderate	None	$ 20	-1.013	61	$ (15.19)	26.63%
Adequate	Low	None	$ 20	-1.043	62	$ (15.64)	26.06%
Minimal	Low	Few and dispersed	$ 10	-1.089	63	$ (16.32)	25.19%
Minimal	High	Few and dispersed	$ 20	-1.115	64	$ (16.71)	24.70%
Adequate	Moderate	Few and dispersed	$ 20	-1.144	65	$ (17.16)	24.15%
Excellent	Low	Few and dispersed	$ 20	-1.174	66	$ (17.60)	23.62%
Minimal	Moderate	Numerous and dense	$ 10	-1.190	67	$ (17.84)	23.32%
Adequate	Low	Numerous and dense	$ 10	-1.220	68	$ (18.29)	22.80%
Adequate	High	Numerous and dense	$ 20	-1.246	69	$ (18.68)	22.35%
Excellent	Moderate	Numerous and dense	$ 20	-1.275	70	$ (19.12)	21.84%
Minimal	Low	None	$ 20	-1.334	71	$ (20.00)	20.85%
Minimal	Moderate	Few and dispersed	$ 20	-1.435	72	$ (21.52)	19.23%
Adequate	Low	Few and dispersed	$ 20	-1.465	73	$ (21.96)	18.77%
Minimal	Low	Numerous and dense	$ 10	-1.511	74	$ (22.65)	18.09%
Minimal	High	Numerous and dense	$ 20	-1.537	75	$ (23.04)	17.70%
Adequate	Moderate	Numerous and dense	$ 20	-1.566	76	$ (23.48)	17.28%
Excellent	Low	Numerous and dense	$ 20	-1.596	77	$ (23.93)	16.86%
Minimal	Low	Few and dispersed	$ 20	-1.756	78	$ (26.32)	14.73%
Minimal	Moderate	Numerous and dense	$ 20	-1.857	79	$ (27.84)	13.51%
Adequate	Low	Numerous and dense	$ 20	-1.887	80	$ (28.29)	13.16%
Minimal	Low	Numerous and dense	$ 20	-2.177	81	$ (32.65)	10.18%

Figure 4-5 Evaluation of alternatives for the animal species combination – ocean and beach parks (OBAS)

FA	PS	IS	FE	Utility	Ranking	WTP	P%A vs Base
Excellent	High	None	Free	0.855	1	$ 12.86	70.16%
Adequate	High	None	Free	0.648	2	$ 9.75	65.66%
Excellent	Moderate	None	Free	0.635	3	$ 9.55	65.35%
Excellent	High	Few and dispersed	Free	0.495	4	$ 7.45	62.14%
Minimal	High	None	Free	0.441	5	$ 6.64	60.85%
Adequate	Moderate	None	Free	0.428	6	$ 6.43	60.53%
Excellent	Low	None	Free	0.414	7	$ 6.23	60.21%
Adequate	High	Few and dispersed	Free	0.288	8	$ 4.34	57.16%
Excellent	Moderate	Few and dispersed	Free	0.275	9	$ 4.13	56.83%
Minimal	Moderate	None	Free	0.221	10	$ 3.32	55.49%
Adequate	Low	None	Free	0.207	11	$ 3.11	55.16%
Excellent	High	None	$ 10	0.190	12	$ 2.86	54.75%
Excellent	High	Numerous and dense	Free	0.136	13	$ 2.04	53.38%
Minimal	High	Few and dispersed	Free	0.081	14	$ 1.22	52.03%
Adequate	Moderate	Few and dispersed	Free	0.068	15	$ 1.02	51.69%
Excellent	Low	Few and dispersed	Free	0.054	16	$ 0.82	51.36%
Minimal	*Low*	*None*	*Free*	*0.000*	*17*	*NA*	*50.00%*
Adequate	High	None	$ 10	-0.017	18	$ (0.25)	49.58%
Excellent	Moderate	None	$ 10	-0.030	19	$ (0.45)	49.25%
Adequate	High	Numerous and dense	Free	-0.071	20	$ (1.08)	48.21%
Excellent	Moderate	Numerous and dense	Free	-0.085	21	$ (1.28)	47.88%
Minimal	Moderate	Few and dispersed	Free	-0.139	22	$ (2.09)	46.52%
Adequate	Low	Few and dispersed	Free	-0.153	23	$ (2.30)	46.19%
Excellent	High	Few and dispersed	$ 10	-0.169	24	$ (2.55)	45.77%
Minimal	High	None	$ 10	-0.224	25	$ (3.36)	44.43%
Adequate	Moderate	None	$ 10	-0.237	26	$ (3.57)	44.10%
Excellent	Low	None	$ 10	-0.251	27	$ (3.77)	43.76%
Minimal	High	Numerous and dense	Free	-0.279	28	$ (4.19)	43.08%
Adequate	Moderate	Numerous and dense	Free	-0.292	29	$ (4.39)	42.75%
Excellent	Low	Numerous and dense	Free	-0.306	30	$ (4.60)	42.42%
Minimal	Low	Few and dispersed	Free	-0.360	31	$ (5.41)	41.10%
Adequate	High	Few and dispersed	$ 10	-0.376	32	$ (5.66)	40.70%
Excellent	Moderate	Few and dispersed	$ 10	-0.390	33	$ (5.87)	40.37%
Minimal	Moderate	None	$ 10	-0.444	34	$ (6.68)	39.07%
Adequate	Low	None	$ 10	-0.458	35	$ (6.89)	38.75%
Excellent	High	None	$ 20	-0.474	36	$ (7.14)	38.36%
Minimal	Moderate	Numerous and dense	Free	-0.499	37	$ (7.51)	37.78%
Adequate	Low	Numerous and dense	Free	-0.513	38	$ (7.71)	37.46%
Excellent	High	Numerous and dense	$ 10	-0.529	39	$ (7.96)	37.07%
Minimal	High	Few and dispersed	$ 10	-0.583	40	$ (8.78)	35.81%
Adequate	Moderate	Few and dispersed	$ 10	-0.597	41	$ (8.98)	35.50%
Excellent	Low	Few and dispersed	$ 10	-0.611	42	$ (9.18)	35.19%
Minimal	Low	None	$ 10	-0.665	43	$ (10.00)	33.97%
Adequate	High	None	$ 20	-0.681	44	$ (10.25)	33.59%
Excellent	Moderate	None	$ 20	-0.695	45	$ (10.45)	33.29%
Minimal	Low	Numerous and dense	Free	-0.720	46	$ (10.83)	32.75%
Adequate	High	Numerous and dense	$ 10	-0.736	47	$ (11.08)	32.38%
Excellent	Moderate	Numerous and dense	$ 10	-0.750	48	$ (11.28)	32.09%
Minimal	Moderate	Few and dispersed	$ 10	-0.804	49	$ (12.09)	30.92%
Adequate	Low	Few and dispersed	$ 10	-0.818	50	$ (12.30)	30.63%
Excellent	High	Few and dispersed	$ 20	-0.834	51	$ (12.55)	30.28%
Minimal	High	None	$ 20	-0.888	52	$ (13.36)	29.14%
Adequate	Moderate	None	$ 20	-0.902	53	$ (13.57)	28.86%
Excellent	Low	None	$ 20	-0.915	54	$ (13.77)	28.59%
Minimal	High	Numerous and dense	$ 10	-0.943	55	$ (14.19)	28.02%
Adequate	Moderate	Numerous and dense	$ 10	-0.957	56	$ (14.39)	27.75%
Excellent	Low	Numerous and dense	$ 10	-0.970	57	$ (14.60)	27.48%
Minimal	Low	Few and dispersed	$ 10	-1.025	58	$ (15.41)	26.41%
Adequate	High	Few and dispersed	$ 20	-1.041	59	$ (15.66)	26.09%
Excellent	Moderate	Few and dispersed	$ 20	-1.055	60	$ (15.87)	25.83%
Minimal	Moderate	None	$ 20	-1.109	61	$ (16.68)	24.81%
Adequate	Low	None	$ 20	-1.123	62	$ (16.89)	24.55%
Minimal	Moderate	Numerous and dense	$ 10	-1.164	63	$ (17.51)	23.80%
Adequate	Low	Numerous and dense	$ 10	-1.177	64	$ (17.71)	23.55%
Excellent	High	Numerous and dense	$ 20	-1.194	65	$ (17.96)	23.25%
Minimal	High	Few and dispersed	$ 20	-1.248	66	$ (18.78)	22.30%
Adequate	Moderate	Few and dispersed	$ 20	-1.262	67	$ (18.98)	22.07%
Excellent	Low	Few and dispersed	$ 20	-1.275	68	$ (19.18)	21.84%
Minimal	Low	None	$ 20	-1.330	69	$ (20.00)	20.92%
Minimal	Low	Numerous and dense	$ 10	-1.384	70	$ (20.83)	20.03%
Adequate	High	Numerous and dense	$ 20	-1.401	71	$ (21.08)	19.77%
Excellent	Moderate	Numerous and dense	$ 20	-1.415	72	$ (21.28)	19.55%
Minimal	Moderate	Few and dispersed	$ 20	-1.469	73	$ (22.09)	18.71%
Adequate	Low	Few and dispersed	$ 20	-1.482	74	$ (22.30)	18.51%
Minimal	High	Numerous and dense	$ 20	-1.608	75	$ (24.19)	16.69%
Adequate	Moderate	Numerous and dense	$ 20	-1.622	76	$ (24.39)	16.50%
Excellent	Low	Numerous and dense	$ 20	-1.635	77	$ (24.60)	16.31%
Minimal	Low	Few and dispersed	$ 20	-1.689	78	$ (25.41)	15.59%
Minimal	Moderate	Numerous and dense	$ 20	-1.829	79	$ (27.51)	13.84%
Adequate	Low	Numerous and dense	$ 20	-1.842	80	$ (27.71)	13.68%
Minimal	Low	Numerous and dense	$ 20	-2.049	81	$ (30.83)	11.41%

Figure 4-6 Evaluation of alternatives for the plant species combination – ocean and beach parks (OBPS)

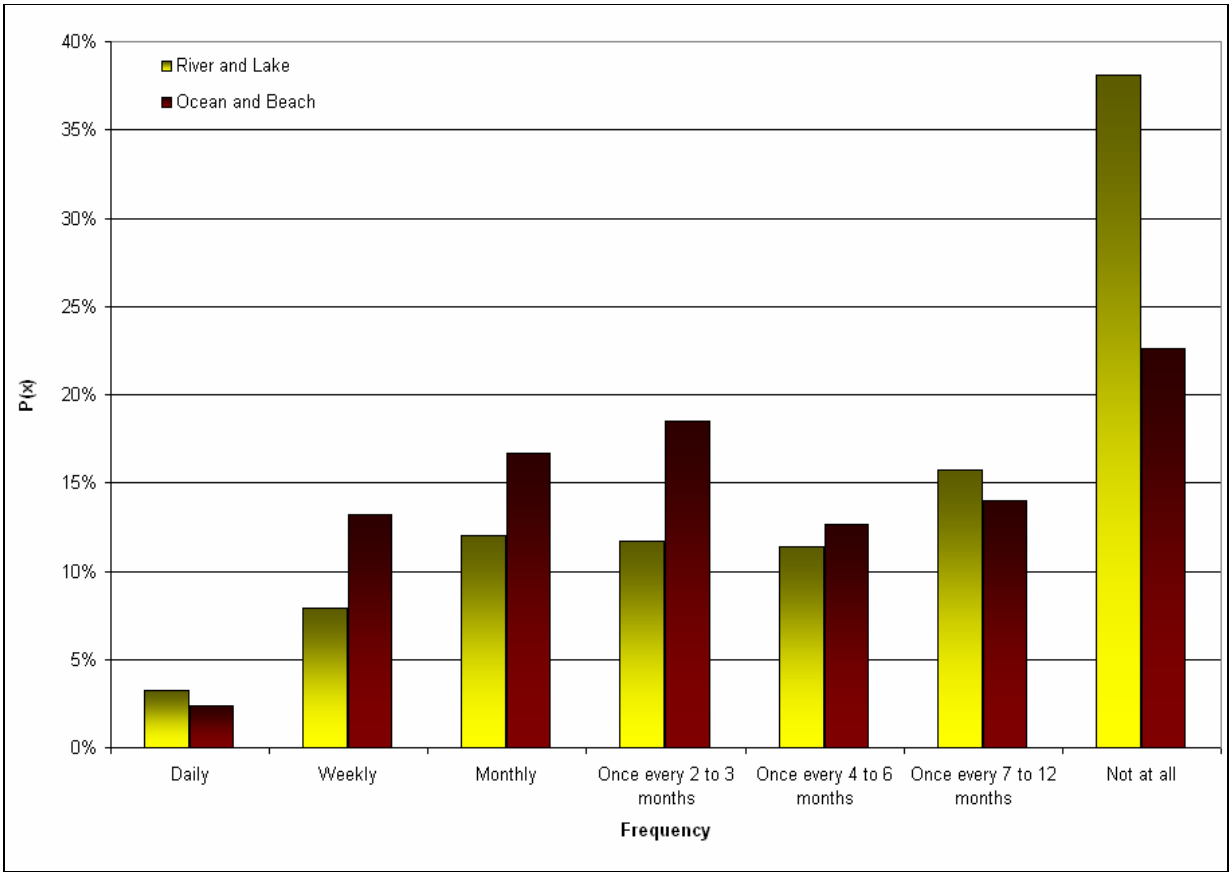

Figure 4-7 Estimated probabilities for frequency of visit to OB and RL parks

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

In this study we were able to appraise the value that Florida's population give to the problem of invasive plants through the determination of the public's utility function derived from their participation on recreational activities in two types of aquatic parks: ocean/beach and river/lake parks.

It was determined that people assigns a negative value to the presence of invasive plants reflected in a negative willingness to pay for this attribute in each location. To be precise it was found that the average MWTP (per visit) for the IS attribute derived from people's utility function were -$6.15 for RL parks and -$5.95 for OB parks. This was the highest MWTP in absolute value among all the attributes in both locations. Therefore the IS attribute presented the highest level of impact (MWTP) on the respondent's utility compared to the other attributes. Even more since the sign for this attribute was negative; this large negative number indicates a strong aversion of respondents to the presence of invasive plants in aquatic areas. Furthermore the fact that this negative effect (MWTP) is higher in absolute value than the positive effects of the other attributes (facilities, animal species and plant species) implies that is not sufficient an enhancement in these other attributes (pure tradeoff effect) to reduce the harmful impact of invasive plants on the public's utility. On the contrary it is recommended to take direct actions to control and attack this problem.

Conversely when we analyzed the standardized estimators of the people's utility function including the cost attributes (that in our case represents all the fees asked in a park), we found that the FE attribute is the most important of all in both locations followed in a second place by the IS attribute. This result induce us to think that people's utility derived from participation in recreational activities on RL and OB parks are driven mainly by the level of fees and second by the presence of invasive plants.

This was more evident when we built a ranking for all the 81 possible park alternatives for each location. It was determined that among 80% and 95% of parks that generates a utility greater or equal than zero for respondents were free. This reflects again the high importance that people provide to the fee attribute and how the utility and preferences of respondents are skewed to alternatives that offer an adequate or maximum (minimum) level of “positive” (“negative”) attributes but at no cost.

This analysis was extended to evaluate whether socioeconomic characteristics, as well as experiential features of people have any effect over the attributes importance on their utility. It was found that people’s socioeconomic characteristics do not have any statistical significant impact on the negative weight that people provide to the IS attribute when attending OB and RL parks. On the other hand when the experiential factors are analyzed both the real knowledge (AF) and benefits (BE) perceived from invasive plants have a statistical significant effect on people’s perception about the effect of these species. In contrast the stated knowledge (K) does not have any influence on respondent’s valuation of the impact of invasive plants on their utility. This permits us to conclude that there is an important discrepancy between the effects of the stated (K) and real (AF) knowledge on people’s utility.

This is congruent with the findings obtained from chapter two. In that part it was determined the importance for people of having an adequate background of knowledge in order to fully discern the impact of invasive plants on their satisfaction when engaging in outdoor recreational activities in aquatic parks. It was also established that the odds that a person who does not possess a good level of knowledge to recognize the real effect of these species on his/her welfare is 0.31 times the odds of a person who has a good level of knowledge. Furthermore there is a 44% probability that a person who thinks s/he has knowledge of invasive species actually possesses little or no knowledge. Therefore if we assume that the knowledge that people say to have is their real level of knowledge we will overrating them and this would be prejudicial for the success of any control and management policy since both type of knowledge have different impacts on people's utility.

This result is more relevant when we analyze the effect of the real knowledge on people's utility and preferences. It was found that when people have a good level of knowledge they will require stricter measures of controlling invasive plants in aquatic areas. This is reflected in a higher WTP for people well-informed about the invasive species problem than those who lack this type of knowledge. This higher WTP can be translated in the fact that informed people are more eager to collaborate in invasive plants eradication. This is because a higher information background increases the perceived impact of these plants on people's utilities due to an enhancement in their discernment.

In addition it was determined that the "potential impact" on the population's welfare due to the presence of invasive plants in Florida's aquatic areas could be substantial. This impact is estimated in an amount (per year) of -$1,065,150,630 for OB parks and -$992,580,540 for RL parks approximately. For this reason any action to reduce the presence of invasive plants in these natural areas in Florida is justified because of their sizeable potential impact on the welfare and quality of life of Floridians. Although the results obtained from these programs would be even stronger if they are accompanied by an aggressive educational program. Since it was determined that the impact of invasive plants on people's utility would be larger if the population were adequate informed. This impact would reach to -$1,615,092,363 for OB parks and

-$1,451,284,807 for RL parks; that is, approximately $500 million additionally in each location. Therefore any type of strategy of control and management implemented along with educational programs would increase people's awareness on this issue and in turn their WTP to eradicate the invasive plant species problem. Hence we recommend that if any governmental agency wants to be successful in this war against invasive plants, it is essential to educate the population first, so as to reach the necessary level of social effort in order to accomplish such an important objective.

Finally further research is required on this topic to determine the impact of the presence of invasive plants in specific aquatic parks. In other words, in order to test unambiguously what the effects of invasive plants are on the visitors' utility and to measure people's WTP as consumers, analyses for particular cases in specific aquatic parks along Florida would be necessary. With those more detailed inferences of this problem on aquatic areas would be obtained due to the application of narrower experimental designs.

Additionally, in this study the importance of the real knowledge was determined however further research about the source of this knowledge is necessary. To be precise it is relevant to determine if this knowledge comes from formal education, experience, or awareness campaigns from the government. This would permit to estimate the level of effectiveness of governmental educational programs about this issue and how these programs can be successfully applied to enhance the eradication task of these species through the involvement of the population.

APPENDIX A
SURVEY OF AWARENESS OF INVASIVE SPECIES (COVER LETTER)

Dear Florida Resident,

We are asking for your collaboration in a study about **"**People's Awareness of Invasive Plants**"**, conducted by the Institute of Food & Agricultural Sciences of the University of Florida, and funded by The Florida Department of Environmental Protection. This survey is the first step in helping us analyze how invasive or non-native plants affect people's satisfaction when visiting Natural Areas in Florida.

You have been selected as a part of a small sample of Florida residents who are being asked to complete an online questionnaire (the link to the survey webpage is located at the bottom of this letter). When answering to the survey, please keep in mind that there are no right or wrong answers. We truly value your honest opinion. Your participation is completely voluntary and you do not have to answer any question you do not wish to answer. You are free to discontinue participation in the questionnaire at any time without consequence. Completion of the questionnaire should take no longer than 10 minutes, and you must be 18 years old or older in order to complete the questionnaire. You are assured complete confidentiality. Results will only be reported as summarized data. There is no compensation or anticipated risks for participating in this survey.

Thank you very much for your participation in this study. If you have any questions regarding this research study or the questionnaire, you may contact the investigators Santiago Bucaram (santibu@ufl.edu) or Frida Bwenge (fbwenge@ufl.edu). For questions about your rights as a research participant, contact the University of Florida Institutional Review Board (PO Box 112250, Gainesville, Fl 32611, telephone 352-392-0433)

Sincerely,

SURVEY LINK:
http://www.surveymonkey.com/s.aspx?sm=UuCoQDb3rRiSM2rQNFgErg_3d_3d

APPENDIX B
SURVEY OF AWARENESS OF INVASIVE SPECIES (QUESTIONNAIRE)

This is a study of Florida residents awareness of "Invasive or Non-native Plants" , conducted by the Institute of Food & Agricultural Sciences at the University of Florida, and funded by The Florida Department of Environmental Protection.

The information from this survey will be used to better understand Florida resident knowledge of Invasive or Non-native plant species and their impact on natural recreational areas.

Individual preferences are very important to us and the outcome of this study. We thank you in advance for taking the time to answer all of our questions.

Question 1/13

Do you live in Florida?

- ◯ Yes, part of the year
- ◯ Yes, all the year
- ◯ No

Question 2/13

How many months of the year do you live in Florida?

- ◯ 1 - 3
- ◯ 4 - 6
- ◯ More than 6 months (please specify)

Question 3/13

How long have you been living seasonally in Florida?

- ◯ Less than 1 year
- ◯ 1 – 4 years
- ◯ 5 – 9 years
- ◯ 10 – 20 years
- ◯ Longer than 20 years

Question 4/13

How long have you been living in Florida?

- ◯ Less than 1 year
- ◯ 1 – 4 years
- ◯ 5 – 9 years
- ◯ 10 – 20 years
- ◯ Longer than 20 years

Question 5/13

What is the county of your primary residence in Florida? (choose from the menu below)

Question 6/13

How would you characterize the extent of your knowledge of exotic invasive plants in Florida's natural areas?

- ◯ None
- ◯ Little
- ◯ Modest
- ◯ Well versed
- ◯ Expert

Question 7/13

How much do you agree with the following statement: "At the moment, non-native species are an important problem for Natural Areas (State Parks) in Florida"?

- ◯ Strongly disagree
- ◯ Disagree
- ◯ I don't know
- ◯ Agree
- ◯ Strongly agree

Question 8/13

Check the box indicating whether the following plants are non-invasive or invasive:

	Invasive	Non-Invasive	Not sure	Never heard of it
Air Potato	◯	◯	◯	◯
Mimosa	◯	◯	◯	◯
Baby's Tears	◯	◯	◯	◯
Water Lily	◯	◯	◯	◯
Australian Pine	◯	◯	◯	◯
Water Hyacinth	◯	◯	◯	◯

	Invasive	Non-Invasive	Not sure	Never heard of it
Slash Pine	◯	◯	◯	◯
Duck Weed	◯	◯	◯	◯
Sweet Flag	◯	◯	◯	◯
Water Shield	◯	◯	◯	◯
Fire Flag	◯	◯	◯	◯
Hydrilla	◯	◯	◯	◯

Question 9/13

Have invasive plants in Florida's natural areas affected your "CHOICE OF LOCATIONS FOR OUTDOOR ACTIVITIES"?

- ◯ Yes
- ◯ No
- ◯ Not Sure

Question 10/13

Have invasive plants in Florida's natural areas affected (positively or negatively) your "ENJOYMENT OF OUTDOOR ACTIVITIES"?

- ◯ Yes
- ◯ No
- ◯ Not Sure

Question 11/13

How have invasive plants in Florida's natural areas affected your enjoyment of outdoor activities?

- ◯ Strongly positively
- ◯ Somewhat positively
- ◯ Somewhat negatively
- ◯ Strongly negatively
- ◯ Not Sure

Question 12/13

In what way have invasive plants in Florida's natural areas affected you? Check all that apply

- ☐ No change in activity
- ☐ Visited the location with invasive plants less frequently.
- ☐ Visited the location with invasive plants more frequently.
- ☐ Visited an alternative location with fewer invasive plants, more frequently.
- ☐ Drove or traveled farther to visit an alternative location with fewer invasive plants.
- ☐ Became active to help remove invasive plants from natural areas.
- ☐ Donated money or supplies to help remove invasive plants from natural areas.
- ☐ Other, please specify

Question 13/13

Finally give a brief explanation about what other effects do you think invasive plants have caused to natural environment?

DEMOGRAPHIC QUESTIONNAIRE (1/4)

Which of the following best describes the area in which you live?

- ◯ Urban Area – city or town
- ◯ Suburban Area- within 5 miles of a city or town
- ◯ Rural Area - more than 5 miles from a city or town

What is your gender?

- ◯ Male
- ◯ Female

Would you consider yourself an environmentally conscious person?

- ◯ Not at all
- ◯ A little conscious
- ◯ Moderately conscious
- ◯ Very conscious
- ◯ Extremely conscious

DEMOGRAPHIC QUESTIONNAIRE (2/4)

What is your age?

- ◯ 0 – 18 years
- ◯ 19 – 25 years
- ◯ 26 – 35 years
- ◯ 36 – 45 years
- ◯ 46 - 55 years
- ◯ 56 - 65 years
- ◯ more than 65 years

What is your marital status?

- ◯ Single
- ◯ Married
- ◯ Divorced
- ◯ Widowed

DEMOGRAPHIC QUESTIONNAIRE (3/4)

What is your race/ethnic background?

- White/Caucasian
- Black/African-American
- Hispanic, Latino, Chicano
- Asian or Pacific Islander
- Native American
- Bi-racial or mixed ethnic
- Other, please specify

What is the highest level of education you completed?

- Some high school
- High school graduate
- Some college courses
- Associate (or other 2 year technical) degree
- Bachelor's (or other 4 year) degree
- Some Graduate courses
- Graduate/professional degree

DEMOGRAPHIC QUESTIONNAIRE (4/4)

Which of the following describes your employment status?

- Employed full-time
- Employed part-time
- Homemaker
- Student
- Retired
- Unemployed, looking for work
- Unemployed, not looking for work

What is your annual household income before taxes?

- $0 - $19,999
- $20,000 - $39,999
- $40,000 - $59,999
- $60,000 - $79,999
- $80,000 - $99,999
- $100,000 - $120,000
- More than $120,000

Thank you for participating in this study. The information you provided is important.

For questions about this study, please contact graduate research assistants Santiago Bucaram (santibu@ufl.edu) or Frida Bwenge (fbwenge@ufl.edu).

For questions about your rights as a research participant, contact the University of Florida Institutional Review Board (PO Box 112250, Gainesville, Fl 32611, telephone 352-392-0433).

APPENDIX C
PARK'S MANAGERS SURVEY

Dear Park Managers,

Thank you very much for agreeing to help us with this FDEP study on the effect of invasive plants on recreational use of Florida's natural areas. Your responses to these questions are vital to our creation of a good survey that will allow us to measure how recreational users of natural areas are impacted by various levels of invasive plants.

Please fill out the questions in the attachment and send it back to us as an attachment as well. If you have any questions regarding this study, please feel free to contact us. Once again thank you very much for your help.

1. What is the name of the park that you manage?
2. What do you think that are the characteristics of this park that people value the most?
3. How has the trend of visits been in your park (increasing, decreasing, static).
4. Approximately how many visitors on average do you get per year?
5. What is the most number of visitors on a single day that have visited your park?
6. Have you had problems related with non native invasive plant species? Please explain what types of species?
7. If so, do you think that this situation (non native invasive plant species) has affected the visitors' satisfaction? If yes, explain why and how?
8. What are the most frequent complaints (other than invasive species) that you have received from visitors (i.e. parking lots, fees, facilities, congestion, etc.)?
9. If you had $200,000 to improve your park to attract more visitors, how would you spend it?
10. Roughly speaking, how much does the average visitor to your park spend per visit (park fees and other expenses)?
11. Roughly what percentages of your visitors come from:

Distance	Percentage
Within 10 miles	
Within 50 miles	
More than 50 miles	

12. As a park manager, do you have any other comments regarding invasive species?

APPENDIX D
SURVEY OF NATURE RELATED OUTDOOR ACTIVITIES (COVER LETTER)

Dear Florida Resident,

We are asking for your collaboration in a study on Florida Residents' **"**Use of Natural Aquatic Parks and Participation in Outdoor Recreational Activities**",** conducted by the Institute of Food & Agricultural Sciences of the University of Florida and funded by The Florida Department of Environmental Protection. Through this survey we will try to determine the criteria that Florida park visitors consider when choosing to visit a natural recreational park. The results of the survey will be used in a more extensive investigation related to the impact of non-native plant species on visitor satisfaction of Florida's natural areas.

You have been selected as a part of a small sample of Florida residents who are being asked to complete an online questionnaire (the link to the survey webpage is located at the bottom of this letter). Your participation is completely voluntary. You do not have to answer any question you do not wish to answer. You are free to discontinue participation in the questionnaire at any time without consequence. Completion of the questionnaire should take no longer than 10 minutes, and you must be 18 years old or older in order to complete the questionnaire. You are assured complete confidentiality. Results will only be reported as summarized data. There is no compensation or anticipated risks for participating in this survey.

Thank you very much for your participation in this study. If you have any questions regarding this research study or the questionnaire, you may contact the investigators Santiago Bucaram (santibu@ufl.edu) or Frida Bwenge (fbwenge@ufl.edu). For questions about your rights as a research participant, contact the University of Florida Institutional Review Board (PO Box 112250, Gainesville, Fl 32611, telephone 352-392-0433)

Sincerely,

SURVEY LINK:
http://www.surveymonkey.com/s.aspx?sm=XerOGJ1z1YtZ7W5rX_2fxvKQ_3d_3d

APPENDIX E
SURVEY OF NATURE RELATED OUTDOOR ACTIVITIES (QUESTIONNAIRE)

This is a study of Florida residents use of natural parks and participation in outdoor recreational activities, conducted by the Institute of Food & Agricultural Sciences at the University of Florida, and funded by The Florida Department of Environmental Protection.

The information from this survey will be used to better understand Florida resident preferences for natural parks and outdoor activities.

Individual preferences are very important to us and the outcome of this study. We thank you in advance for taking the time to answer all of our questions.

Question 1 / 19

Do you live in Florida?

- ◯ Yes, part of the year
- ◯ Yes, all the year
- ◯ No

Question 2 / 19

How many months of the year do you live in Florida?

- ◯ 1 - 3
- ◯ 4 - 6
- ◯ 7 - 9
- ◯ More than 9 months (please specify)

Question 3 / 19

How long have you been living seasonally in Florida?

- ◯ Less than 1 year
- ◯ 1 – 4 years
- ◯ 5 – 9 years
- ◯ 10 – 20 years
- ◯ Longer than 20 years

Question 4 / 19

How long have you been living in Florida?

- ◯ Less than 1 year
- ◯ 1 – 4 years
- ◯ 5 – 9 years
- ◯ 10 – 20 years
- ◯ Longer than 20 years

Question 5 / 19

What is the county of your primary residence in Florida? (choose from the menu below)

Question 6 / 19

Which nature related outdoor activities have you participated in within the last twelve months in Florida?
(Check all that apply)

- ☐ Backpacking and camping
- ☐ Bird watching
- ☐ Freshwater fishing
- ☐ Mountain biking
- ☐ Motocross, 4-wheeling, offroading
- ☐ Nature watching or observing
- ☐ Personal watercraft, wakeboarding, water skiing
- ☐ Photography
- ☐ Sunning, swimming, surfing at the beach
- ☐ Surf fishing, salt water fishing
- ☐ Hunting
- ☐ Swimming or diving in rivers and lakes
- ☐ Team Sport Activities
- ☐ Tubing
- ☐ Recreational boating
- ☐ Walking, hiking, running
- ☐ NONE, I HAVE NOT PARTICIPATED IN ANY NATURE RELATED OUTDOOR ACTIVITY

Question 7 / 19

What are your reasons for participating in outdoor recreational activities?
(Check all that apply):

- ☐ To enjoy and experience nature
- ☐ To do something as a family
- ☐ To meet with my friends
- ☐ To be with people with similar interests
- ☐ To get exercise/to improve health
- ☐ To meet new people
- ☐ To share knowledge and skills with others
- ☐ To be engaged in thrill situations
- ☐ Other (please specify)

Question 8 / 19

How frequently have you participated in nature related outdoor activities at any of the following locations during the past 12 months?

	Daily	Weekly	Monthly	Once every 3 months	Once every 6 months	Once in the year	Not at all
Ocean / Beach	◯	◯	◯	◯	◯	◯	◯
River / Lake	◯	◯	◯	◯	◯	◯	◯
Wooded park and forest	◯	◯	◯	◯	◯	◯	◯

Question 9 / 19

What is the distance from your primary residence to the "CLOSEST" natural area in Florida that you have visited during the last 12 months?

	0 to 15 miles	16 to 30 miles	31 to 45 miles	46 to 60 miles	61 to 75 miles	More than 75	I have not visited
Ocean / Beach	◯	◯	◯	◯	◯	◯	◯
River / Lake	◯	◯	◯	◯	◯	◯	◯
Wooded park / Forest	◯	◯	◯	◯	◯	◯	◯

Question 10 / 19

What is the distance from your primary residence to the "FARTHEST" natural area in Florida that you have visited during the last 12 months?

	0 to 40 mile	41 to 80 miles	81 to 120 miles	121 to 160 miles	161 to 200 miles	More than 200 miles	I have not visited
Ocean / Beach	◯	◯	◯	◯	◯	◯	◯
River / Lake	◯	◯	◯	◯	◯	◯	◯
Wooded park / Forest	◯	◯	◯	◯	◯	◯	◯

Question 11 / 19

How much time on average (excluding travel time) do you spend typically during a visit to natural areas in Florida?

	less than 1 hour	1 - 2 hours	3 - 6 hours	7 hours - one day	2 - 3 days	3 - 7 days	more than 7 days	I have not visited
Ocean / Beach	◯	◯	◯	◯	◯	◯	◯	◯
River / Lake	◯	◯	◯	◯	◯	◯	◯	◯
Wooded park / Forest	◯	◯	◯	◯	◯	◯	◯	◯

Question 12 / 19

Which of the following best reflects the amount of money you spend typically (e.g. fees, food and recreational expenses -- exclude transportation cost) per person when visiting natural areas in Florida?

	Less than $10	$10 - $50	$51 - $100	$101 - $150	$151 - $250	$251 - $350	$351 - $500	More than $500	I have not visited
Ocean / Beach	○	○	○	○	○	○	○	○	○
River / Lake	○	○	○	○	○	○	○	○	○
Wooded park / Forest	○	○	○	○	○	○	○	○	○

Question 13 / 19

How do you rate the maintenance & sanitation provided to the "FACILITIES" in the Florida's Natural Areas that you have visited?

	Excellent	Very good	Good	Fair	Poor	I don't know
Ocean / Beach	○	○	○	○	○	○
River / Lake	○	○	○	○	○	○
Wooded park / Forest	○	○	○	○	○	○

Question 14 / 19

How do you rate the maintenance and protection provided to "NATIVE PLANTS" in the Florida's Natural Areas that you have visited?

	Excellent	Very good	Good	Fair	Poor	I don't know
Ocean / Beach	○	○	○	○	○	○
River / Lake	○	○	○	○	○	○
Wooded park / Forest	○	○	○	○	○	○

Question 15 / 19

How do you rate the maintenance and protection provided to "ANIMAL SPECIES AND WILDLIFE" in the Florida's Natural Areas that you have visited?

	Excellent	Very good	Good	Fair	Poor	I don't know
Ocean / Beach	○	○	○	○	○	○
River / Lake	○	○	○	○	○	○
Wooded park / Forest	○	○	○	○	○	○

Question 16 / 19

Grade the importance to you of each of the following attributes when visiting an "OCEAN / BEACH" in Florida.

	Extremely important	Somewhat important	Indifferent	Somewhat unimportant	Not important	Don't know
Animal species including aquatic species						
Facilities including picnic tables, restrooms, campsites, parking lots, etc.						
Plant species and/or scenic beauty						
Number of other visitors						
Travel distance						
Fees and other expenses (food, transportation costs and recreational expenses)						

Question 17 / 19

Grade the importance to you of each of the following attributes when visiting a "RIVER / LAKE" in Florida.

	Extremely important	Somewhat important	Indifferent	Somewhat unimportant	Not important	Don't know
Animal species including aquatic species and birds						
Facilities including picnic tables, restrooms, campsites, parking lots, etc.						
Plant species and/or scenic beauty						
Number of other visitors						
Travel distance						
Fees and other expenses (food, transportation costs and recreational expenses)						

Question 18 / 19

Grade the importance to you of each of the following attributes when visiting a "WOODED PARK / FOREST" in Florida.

	Extremely important	Somewhat important	Indifferent	Somewhat unimportant	Not important	Don't know
Animal species including birds						
Facilities including picnic tables, restrooms, campsites, parking lots, etc.						
Plant species and/or scenic beauty						
Number of other visitors						
Travel distance						
Fees and other expenses (food, transportation costs and recreational expenses)						

Question 19 / 19

If the state government wants to invest tax revenues in natural areas, where would you want to see improvements?
(Check only one alternative for each of the locations showed in the following three tables)

	Ocean / Beach
Preservation/Restoration of native plants	◯
Preservation/Restoration of native wildlife	◯
Reduce overcrowding	◯
Improve maintenance	◯
Provide more campground facilities (including parking lots)	◯
Provide more recreational facilities	◯
Reduce entrance fee	◯

	River / Lake
Preservation/Restoration of native plants	◯
Preservation/Restoration of native wildlife	◯
Reduce overcrowding	◯
Improve maintenance	◯
Provide more campground facilities (including parking lots)	◯
Provide more recreational facilities	◯
Reduce entrance fee	◯

	Wooded park / Forest
Preservation/Restoration of native plants	◯
Preservation/Restoration of native wildlife	◯
Reduce overcrowding	◯
Improve maintenance	◯
Provide more campground facilities (including parking lots)	◯
Provide more recreational facilities	◯
Reduce entrance fee	◯

DEMOGRAPHIC QUESTIONNAIRE (1/5)

Which of the following best describes the area where you live?

◯ Urban Area – city or town
◯ Suburban Area- within 5 miles of a city or town
◯ Rural Area - more than 5 miles from a city or town

What is your gender?

◯ Male
◯ Female

DEMOGRAPHIC QUESTIONNAIRE (2/5)

What is your age?

- ◯ 0 – 18 years
- ◯ 19 – 25 years
- ◯ 26 – 35 years
- ◯ 36 – 45 years
- ◯ 46 - 55 years
- ◯ 56 - 65 years
- ◯ more than 65

What is your marital status?

- ◯ Single
- ◯ Married
- ◯ Divorced
- ◯ Widowed

DEMOGRAPHIC QUESTIONNAIRE (3/5)

What is your race/ethnic background?

- ◯ White/Caucasian
- ◯ Black/African-American
- ◯ Hispanic, Latino, Chicano
- ◯ Asian or Pacific Islander
- ◯ Native American
- ◯ Bi-racial or mixed ethnic
- ◯ Other (please specify)

What is the highest level of education you completed?

- ◯ Some high school
- ◯ High school graduate
- ◯ Some college courses
- ◯ Associate (or other 2 year technical) degree
- ◯ Bachelor's (or other 4 year) degree
- ◯ Some Graduate courses
- ◯ Graduate/professional degree

DEMOGRAPHIC QUESTIONNAIRE (4/5)

Which of the following best describes your employment status?

- ◯ Employed full-time
- ◯ Employed part-time
- ◯ Homemaker
- ◯ Student
- ◯ Retired
- ◯ Unemployed, looking for work
- ◯ Unemployed, not looking for work

What is your annual household income before taxes?

- ◯ $0 - $19,999
- ◯ $20,000 - $39,999
- ◯ $40,000 - $59,999
- ◯ $60,000 - $79,999
- ◯ $80,000 - $99,999
- ◯ $100,000 - $120,000
- ◯ More than $120,000

DEMOGRAPHIC QUESTIONNAIRE (5/5)

Would you consider yourself an environmentally conscious person?

- ◯ Not at all
- ◯ A little conscious
- ◯ Moderately conscious
- ◯ Very conscious
- ◯ Extremely conscious

How many children younger than 16 do you have?

Thank you for participating in this study. The information you provided is important.

For questions about this study, please contact graduate research assistants Santiago Bucaram (santibu@ufl.edu) or Frida Bwenge (fbwenge@ufl.edu).

For questions about your rights as a research participant, contact the University of Florida Institutional Review Board (PO Box 112250, Gainesville, Fl 32611, telephone 352-392-0433).

APPENDIX F
MULTIATTRIBUTE UTILITY SURVEY – RIVER AND LAKE/PLANT SPECIES COMBINATION (RLPS) EXAMPLE (COVER LETTER)

Dear Florida Resident,

We are requesting your participation in a University of Florida survey on “Recreation and Invasive Plants in Florida’s State Parks” (the link to the survey webpage is located at the bottom of this letter). You have been selected as a part of a small sample of Florida residents who are being asked to complete this online questionnaire. Please take a few minutes to complete the survey.

This survey is divided in three parts. In the first part you will be asked to provide different valuations about a specific natural area and a second one of your choice, which is optional. In the second part you will be asked to give your opinion about what effects invasive species have had in your decision of which location to attend and enjoyment when engaging in outdoor recreational activities. Finally, we will ask you to give us some socio-economic information for our analysis.

Remember that to participate in this survey you must be 18 years or older. Participation is voluntary. You do not have to answer any questions you do not wish to answer. You are free to stop the questionnaire at any time. There are no anticipated risks, compensation, or other direct benefits to you as a participant in this study. You may be assured of complete confidentiality. You will not be identified or connected with the questionnaire in any way and participation is totally anonymous. Results will only be reported as summarized data. The information gathered in this study may be published in professional journals or presented at scientific meetings, but will not be accessible as individual data.

The survey is funded by the Florida Department of Environmental Protection and is administered by the University of Florida and the Institute of Food and Agricultural Sciences. For questions about this study, please feel free to contact graduate student investigators Santiago Bucaram (santibu@ufl.edu) or Frida Bwenge (fbwenge@ufl.edu). For questions about your rights as a research participant, please contact the University of Florida Institutional Review Board (PO Box 112250, Gainesville, Fl 32611, telephone 352-392-0433).

Please remember that your answers to this survey are extremely important and may impact your future enjoyment of Florida’s state parks.

Thank you for your cooperation.

SURVEY LINK:
http://www.surveymonkey.com/s.aspx?sm=4hO2JNiwP2qIMFj38zT92w_3d_3d

APPENDIX G
MULTIATTRIBUTE UTILITY SURVEY – RIVER AND LAKE/PLANT SPECIES COMBINATION (RLPS) EXAMPLE (QUESTIONNAIRE)

Do you live in Florida?

◯ Yes
◯ No

What is the county of your primary residence in Florida? (choose from the menu below)

How frequently have you participated in nature related outdoor activities at each of the following locations during the past 12 months?

	Daily	Weekly	Monthly	Once every 2 to 3 months	Once every 4 to 6 months	Once every 7 to 12 months	Not at all
OCEAN AND BEACH	◯	◯	◯	◯	◯	◯	◯
RIVER AND LAKE	◯	◯	◯	◯	◯	◯	◯
WOODED PARK	◯	◯	◯	◯	◯	◯	◯

RIVER AND LAKE

We would like to know more about how invasive plants affect your recreation decisions and your enjoyment of Florida parks.

In the questions to follow we would like you to:
(1) Compare pairs of "RIVER AND LAKE" parks
based on the 4 features shown in the table on the right
(2) Indicate your preference by choosing ONE park
(3) Do this 7 times

This part of the survey should take no more than 5 minutes

1.- PARK FACILITIES CONDITION: Park facilities include parking lots, boat docks, boat ramps, picnic tables, restrooms, showers, among others
2.- DIVERSITY OF PLANT SPECIES: Include all the plants which are natural or indigenous to Florida
3.- FEES: Include fees for admission, parking, camping among others
4.- PRESENCE OF INVASIVE SPECIES: All non-native plants known to disrupt ecosystem processes

CASE 1 OF 7

	PARK A	PARK B
Facilities condition	Minimal	Adequate
Native plant diversity	Moderate	High
Presence of invasive species	Few and dispersed	Numerous and dense
Fees	$10	$20

Which of the two parks do you prefer?

○ Park A　　○ Park B

CASE 2 OF 7

	PARK A	PARK B
Facilities condition	Minimal	Excellent
Native plant diversity	Low	High
Presence of invasive species	None	Few and dispersed
Fees	Free	$20

Which of the two parks do you prefer?

○ Park A　　○ Park B

CASE 3 OF 7

	PARK A	PARK B
Facilities condition	Excellent	Adequate
Native plant diversity	High	Low
Presence of invasive species	None	Numerous and dense
Fees	$20	Free

Which of the two parks do you prefer?

- ○ Park A
- ○ Park B

CASE 4 OF 7

	PARK A	PARK B
Facilities condition	Minimal	Excellent
Native plant diversity	High	Moderate
Presence of invasive species	Few and dispersed	None
Fees	$10	$20

Which of the two parks do you prefer?

- ○ Park A
- ○ Park B

CASE 5 OF 7

	PARK A	PARK B
Facilities condition	Adequate	Excellent
Native plant diversity	Moderate	High
Presence of invasive species	None	Numerous and dense
Fees	$10	Free

Which of the two parks do you prefer?

○ Park A ○ Park B

CASE 6 OF 7

	PARK A	PARK B
Facilities condition	Excellent	Minimal
Native plant diversity	Moderate	High
Presence of invasive species	Few and dispersed	Numerous and dense
Fees	$10	Free

Which of the two parks do you prefer?

○ Park A ○ Park B

CASE 7 OF 7

	PARK A	PARK B
Facilities condition	Excellent	Minimal
Native plant diversity	High	Low
Presence of invasive species	Numerous and dense	None
Fees	$20	$10

Which of the two parks do you prefer?

○ Park A ○ Park B

There are two other types of parks that are highly impacted by invasive plants. Of the two, which one would you answer more questions about?

○ Ocean and Beach

○ Wooded Park

○ Neither. I would like to proceed to other questions

In this part of the survey respondents were asked to answer another set of questions regarding to another type of park. It was provided three options; two of them about two different parks and one of them in which respondents were able to express that they are not willing to answer more pair-wise choice questions but instead agree to proceed to the rest of the survey.

If they agreed to answer an additional set of pair wise questions this would be similar to the previously presented but with images and explanations related to the specific park that was chosen.

ADDITIONAL QUESTIONS (1/4)

Please indicate your knowledge of invasive plants prior to this survey.

- ◯ I knew a lot about invasive plants
- ◯ I knew a little about invasive plants
- ◯ I knew nothing about invasive plants

ADDITIONAL QUESTIONS (2/4)

Indicate your agreement or disagreement with the following statements:

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree
Invasive plants have affected my enjoyment of outdoor recreation activities in State Parks	◯	◯	◯	◯	◯
Invasive plants have affected the number of my visits to State Parks	◯	◯	◯	◯	◯
Invasive plants have affected which State Parks I attend	◯	◯	◯	◯	◯
Invasive plants can also provide benefits to Florida's parks	◯	◯	◯	◯	◯

ADDITIONAL QUESTIONS (3/4)

Have you taken any personal actions in response to invasive plants in Florida?

- ◯ Yes
- ◯ No

Examples of actions against invasive species are:
To become active to help remove invasive plants from natural areas;
To drive or travel farther to visit an alternative location with fewer invasive plants;
To donate money or supplies to help remove invasive plants from natural areas; among others

ADDITIONAL QUESTION (4/4)

Please indicate whether you have done any of the following in response to invasive plants:

- ☐ I helped remove invasive plants from natural (public) areas
- ☐ I made a personal contribution (money or supplies) to help remove invasive plants from natural (public) areas.
- ☐ I have driven to farther parks just to avoid invasive species plants
- ☐ Other (please specify)

DEMOGRAPHIC QUESTIONNAIRE (1/4)

Please indicate the area that best describes where you live

- ◯ Urban Area – city or town
- ◯ Suburban Area- within 5 miles of a city center or town
- ◯ Rural Area - more than 5 miles from a city center or town

Please indicate your gender

- ◯ Male
- ◯ Female

Please indicate your age

- ◯ 18 - 24
- ◯ 25 – 34
- ◯ 35 – 44
- ◯ 45 – 54
- ◯ 55 – 64
- ◯ 65 or older

DEMOGRAPHIC QUESTIONNAIRE (2/4)

Please indicate your marital status

- ◯ Single, never married
- ◯ Married
- ◯ Divorced
- ◯ Widowed

How many people including yourself occupy the residence where you live?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ more than 5

How many people under age 18 live with you?

- ◯ None
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ more than 5

DEMOGRAPHIC QUESTIONNAIRE (3/4)

Indicate the highest level of education you have completed

- ◯ Some high school
- ◯ High school graduate
- ◯ Associate (AA) or 2 year technical degree
- ◯ Bachelor (BA, BS, or other 4 year degree)
- ◯ Advanced or Professional training beyond a bachelor degree

Indicate your race or ethnic background

- ◯ White/Caucasian
- ◯ Black/African-American
- ◯ Hispanic, Latino, Chicano
- ◯ Asian or Pacific Islander
- ◯ Native American

Is anyone in your household affiliated with an environmental organization?

- ◯ Yes
- ◯ No

DEMOGRAPHIC QUESTIONNAIRE (4/4)

What is your employment status? (Check only one answer)

- ◯ Employed
- ◯ Not employed, but seeking work
- ◯ Not employed and not seeking work
- ◯ Student
- ◯ Retired

What is your annual household income before taxes? (Check only one answer)

- ◯ Less than $14,999
- ◯ $15,000 - $34,999
- ◯ $35,000 - $59,999
- ◯ $60,000 - $74,999
- ◯ $75,000 - $99,999
- ◯ $100,000 - $149,999
- ◯ More than $150,000

Thank you for participating in this study. The information you provided is important. For questions about this study, please contact graduate research assistants Santiago Bucaram (santibu@ufl.edu) or Frida Bwenge (fbwenge@ufl.edu). For questions about your rights as a research participant, contact the University of Florida Institutional Review Board (PO Box 112250, Gainesville, Fl 32611, telephone 352-392-0433). Click here to qualify for your incentive

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BIOGRAPHICAL SKETCH

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