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A Community Economics Perspective on Coastal Erosion Mangement

Warren Kriesel, Assoc. Prof., Ag. and Applied Econ., 312 Conner Hall, University of Georgia, Athens, Georgia 30602 USA

Steve Turner, Prof., Ag. and Applied Econ., 312 Conner Hall, University of Georgia, Athens, Georgia 30602 USA

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Abstract

Fifty-five percent of Georgia's developed coastline has been armored with various types of erosion protection devices. This paper is about beach improvement projects at Jekyll Island that would operate under: (a) a nourishment policy or (b) a retreat policy. Benefits are calculated from an intensive, on-site survey of beach visitors and the costs are calculated from observable sources. Two financing methods are considered: general revenue and user fee financing. The smallest benefit/cost ratio is 1.5. The high B/C ratios for all options imply recommending beach improvement as an economically efficient policy within the considered time frame.

Key words: economics, beach erosion, nourishment, retreat

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Introduction

The problem of shoreline erosion is a major concern among those involved in coastal management. Public policy makers are faced with difficult choices over a wide set of alternatives that they can employ to best serve all groups that may be affected by their decisions. In managing erosion there are three broad alternatives: (1) replenishing a beach with more sand, (2) constructing hard stabilizers such as groins and seawalls, and (3) relocating threatened property improvements and permitting nature to take its course. The first and second alternatives are commonly used in tandem. However, the relative desirability of each erosion management alternative has been the subject of controversy between coastal geologists and engineers. The position of coastal geologists is summarized in Pilkey, et al. (1982), while the opinion of engineers is summarized in O'Brien (1982). The debate has been reported in popular outlets, eg. Ackerman (1997) and Dean (1999).

Public policy makers also recognize that each alternative has different effects on coastal user groups. Hard stabilization tends to benefit the owners of property improvements because it protects houses, hotels and businesses. However, stabilization may diminish the beach amenities sought by visitors. Beach nourishment has some protective value for property improvements, plus it increases the amenity value associated with sandy beaches. However, both of these management alternatives can disrupt natural accretion patterns and cause serious side effects. The relocation alternative primarily affects property owners, who may benefit if they are well compensated for their losses. Visitors may also benefit from relocation if the resulting pattern of businesses and services is an improvement upon the status quo, and if beach amenities are improved.

Whatever method is decided upon must be paid for. Financing is a question of growing importance as the Executive branch of the federal government has been unwilling to provide public financing for these projects (Marlowe, 2001). General budgetary pressure and increasing skepticism about the broad public benefits of large-scale water projects of all kinds have led to a situation where the direct beneficiaries of beach improvement are much more likely to have to provide at least some portion of the financing.

As with any investment in public infrastructure, the primary financing options that can apply to beach improvement projects are (a) user fees and (b) general revenue financing. Revenue from user fees has been popular for financing public infrastructure investments such as bridges and roads. For a project with substantial fixed costs, a bond is issued, the proceeds pay for the project, and the bond is paid off with the user fee revenue. This is popular because it is a type of tax that is paid by the direct beneficiaries of a specific project, and this tax is usually agreeable to all parties along the political spectrum. The parking fee is a widely-adopted type of user fee and it is collected in numerous beach communities. Parking fees can be collected at public parking lots, at island access points, and along city streets by parking meters. If user fee financing is to be used, then the rule in deciding whether a project is feasible is that expected parking revenues should be sufficient to cover the project's cost (Randall, 1987). If the user fee is a choice variable, then a preliminary problem is to estimate the parking fee and usage level that would generate the required revenues.

The more typical situation has been where general revenue financing is used. In the case of beach improvements, funding from local, state and federal sources has been employed (Stronge, 1999). The typical rule for a project's feasibility is that the project should pass a benefit-cost analysis (Field, 1997). Projects that pass this test should be a net benefit to society.

Analogous to the user fee case, a preliminary problem is to estimate economic benefits, in the form of willingness to pay (WTP), against which cost estimates can be compared.

Georgia has four barrier islands (Tybee, Sea, St. Simons and Jekyll) where property improvements are vulnerable to erosion damage. As noted in Clayton, et al. (1992) these four islands contain 19 miles of beach shoreline, of which 55 percent has been armored with various types of erosion protection devices. Erosion and accretion patterns vary tremendously. At each stretch of coast that has been armored to prevent property losses, resulting natural processes have led to a narrower sandy beach and the beach disappears at high tide. Tourists who visit these in search of beach recreation may be disappointed and seek another beach for their next vacation. Sandy beaches are a vital input to tourism and to residential property values on these islands, and the tourist industry is a vital part of the local economy.

This paper describes a survey of beach visitors at Jekyll Island, Georgia. The survey instrument was designed to obtain data for estimating both the willingness to pay and the parking revenue, that would be associated with a local beach quality improvement project. After reviewing the previous research, there is a description of our survey method. Next, there are two sections that deal with the estimation methods in turn. A final section compares the viability of the two approaches. The results suggest that under every scenario considered, a beach improvement project for Jekyll Island is economically feasible.

Previous Research

The Corps of Engineers undertakes a limited form of benefit cost analysis for its projects along the coast. The Corps measures the benefits of beach nourishment by the probability-weighted present value of property saved from future damage. Potential benefits to beach visitors are not counted. This valuation approach is limited to valuing preventable, tangible

property losses, and therefore has an intuitive appeal to nonspecialists. However, the approach is not based upon the economic theory of measuring the benefits of public goods which dictates that Hicksian compensating variation is most valid (see, eg., Pearce, 1983). This approach effectively disenfranchises beach visitors, and by extension the general public, from any claims they may have on this valuable public resource. By excluding visitors' benefits this method leads to providing a lower level of beach amenities than what the public demands (Stronge, 1993).

Black, Donnelley and Settle (1990) present a full set of financing options for beach nourishment projects in Delaware. They illustrate tests for the equitable distribution of project costs among the primary beneficiaries of beach improvements. It is argued that coastal communities, rather than the public at large, should shoulder beach nourishment costs through beach access fees and special assessments on beach real estate. Pompe and Rinehart (1999) share a similar concern for equity. To finance a nourishment program for the private beach at Seabrook Island, South Carolina, they propose charging fees to property owners that are based upon the property's proximity to the beach.

Recent research by Parsons and Powell (2001) has analyzed the comparative costs of a retreat policy versus a nourishment policy in Sussex County, Delaware. The hedonic price method was used to value the effects of the policies upon property owners. They categorize the costs of a retreat policy into land loss, capital (structures) loss, proximity loss and transition loss. We apply this approach to the case of Jekyll Island. Their primary finding was that a nourishment policy was more cost effective over a fifty-year time horizon.

Previous economic research on estimating the benefits of beach amenities or shore erosion protection is not extensive. McConnell (1977) applied the contingent valuation method to estimating willingness to pay for a beach visit in Rhode Island. Using regression results from a model that explained willingness to pay as a function of congestion and other variables,

McConnell suggested optimal crowding standards for these beaches. Bell and Leeworthy (1990) applied the travel cost method to valuing visitor days at Florida beaches. Focusing upon visitors who traveled long distances, they found that the daily consumer surplus was nearly $34.00.

Silberman, Gerlowski and Williams (1992) used contingent valuation to estimate option values for users and nonusers of the amenities associated with beach nourishment. An on-site survey obtained values from beach users, while nonuser values were obtained from a telephone survey. They found that the average beach user would pay $15.10, while nonusers would pay $9.26, for a project that would restore the beach width to 200 feet. Kaoru (1993) estimated WTP for beach access at Martha's Vineyard for two user groups: local residents and visitors. Using the contingent valuation method, he found that visitors' beach recreation benefits per trip were substantially higher than the local residents. We apply the contingent valuation method of estimating willingness to pay to the case of Jekyll Island.

Data Collection

The foregoing discussion highlights the objectives of this research. They are to estimate the benefits of beach amenities associated with erosion management alternatives, with emphasis upon measuring: (1) the different valuations from beach visitors and local residents, (2) the different effects that result from a retreat policy versus a nourishment policy, and (3) the seasonal variation in visitation and benefits. We addressed these objectives by a substantial survey of beach visitors to Jekyll Island. Three seasonal samples were collected: Winter (February, 1998), Spring (May, 1998) and Summer (July, 1998).

The questionnaire for this research was eight pages long, with three pages printed in full color. The status quo beach conditions were presented in a map of the island, beside another map that showed how beach conditions would be improved. One version of the questionnaire

gave no specific information about which policy would be used to produce wider beaches. Another version specifically stated that nourishment would be used, while another stated that a retreat policy would be enforced. This multi-version approach allowed us to test, independently of the alternatives, which beach policy approach resulted in higher valuations. A full description of the questionnaire is presented in the Appendix.

The questionnaire asked respondents whether they preferred the status quo beach conditions (with the prevailing parking fee of $2.00/day) or the improved beach conditions with a higher parking fee. At the time of the survey visitors paid the $2.00 fee at the island entrance gate, and we decided to use this payment method in our questionnaire design. In different questionnaire versions, the increased parking fee was between $2.05/day and $25/day, in one of 11 increments. The parking fee considered by a visitor was determined by the luck of the draw. This question generated the data for estimating the willingness to pay for the improved beach. A secondary valuation question asked how they would adjust their visitation at the higher parking fee. This question generated the data for estimating the parking revenue that would be generated at alternative parking fee levels.

The survey was conducted as follows: a survey enumerator approached people at the beach and asked them if they wished to complete a short survey. Ten questions were asked, and the enumerator recorded their name, address, and information about visitation. Then the enumerator gave them a questionnaire and mailing envelop. They were asked to complete the questionnaire at their convenience and mail it back to us. To minimize the problems of non-response, Dillman's (1978) repeat contact method was employed: if we did not receive the questionnaire after four weeks, a postcard reminder was sent. If there was no subsequent response within four weeks, an additional questionnaire was sent. 2,672 visitors were contacted on Jekyll Island, and 1,483 questionnaires were returned in the mail for a response rate of 55.5

percent. 1,040 of the returned questions contained complete sets of data that were used in the analysis.

Table 1 contains definitions of variables used and the summary statistics for data analyzed from the beach survey. The average household income of respondents is quite high at $60,400, and their age averages 45 years. There is considerable seasonal variation in these averages, as the winter sample became more wealthy and aged due to the cold-weather influx of visitors from the northeast U.S. and Canada. People in the summer sample were younger, poorer, and they tended to live nearby. Fifty-five percent of respondents were interviewed in the summer, while the rest were evenly split between the winter and spring interview seasons.

Table 1 also contains the direction of influence we expect each variable to have in the two regression analyses. In both analyses, the dependent variable is a measure of how highly the respondent values the improvement in beach conditions posited in the questionnaire. A key economic variable is the increase in the parking fee that will be charged, and if beach improvement is a normal good, then its demand curve should be downward sloping and the price effect will be negative. Another key economic variable is the respondent's income. Again, if beach improvement is a normal good then income should have a positive effect.

Seven of the variables relate to the respondent's characteristics, and most of these variables are fairly common in valuation studies. Older respondents may have less need for beach recreation than younger people, so the variable for the respondent's age should have a negative effect. Respondents with more experience with the Jekyll Island beach probably have a greater appreciation of its declining quality, and this may lead to a higher valuation of an improvement project. For similar reasons, we expect that respondents with higher education levels should value the beach improvements more.

People with a pro-government attitude are hypothesized to be less skeptical of public works projects, and they would therefore have a higher valuation. On the other hand, people who identified themselves as environmentalists would probably view a beach improvement project as an undesirable intervention into natural processes, and they would tend to have lower valuations. Respondents who traveled to the island from far away, as indicated by the travel time variable, necessarily should have a higher valuations. As suggested by Kaoru's findings, we expect that local people's valuations would be lower than that of visitors. A dummy variable captured the seasonal effect by whether the interview was conducted in the summer or not. The remaining two dummy variables are the effects from the different questionnaire versions that were described previously: (a) nourishment policy versus (b) retreat policy versus (c) both policies were described but neither was specified.

General Revenue Financing

In order to estimate the economic benefits to property owners and coastal visitors we employed the contingent valuation method (CVM) of pricing public goods that include environmental amenities. Starting from roots in the early 1970's, CVM has matured into a textbook research method with certain features as standard (Field, 1997). A status quo is described to the CVM survey participant, with respect to institutions and the provision level of one or more non-market goods; an alternative level is proposed; then, within well-specified conditions under which the alternative level will be provided and individual payments collected, the investigator elicits the participant's contingent valuation according to a preselected method. Reliable information elicited in this way can then be used to calculate economic benefit measures.

Some economists have posited several reasons to doubt the validity of CVM results. For example, problems of starting point bias and informational effects are related to the question of survey design. These concerns have resulted in a body of experimental and empirical literature which has generally found the method to be valid when survey design is carefully done and there is rigorous pre-testing of instruments (Mitchell and Carson, 1989). Our questionnaire was subjected to very concentrated pre-testing.

There is also concern with hypothetical bias, which results from a respondent's scepticism that the proposed contingent market is "real". This is not a problem in this research. A parking fee has been enforced and collected on Jekyll Island, and it acts as an effective rationing mechanism that is quite real to people. In the CVM questionnaire, the improved beach amenity was offered to people and it was made clear they would have to pay higher parking fees for it.

Strategic bias can result when respondents misrepresent their true willingness to pay in order to bias the results of the investigation toward their preferred outcome. An impressive literature on the incentive characteristics of various value elicitation methods has resulted. Our questionnaire employed a device that is relatively immune to strategic behavior: the “closed-ended referendum.” Here, the respondent is asked to vote for or against the policy change at the stated program price. These yes-no responses are then analyzed in either logit or probit- type regression models.[1] Finally, the reliability of the method has been called into question much more seriously when investigating the non-use value of natural resources. We avoid this potential problem by estimating willingness-to-pay for people who actually use the beach.

[1] These regression methods are preferred to ordinary least squares, which would yield unbiased but inefficient estimates in the case of a limited dependent variable (Greene, 2000)

Table 2 contains the logit regression results. 1,040 observations are analyzed in this model which obtained a correct prediction ratio of 82 percent. Of the thirteen variables in this model, 7 of the effects are different from zero at the five percent significance level. All of the significant variables have their hypothesized signs of influence. The key economic variable, Price, is negative and significant. People with a higher education level had a higher propensity to prefer the beach improvement project, as did people with Pro-Government and non-Green attitudes. Local people tended not to vote in favor of the project. People who indicated they would visit another beach had a lower propensity to vote for the project, and people presented with the retreat policy version of the questionnaire had a higher propensity to vote for it. As shown below, these positive and negative propensities translate directly into valuations.

The logistic coefficients are slopes in the usual regression sense, but their interpretation is different because the "dependent variable" is actually an index, Z, related to the independent variables, X, according to

$$Z = \beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k \qquad (1)$$

where the βs are the slope coefficients. For any observation, its predicted response is the probability of voting in favor of the beach improvement project, and is found by the logistic transformation,

$$\text{Prob}\ (Y=1) = 1/\ (1 + e^{-Z}) \qquad (2)$$

where e is the natural number 2.17.... For any independent variable, its effect on the probability of voting yes can be found by evaluating this transformation. For example, the key economic variable, the new daily parking fee, is negative and highly significant. If the Z function is evaluated at the means of the other independent variables, and with the price variable varying over its observed range, the response curve in Figure 1 can be produced.

Figure 1 demonstrates that respondents' acceptance of the beach improvements are highly responsive to price. For very small price increases the acceptance rate is around 70 percent. This indicates that if the project were put to a referendum vote, it would be approved. However, the approval rate declines sharply. For price increases greater than $5.00, the referendum probably would not pass because fewer than 50 percent would prefer the program.

Using the coefficients reported in Table 2 and assuming that the underlying WTP function is linear in its arguments, then the median respondent's WTP can be calculated simply as

$$WTP = (!3\ X\beta) / \beta_p \qquad (3)$$

where β_p is the coefficient for the price increase variable (Cameron, 1988). This calculation yielded an overall estimated WTP of $5.57/day, or $30.53 per year for the average household that visits 5.48 days per year. According to information from the Island's Annual Report, there are approximately 140,000 parties that visit Jekyll each year. Therefore, the total annual willingness to pay among the visitors for improved beach conditions is about $4,274,000 per year. It is also possible that non-users of Jekyll Island may also place a positive value on these beach improvements. If they do, then this amount would represent a lower bound estimate for the true level of economic benefits.

It is an open question whether this evidence of a large economic benefit would convince the US Congress or the state legislature to actually fund a beach nourishment project. Legislators may feel that this would be a project that primarily benefits a single county's economy, and that Glynn County should therefore pay for it. A similar problem could arise within Glynn County. Inland residents may resent their tax dollars being used to benefit out-of-town visitors, and the owners of homes and businesses on Jekyll Island. The direct beneficiaries could counter with the argument that because of the business ripple effects, the entire county

would also benefit. Opponents may reply that the project is an attempt at rent-seeking and deny subsidies to Jekyll Island.

Financing with User Fees

For the case of financing beach improvements by revenue raised from parking fees, this question is a common one in marketing research: If the quality and price of a product is changed, how will the public react? The response to the change in beach quality should be non-negative, i.e. people might be indifferent, and they will likely visit the beach more often. The response to the price change should be non-positive, i.e. people may reduce their visitation, or they may stop visiting Jekyll Island altogether.

The survey's second valuation question elicited respondents' reactions to the posited quality and price changes in terms of the number of days that they would visit the island. People had the option of reducing their visitation to zero, and 28 percent of the respondents replied this way. These visitation data can be analyzed with regression methods, but OLS applied to the censored dependent variable would yield parameter estimates that are biased and inconsistent (Greene, 2000). Tobit regression is the proper method to apply to this problem. With the tobit model there is an observable dependent variable y that takes on values of zero and above, according to the relationship:

$y = 0$ if y^* # 0,

$y = y^*$ if $y^* > 0$, and

$$y^* = \beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k + e \qquad (4)$$

where y* is the underlying, latent dependent variable.

The tobit regression estimates are reported in Table 2. Four of the independent variables are significant at the 5 percent level, and they display the effects that were hypothesized. These

variables were the price (i.e., the increase in the existing parking fee), household income, the years visited Jekyll, and the use of a substitute vacation beach. It is interesting to note that the seasonal difference did not have a significant effect on valuation, in the tobit model or the logit model. Also, a respondent's age, the travel time and the prospect of a nourishment project did not significantly effect valuation in either model.

To calculate the revenue that could be raised under various increases in the parking fee, we use an approach similar to Teasley, Bergstrom and Cordell (1994), where they estimated parking revenues at state recreational parks. The approach is to calculate parking revenue as:

$$\text{Revenue} = \text{Price} \times \text{Days} \times 140{,}000 \qquad (5)$$

where Price is the increased daily parking fee. 140,000 is the approximate number of parties that visit Jekyll Island annually. Days is the number of days per year that a party will visit Jekyll Island at a given price increase, as predicted by the tobit model's y variable in (4):

$$\text{Days} = \Phi\,(\beta\mathbb{N}X / \sigma)\,(\beta\mathbb{N}X + \sigma\lambda) \qquad (6)$$

where $\beta\mathbb{N}X = \beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k$, $\lambda = (\varphi(\beta\mathbb{N}X / \sigma)) / (\Phi\,(\beta\mathbb{N}X / \sigma))$, φ and Φ are the probability and cumulative distribution function operators, and σ is the variance of the error in the tobit model. It is also noted that this estimate of Days is conditioned on the proportion of parties that will continue to visit Jekyll Island at a given price. According to Greene (2000), this proportion is calculated from the tobit model as:

$$\text{Proportion} = \Phi\,((\beta\mathbb{N}X) / \sigma) \qquad (7)$$

The calculation for Days can be iterated over different values of Price to produce a downward sloping demand curve. Taken together, the revenue equation (5) captures two separate effects from increasing the parking fee, as illustrated in Figure 2. A higher price will generate more revenue, obviously, but as the price increases people will reduce the number of days they visit the island, and some people will stop visiting Jekyll entirely.

According to Figure 2, the parking fee increase that maximizes revenue is at $14.50 per day (or, a total fee of $16.50), and it generates about $2.8 million in parking revenue annually. Raising the fee this high may cause outrage among some user groups. However, in the next section it is shown that a parking fee of only $7.00/day (i.e., the current $2 plus a $5.00 increase) is needed to cover the cost of a beach improvement project. Even a $7.00 parking fee would be a very substantial increase over 1998's prevailing charge of $2 per day. However, nearby recreational activities such as dolphin watching, deep sea fishing, and golf cost considerably more than $7.00 per party for a day at the beach.

Comparing Benefits with Costs

The previous sections have presented the benefits associated with alternative beach improvement policy scenarios. In this section we conduct the feasibility analysis for the policies using hypothetical, but realistic cost estimates. The policies represented in different questionnaire versions were a nourishment versus a retreat policy, and there are two financing alternatives. For each of these four policy combinations there are different costs and benefits that must be calculated.

The two sets of WTP estimates are made by alternatively evaluating equation (3) with Nourishment =1 and =0, and with Retreat =0 and =1. A nourishment policy would be valued at $6.32/day ($4.8 million/year) while a retreat policy would be $7.02/day ($5.4 million/year). Calculating the parking revenue is a similar process. A nourishment policy would generate a maximum of $3.0 million/year at a daily fee increase of $15.00, while a retreat policy would generate $6.6 million/year at a daily fee increase of $15.00. These WTP and parking revenue estimates are reported in Table 3 where the benefit cost analysis is summarized.

Estimation of the costs of a nourishment project can be made on the basis of the 1990 nourishment project at Sea Island, Ga, located eight miles north of Jekyll. Details of the project are described in Oertel, Foster and Graham (1996). The nourishment project initially cost $7 million for constructing two terminal groins and sand dredging, with annual maintenance costs of $250,000 for two miles of the Sea Island beach. If a comparable project had been conducted at Jekyll Island in 1998 and maintenance lasted for 10 years, and assuming that the costs would increase linearly for the 2.9 stretch miles of Jekyll that requires nourishment, then the present value of the costs, calculated at a 6 percent discount rate, would be about $8.8 million.

The costs of a retreat policy are estimated within the four-category framework used by Parsons and Powell (2001). Data were obtained from a GIS-based inventory of the houses and other buildings on Jekyll Island. Details about this data collection effort are contained in Crowell and Leatherman (1999) and Leatherman, Merrell and Friedman (2001). We identified 38 buildings on the northern one-third of the island that are located inside the 30-year erosion hazard area. This erosion hazard area is the strip of land that should disappear within the next 30 years, given the historical erosion rate. Twenty-three of the buildings were houses valued in 1998 by the county tax assessor at $3.7 million, net of the land value. The remaining fifteen buildings were part of a condominium group, and they were valued at $18.2 million. Therefore, the total capital loss sums to $21.9 million. The second cost category, land loss, was not considered in the user fee financing case because the State of Georgia owns all of the island. The homeowners merely lease the land their house sits upon, so it would not be part of a compensation package for owners. However, the loss of land represents a societal loss, and as such it must be considered in the general revenue financing case.

As discussed in Parsons and Powell, the value of land lost from a retreat policy is not the value of waterfront land. This is because the retreat policy would merely transfer the waterfront

amenity value to the neighbor who formerly was one house back from the water. This transfer process is repeated for all of the neighbors in the community. From a societal stance, the loss of land value is from the land with the least amount of the beach-related amenities. The appropriate tool for measuring land value net of the beach amenities is multiple regression. We happened to have recently completed this type of study for Glynn county coastal properties, and the details are in *citation withheld during review process*. The amenity-free value of land for these 38 properties with an average size of one-quarter acre was estimated to be $1.7 million.

The other costs of a retreat policy would include the demolition of the buildings. This cost may be as much as 15 percent of the buildings' value, or $3.3 million. Finally, 2.9 miles of existing rock revetments would be demolished. This may cost as much as $1 million per mile. These transition costs (the third cost category) sum to $6.2 million. The final cost category considered by Parsons and Powell is the proximity loss, i.e. the loss that results when the retreat policy encourages people to build farther from the shore than they would if the beach were periodically renourished. However, we did not feel that on a low-density island such as Jekyll that proximity loss would be a significant cost.

Summing the capital loss and the transition loss together produces a $28.1 million estimate for the cost of a beach improvement project that would result from a retreat policy under user fee financing. Under the general revenue financing case, costs would these plus the lost land for a total of $29.8 million. These are all one-time, present costs that should not be discounted. Given the historical erosion rate, the beach improvements from the retreat policy should last for thirty years. Therefore, 30 years is the relevant period for discounting the WTP estimates and the parking revenues.

The benefit cost analysis is summarized in Table 3. Each of the four policy combinations generates a benefit/cost ratio greater than one. This implies that a beach improvement project

should be undertaken for Jekyll Island. The fact that all of the benefit cost ratios are considerably higher than one make us very confident in recommending an improvement project.

While all of the options are desirable, the one with the highest benefit cost ratio is the beach nourishment project financed by general revenue. The high benefit cost ratio implies that this policy combination is the most efficient, i.e. it would yield the "biggest bang" for the tax dollars. To the extent that the nourishment sand may be eroded away in less than ten years, our costs may be underestimated. However, the benefits of $4.8 million/year imply that the benefit cost ratio would still be favorable even if the nourishment had to be repeated every four years.

In a previous section, it was noted that the revenue-maximizing entry fee of $16.50/day may cause outrage among some Jekyll Island visitors. However, the high revenue/cost ratios imply that a much lower entry fee could be charged, and beach improvement would still be feasible with a ratio equal to one. This would occur when revenues equal costs. For example, under the beach nourishment policy, additional annual revenues of $1.8 million would be needed to generate $13.2 million over 10 years. This additional revenue can be obtained from an increase in the parking fee from $2.00/day to $7.00/day. This process is repeated for the other policy combination and the results are presented in Table 3 as the break-even parking fees. The break even total parking fee for the retreat policy is $8.00/day (i.e., the current $2 plus a $6 increase).

Summary and Conclusions

The current system of laws and incentives has not prevented the degradation of beaches along developed sections of the American coast. This paper has described two approaches to assess the viability of beach improvement projects at Jekyll Island, Georgia, using data from a intensive survey of visitors. The preliminary step in finding the feasibility of financing from

government general revenue is to estimate the economic benefits for use in a benefit-cost analysis. Through the use of a logit regression model, annual willingness to pay for beach improvements among all users was estimated as $5.57 per day, or $4.3 million per year. However, expenditures upon the Jekyll Island beach could be viewed as a localized project benefitting a small number of people, and it is uncertain whether the Federal or State governments would fund the project.

The alternative approach is finance the project with funds generated from increases to the existing user fee on Jekyll Island. Through the use of a tobit regression model, the parking fee is estimated to generate a maximum of $2.8 million per year at a fee of $16.50 per day before revenues would decrease. However, in the following section it is shown that a parking fee of $8/day is required for any of the beach improvement alternatives to be feasible.

In the benefit cost analysis, each of the four policy combinations generates a benefit/cost ratio greater than one. This implies that a beach improvement project should be undertaken for Jekyll Island. All of the benefit cost ratios are considerably higher than one, and this fact makes us very confident in recommending an improvement project.

The retreat policy could be successfully applied at Jekyll Island because the level of property owner compensation would be small. However, we doubt whether this result could be duplicated at many other beaches. In particular, the policy will not be feasible at beaches that are more intensely developed, and with higher value property. The fact that the land at Jekyll Island is leased from the State, and does not become a part of a compensation package for property owners, obviously plays the major role in the feasibility of user fee financing.

Financing a beach nourishment project by general revenue yields benefit/cost ratios that are roughly twice of those generated under user fee financing. This is entirely the result of the

difference in how rationing operates in the two cases. Under general revenue, the project is financed as a pure public good. By definition there can be no rationing of a public good and people can freely use the good until the effects of congestion discourage its use. The opposite is the case under user fee financing. The good is price-rationed as if it were a private good. This rationing must be done to extract the user fee. As people are priced out of the market, the usage and the associated benefits decline. Thus, user fee financing will always generate lower benefits. Nonetheless, political feasibility and general notions of fairness may argue for user fee financing. In either case, beach improvement appears to be a sound decision for Jekyll Island.

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Appendix

The questionnaire for this research was eight pages long, with three pages printed in full color. The first page gave a short description of the island and the shore erosion phenomena. The second page described the payment vehicle for beach improvements, which was an increase in the parking fees that existed at Jekyll Island, $2.00 per day. Page two also asked questions about the past year's frequency of beach visitation.

Page three presented four color pictures of different beach conditions, taken at different places on the island: widest beach (50 yards wide at high tide), wide beach (20 yards wide), narrow beach (10 yards wide, but with rip-rap present) and narrowest beach (rip-rap present, and no beach at high tide). Page 4 faced page 3, and it had a description of the beach conditions and the two policy alternatives that can maintain wide beaches: (a) nourishment, where sand is pumped or trucked to artificially widen the beach, and (b) retreat policy, where no erosion control is permitted and a minimum distance between the water and buildings is maintained by the relocation or demolition of buildings.

Page five presented two color maps of the island. The first map presented status quo conditions, i.e. the stretches of the coast that were narrowest, narrow, etc, were identified with color coding. We had ascertained the geographical location of the four beach types during the research planning phase with GPS and range finding equipment. We found, for example, that the "narrow" and "narrowest" beaches characterized 2.9 miles, or 35 percent, of Jekyll's 8.4 mile ocean coast. The second map presented improved beach conditions under an "alternative management plan," with the island having no "narrow" or "narrowest" beach types. The text also explained that "widest" beaches would cover 4 miles of the coast, and "wide" beaches would cover the remainder.

Page six faced page 5, and it contained the primary valuation questions. The first elicited the respondent's willingness to pay by the referendum format and was stated as:

Considering the beach conditions and the price of using the beach, which management scenario you would prefer to see at Jekyll Island? (circle one)

a. ***Current Conditions*** *(at $2/day)*

b. ***Alternative Management*** *(at $2.50/day)*

All prices were stated relative to the existing daily parking fee of $2.00/day. In different questionnaire versions, the increased parking fee at Jekyll Island started at $2.05/day and went up to $25/day, in 11 increments. The parking fee considered by a visitor was determined by the luck of the draw. A secondary valuation question elicited data on trip response as follows:

Suppose that the ***alternative management plan*** *happens and beach conditions in the right-hand map result. At the new fee of $2.50/day, how would you change the number of days you visit Jekyll in a one-year period? (circle one)*

a. Visit Jekyll the same number of days,

b. Reduce the days you visit Jekyll. How many fewer days? ____ (fill in blank)

c. Increase the days you visit Jekyll. How many more days? ____ (fill in blank)

From this question we obtained data for estimating the parking revenue that would be generated at various parking fee levels. The remaining two pages of the questionnaire obtained socio-demographic information.

Table 1: Variable definitions and summary statistics for beach improvement valuation survey, Jekyll Island, Georgia, 1998 (n=1,040 respondents)

Variable	Definition	Mean	Std. Dev.
Vote	1 if alternative beach conditions preferred to *Status quo,* 0 otherwise. Dependent variable for willingness to pay analysis.	0.45	0.495
Days	Visitation days under improved conditions Dependent variable for the parking fee model.	5.48	7.08
Price	Increase in the daily parking fee (-)	7.82	7.23
Income	Annual household income (+)	60,400	29,600
Age	Age of respondent (-)	45.01	13.39
Education	1 if more education than high school, else 0 (+)	0.69	0.46
Pro-government	1-10 scale of pro-government attitude, 1 lowest (+)	4.99	1.52
Green	1-15 scale of pro-environment attitude, 1 lowest (-)	9.29	2.12
Travel Time	Hours of travel time to island (+)	6.68	6.91
Local	1 if local county resident, 0 otherwise (-)	0.04	0.19
Years Visited	Years that respondent had visited Jekyll (+)	9.09	11.47
Substitute Beach	0 if island visitation level unchanged, else equaled number of days at substitute beach (-)	2.86	11.19
Nourishment	1 if survey version was beach nourishment, else 0 (?)	0.22	0.42
Retreat	1 if survey version was retreat policy, else 0 (?)	0.21	0.41
Summer	1 if summer survey, else 0 (+)	0.65	0.47

The (+) and (-) signs indicate the variable's hypothesized direction of influence on the dependent variable.

Table 2: Logistic and tobit regression results for beach condition preferences, Jekyll Island, Georgia, 1998.

	Willingness to Pay (Logit)[a]		Parking Revenue (Tobit)[b]	
Variable	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error
Intercept	0.110	0.502	2.277	0.489*
Price	-0.159	0.013*	-0.136	0.010*
Income	0.001	0.001	0.001	0.001*
Age	-0.004	0.006	0.001	0.005
Education	0.464	0.177*	0.050	0.168
Pro-government	0.245	0.051*	0.071	0.047
Green	-0.094	0.035*	0.007	0.033
Travel Time	0.003	0.012	0.005	0.011
Local	-0.651	0.391*	0.070	0.374
Years Visited	-0.001	0.006	0.014	0.006*
Substitute Beach	-0.043	0.015*	-0.020	0.005*
Nourishment	0.252	0.183	0.231	0.177
Retreat	0.363	0.194*	0.265	0.186
Summer	0.078	0.161	0.027	0.155

n=1,040.
a. Dependent variable equals 1 if the respondent preferred the improved beach conditions at the higher price, and equals 0 if the status quo is preferred.
b. Dependent variable is the number of days the respondent would visit the island after completion of the beach improvement project.
* indicates rejection of the one-tailed hypothesis test at the five percent significance level.

Table 3: Summary of a benefit cost analysis for two policies for obtaining beach improvements, under two financing methods, Jekyll Island, Georgia, 1998.

	Beach Nourishment Policy	Retreat Policy
Project life	10 Years	30 Years
General Revenue Financing by Willingness to Pay (WTP) $ million		
Annual WTP	$4.8/year	$5.4/year
Total WTP	$35.8*	$74.3*
Project Costs	$13.2*	$29.8
WTP/Cost ratio	2.7	2.5
User Fee Financing by Parking Revenue $ million		
Annual Revenue	$3.0/year	$3.1/year
Total Revenue	$22.1*	$42.7*
Project Costs	$13.2*	$28.1
Revenue/Cost ratio	1.6	1.5
Break-even Parking Fee	$7.00/car/day	$8.00/car/day

* indicates a present value calculated with a six percent discount rate for the project life.
N.A. stands for Not Applicable.

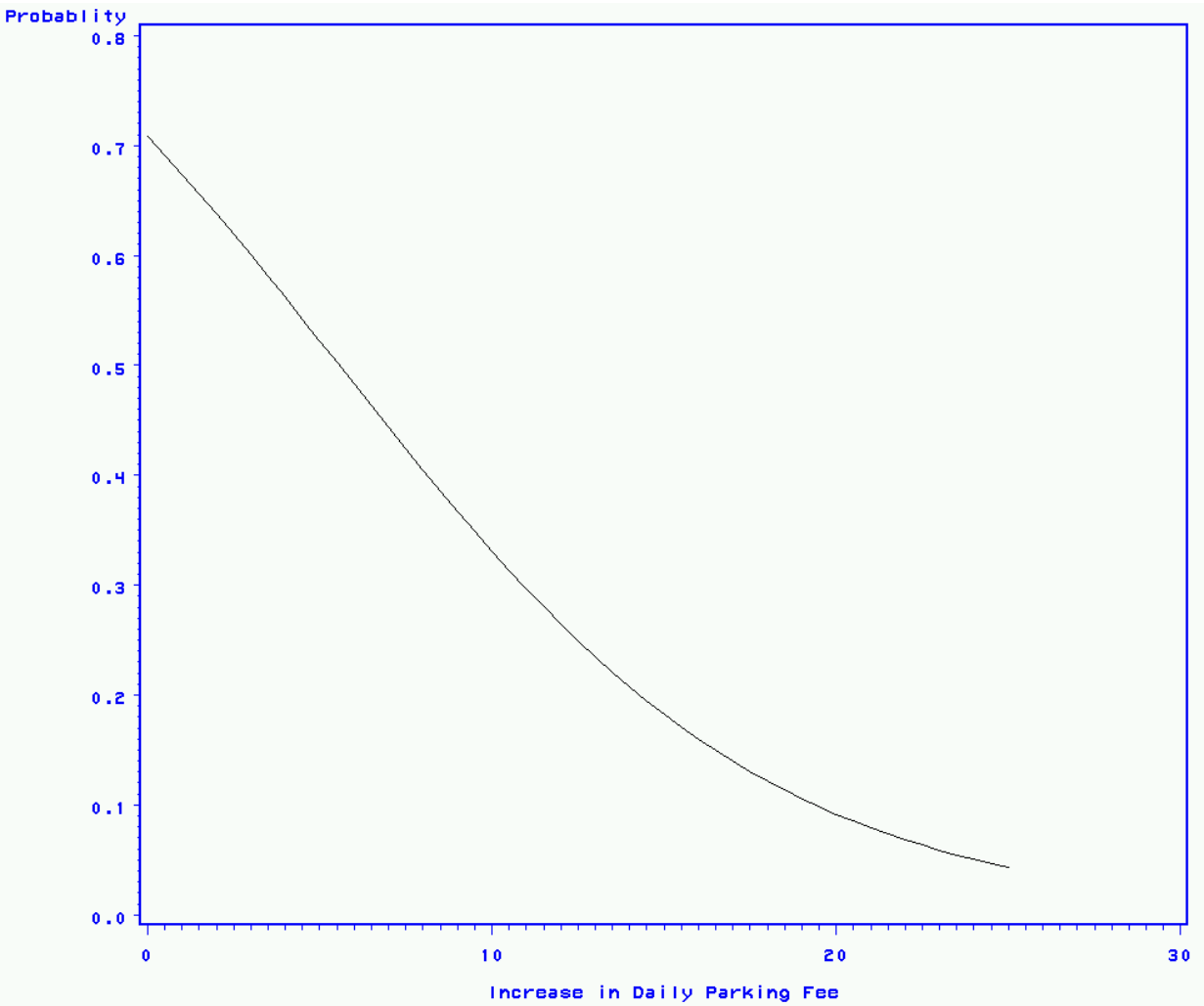

Figure 1: How proposed prices for parking affects the probability of preferring improved beach conditions over the status quo, Jekyll Island, Georgia, 1998.

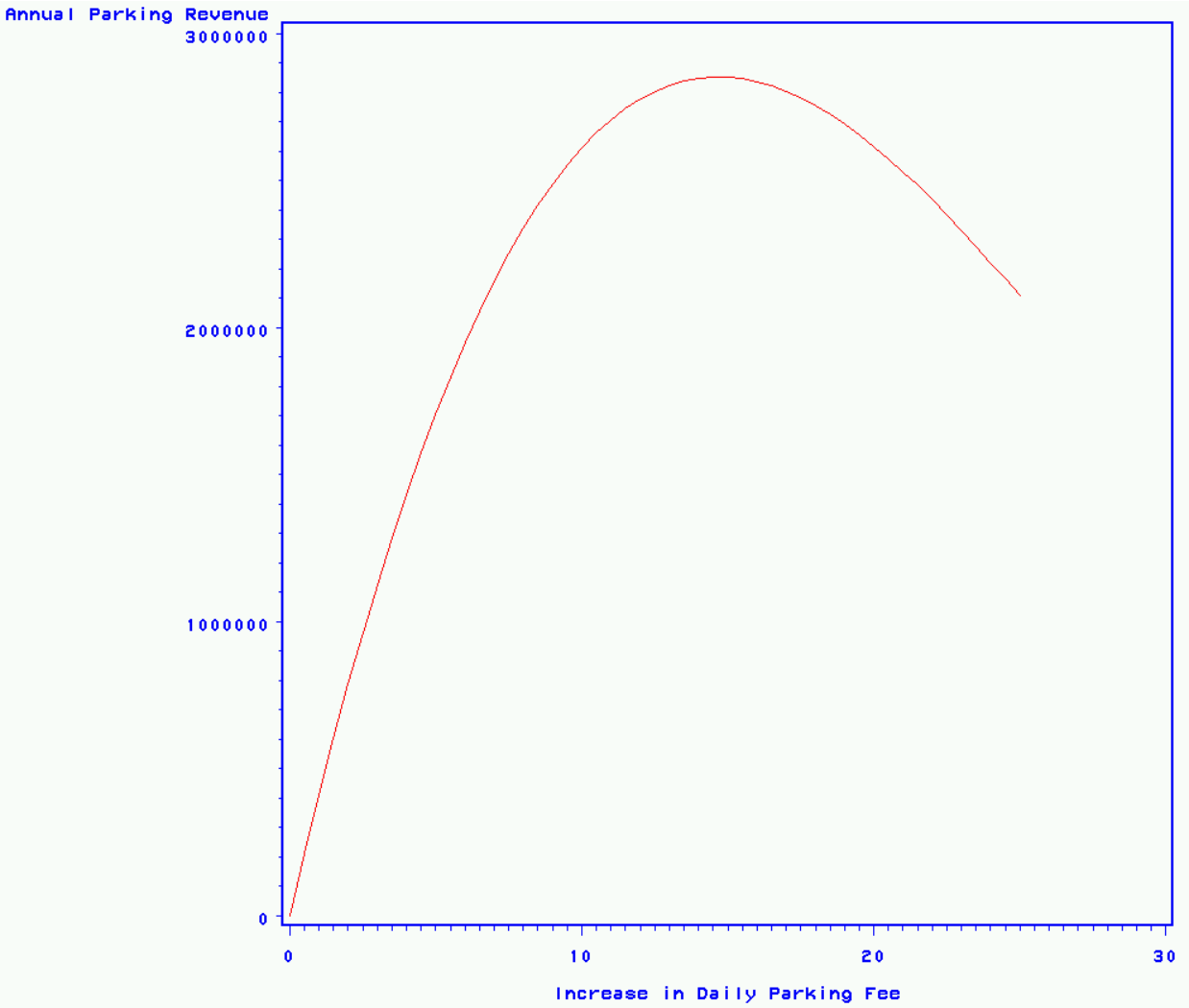

Figure 2: Annual parking revenue depends on the daily parking fee, Jekyll Island, Georgia, 1998.