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Coastal Erosion Management from a Community Economics Perspective: The Feasibility and Efficiency of User Fees

Warren Kriesel, Craig E. Landry, and Andrew Keeler

Coastal communities cannot depend on funding from the state or federal government to maintain high-quality beaches that benefit the public and attract tourist revenues. This article investigates the feasibility and efficiency of beach improvement projects at two Georgia barrier islands through the alternative funding mechanisms of general-revenue financing and user fees. Benefits are calculated from an intensive, on-site survey of beach visitors, and the costs are calculated from observable sources. The analyses presented support beach improvement as an effective policy on both islands under all scenarios considered.

Key words: beach nourishment, coastal erosion, relocation, user fees

JEL Classifications: Q26, R51, R53

Coastal erosion is a major concern among all parties involved in managing coastal lands. Eighty to 90% of the sandy beaches in the continental United States are receding (Leatherman), but erosion and accretion patterns can vary tremendously over both space and time. Developed coastlines are often armored with concrete and rock structures to prevent property losses associated with shoreline erosion. A common result of this approach to management is narrower sandy beaches that often disappear at high tide. These poor-quality beaches may drive tourists away. Sandy beaches are a vital input to tourism in coastal communities, and the tourism industry is often an important part of the local economy.

Public policy makers are faced with two markedly different strategies for managing erosion: (1) artificially nourishing the beach with more sand and (2) permitting nature to take its course by relocating threatened property improvements. Each alternative has different effects on coastal user groups. Beach nourishment offers some protective value for property improvements, plus it increases the amenity value associated with sandy beaches. However, this alternative can disrupt natural accretion patterns and cause serious side effects. The relocation alternative primarily affects property owners, who may, however, 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.

Regardless of the management approach chosen, costs are likely to be considerable;

Warren Kriesel is Associate Professor, Agricultural and Applied Economics Department, University of Georgia; Craig E. Landry is Assistant Professor, Economics Department, East Carolina University; and Andrew Keeler is Associate Professor, School of Public Policy and Management, The Ohio State University.

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beach-management projects are typically large scale, encompassing miles of shoreline. In the past, funding from local, state, and federal sources has been used for beach improvements (Stronge). Economic efficiency requires the project provide a level of benefits that exceeds costs. A primary task is to estimate these benefits, in the form of willingness to pay (WTP), against which cost estimates can be compared. However, the fact that a project has high net benefits is no guarantee that it will be funded, because the federal government has shown increasing reluctance to support beach-improvement projects (Marlowe). Increasing skepticism about the overall public benefits of large-scale water projects of all kinds, combined with general budgetary pressure, have led to a situation where the beach communities themselves are much more likely to provide financing for beach management.

In this fiscal environment, the field of community economics offers appealing insights. The field places special emphasis on the community as another economic agent (Shaffer, Deller, and Marcouiller). Rather than analyzing the beach strictly as a natural resource and a public good, professionals in the field examine the importance of public infrastructure for the well-being of a community. Infrastructure is analyzed as an exclusive or a nonexclusive good. From this insight, the primary financing options that emerge for beach improvement projects are (a) user fees and (b) general-revenue financing. User-fee financing has been popular for infrastructure such as bridges and roads because it is a type of tax that is paid by the direct beneficiaries of a specific project. Also, it is usually agreeable to all parties along the political spectrum. If user-fee financing is to be used, then the rule in deciding whether a project is financially viable for the local government is that expected user-fee revenues should be sufficient to cover the project's cost (Randall). Choosing a user fee requires an understanding of how changes in fee affect the level of usage and resulting overall revenue.

This community-economics approach to analyzing beach improvements was employed by Kriesel, Keeler, and Landry, where they examined the case of Jekyll Island, GA. Located 8 miles from Brunswick, GA, Jekyll's land area is about 5,000 acres, all of which is owned by the State of Georgia and managed by the Jekyll Island Authority. The state legislature voted in 1955 to restrict development to 35% of the land area, and redevelopment of existing structures is not permitted. There are about 200 private, ranch-style homes, most built in the 1950s and 1960s, 10 motels, and a small condominium development. A historical district and golf courses occupy the remaining developed land. Within this context of low-density development, it was found that both beach nourishment and relocation were economically feasible management alternatives under either general-revenue or user-fee financing. That study noted, however, that these results may be limited to low-development cases such as Jekyll. In areas with higher development densities, the costs of a relocation policy could be prohibitively high.

The objective of this article is to compare re-estimated results from Jekyll Island with those from another Georgia barrier island, Tybee. It is located 18 miles from a major metropolitan area, Savannah, and therefore has a higher visitation level than Jekyll. Tybee has been densely developed in single-family residences and condominium units, and most of the land is privately owned. Buildings on Tybee have historically been threatened by coastal erosion. The problem was first managed with a seawall and revetments, and there have been several beach-nourishment projects at roughly 10-year intervals. Thus, Tybee Island is more typical of the East Coast barrier islands, and a comparison with Jekyll will shed light on how the feasibility of community-based solutions to coastal management varies with the characteristics of the community.

Visitor-Survey Analysis

Data representing visitor preferences and valuations were obtained from an on-site survey. In the survey questionnaire, a map of the island presented the status quo beach conditions beside another map that showed how beach conditions would be improved. The status quo conditions depend on the continued existence of riprap and seawalls, which in turn result in an unchanged distribution of beach conditions. Respondents were asked whether they preferred the status quo beach conditions (with the prevailing parking fee of $2.00/day [on Jekyll] or $5.00/day [on Tybee]) or the improved beach conditions with a higher parking fee. Visitors were accustomed to paying this fee for parking, and we decided to use this payment method in our questionnaire design. In different versions of the questionnaire, the parking fee was increased by an amount between $0.05/day and $20/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 WTP for the improved beach. Another question asked how they would adjust their visitation at the higher parking fee, and from this the user-fee revenue was estimated[1].

The respondent received information about relocation and nourishment in the survey instrument's explanatory section on erosion-management techniques. In the valuation question itself, one questionnaire version specified beach nourishment as the policy that would bring about the improved beach conditions described and shown in photographs, another version specified relocation, and a third version did not specify a particular policy. Except for this statement, survey respondents were given identical descriptions of beach conditions and payment vehicles. This allowed examination of whether the means of achieving wider beaches influenced consumer WTP, holding other factors constant.

Data were collected during the spring, summer, and fall seasons of 1998. 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 envelope. They were asked to complete the questionnaire at their convenience and mail it back. To minimize the problems of nonresponse, if we did not receive the questionnaire after 4 weeks, a postcard reminder was sent. If there was no subsequent response within 4 weeks, an additional questionnaire was sent.

Because data were gathered onsite, frequent users will be overrepresented and nonusers will not be represented in the data. The first problem is known as endogenous stratification, while the second is truncation. Shaw shows how to correct for onsite sampling in modeling recreation demand; each observation in the likelihood function must be weighted by the inverse of the expected value of demand. Intuitively, this approach (i) corrects for endogenous stratification because each observation's weight in estimation is inversely proportional to the level of demand (i.e., frequent users receive less weight in estimation while single-day users receive a weight of one) and (ii) corrects for truncation because the resulting weighted likelihood function reflects a ratio of conditional distributions of observed demand. This ratio is equivalent to the ratio of conditional distributions of latent demand because the correction factors—the probability that the latent variable is observed—appear in both the numerator and denominator and thus cancel.

We modeled the contingent choice of survey respondents among the status quo and a randomly assigned alternative as well as the respondents' contingent behavior—stated demand under said alternative conditions. We did not model revealed demand for visits to the beach. Thus, our models differ from that of Shaw, but we follow the same logic. We use the inverse of current demand as a weight in estimating the WTP model (logit) and the stated demand model (tobit). This weight corrects for endogenous stratification of visitors by their choice of demand. Frequent users will receive less weight in estimation of each model, while those that visit less frequently will receive a higher weight. This weighting scheme, however, does not address truncation. Our estimates reflect only current users of beach resources.

Table 1 contains definitions of variables

[1] A copy of the questionnaire is available at www.georgiastats.uga.edu/jekyllsurvey.pdf.

used and the summary statistics for the corrected data. From Jekyll Island, there were 1,040 usable observations, while there were 1,146 usable observations from Tybee Island. The average household income of respondents is quite high, at about $59,000. The proportion of visitors who were county residents was much higher on Tybee because a major metropolitan area, Savannah, is close by. 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 typical 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.

Four of the variables relate to the respondent's characteristics, and most of these variables are fairly common in valuation studies. Respondents with more experience with the island beaches probably have a greater appreciation of its declining quality, and this may lead to a higher valuation of an improvement project. People with a progovernment attitude are hypothesized to be less skeptical of public-works projects, and they would therefore have a higher valuation. As suggested by Kaoru's findings, we expect that local people's valuations would be lower than that of visitors. The remaining two dummy variables are the effects from three different questionnaire versions: (a) nourishment policy versus (b) relocation policy versus (c) both policies were described and mentioned as potential policies.

Results from a Logit Model

We employed the contingent valuation method (CVM) of pricing public goods in order to estimate the economic benefits from a beach-improvement project. To make this CVM exercise as real as possible, three strategic decisions were made. First, the improved beach amenity was offered to respondents, and it was made clear they would have to pay higher parking fees for it. At both islands, a parking fee has always been collected, and for this study, it acted as an effective rationing mechanism that was quite real to people. Second, our questionnaire elicited valuations by 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 logit regression models. Third, we decided to concentrate on the value placed on this resource by those who actually use it, and therefore selected our sample from visitors to the beach.

The logit regression results are listed in Table 2. For Jekyll Island, the predicted probability of an affirmative response was .4737, which is very close to the true probability of .4740. Likewise for Tybee Island, the predicted probability was .3973, very close to the actual probability of .4094. The models were examined for the ill effects of multicollinearity, but no evidence was detected. Of the seven variables in these models, most were significantly different from zero and they had the hypothesized sign. The key economic variable, FEE, is negative and significant in both models.

Using the coefficients reported in Table 2, respondents' WTP can be calculated simply as

$$\text{(1)} \qquad WTP_i = (-\beta' X_i)/\beta_p$$

where β_p is the coefficient for the price increase variable and $\beta' X_i$ is the linear combination of variables and logit coefficients, excluding the price increase variable, for each household in the sample (Cameron). We take the weighted mean of each WTP distribution as a measure of central tendency, where the weight corresponds with the inverse of the number of trips taken. Estimated WTP on Jekyll Island (Tybee Island) is $6.54/household/day ($4.63/household/day).[2]

[2] It is also possible that nonusers of an 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.

Table 1. Definitions, Means, Standard Deviations for Variables from Beach Improvement Valuation Survey, Georgia

Variable	Jekyll Island Mean (SD)	Tybee Island Mean (SD)
Improv is 1 if alternative beach conditions preferred to *status quo*; 0 otherwise. Dependent variable for WTP analysis.	0.474 (0.263)	0.409 (0.272)
Visits is visitation days under improved conditions. Dependent variable for parking fee model.	3.203 (2.918)	3.249 (3.594)
Fee is the increase in the daily parking fee (−).	9.927 (3.918)	13.645 (4.589)
Income is the annual household income in thousands of dollars (+).	58.200 (15.969)	59.249 (16.961)
Government is for a progovernment attitude, with 10 highest (+).	5.054 (0.783)	5.091 (0.897)
Countyres is 1 if local county resident; 0 otherwise (−).	0.019 (0.072)	0.105 (0.170)
Years is the number *f* years that respondent had visited the island (+).	7.194 (5.568)	9.122 (7.631)
Nourishment is 1 if beach nourishment survey; else 0 (?).	0.216 (0.217)	0.197 (0.220)
Relocation is 1 if relocation policy survey; else 0 (?).	0.192 (0.208)	0.211 (0.226)
Number of observations	1,040	1,146

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

Results from a Tobit Model

For user-fee financing of beach improvements, the relevant question is: 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 nonnegative, i.e., people might be indifferent, and they will likely visit the beach more often. The response to the price change should be nonpositive, i.e., people may reduce their visitation or they may stop visiting an island altogether.

The survey questionnaire 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. At Jekyll Island, 20% of the respondents replied this way, while the figure at Tybee was 8%. These visitation data can be analyzed with regression methods, but ordinary least squares applied to the censored dependent variable would yield parameter estimates that are biased and inconsistent (Greene). Tobit regression is the proper method to apply to this problem.

The tobit regression estimates are reported in Table 2. Of the seven independent variables, the FEE variable is consistently significant at the 5% level. Overall, the logit models performed better than the tobit models. 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, where they estimated parking revenues at state recreational parks. The approach is to calculate parking revenue as

$$\text{Revenue} = \text{Fee} \times \text{Visits} \times \text{Visitor base}, \quad (2)$$

where Fee is the increased daily parking fee. Visitor base is the approximate number of parties that visit annually. For Jekyll Island, this was 140,000 parties and, for Tybee, it was 275,000 parties. Visits is the number of days per year that a party will visit an island at a

Table 2. Beach Improvement Valuation Survey, Logistic and Tobit Regression Results, Georgia.

	Willingness to Pay (Logit)[a]		Parking Revenue (Tobit)[b]	
Variable	Jekyll Island Coefficient (SE)	Tybee Island Coefficient (SE)	Jekyll Island Coefficient (SE)	Tybee Island Coefficient (SE)
Intercept	−0.408	−0.624*	2.529	2.212
	(0.300)	(0.269)	(1.625)	(1.584)
Fee	−0.147*	−0.131*	−0.283*	−0.182*
	(0.012)	(0.011)	(0.053)	(0.049)
Income	0.004	0.006*	0.001	0.001
	(0.002)	(0.002)	(0.001)	(0.001)
Government	0.204*	0.181*	0.207	−0.028
	(0.049)	(0.042)	(0.259)	(0.242)
County res	−0.108	−0.440*	0.962	3.193*
	(0.547)	(0.237)	(2.876)	(1.283)
Years	−0.002	−0.017*	0.018	0.032
	(0.007)	(0.005)	(0.036)	(0.029)
Nourishment	0.405*	0.581*	0.644	1.146
	(0.177)	(0.178)	(0.944)	(1.023)
Relocation	0.206	0.171	1.443	−0.072
	(0.185)	(0.170)	(0.993)	(0.997)
Ln *L*	−591.548	−648.253	−792.738	−1,037.889
Obs	1,040	1,146	1,040	1,146

[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 5% significance level.

given price increase, as predicted by the tobit model as

$$(3)\qquad \text{Visits} = \Phi(\beta'X/\sigma)(\beta'X + \sigma\lambda),$$

where $\beta'X = \beta_0 + \beta_1X_1 + \cdots + \beta_kX_k$, $\lambda = (\varphi(\beta'X/\sigma))/(\Phi(\beta'X/\sigma))$, φ and Φ are the probability density 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 Visits is conditioned on the proportion of parties that will continue to visit an island at a given fee. According to Greene, this proportion is calculated from the tobit model as

$$(4)\qquad \text{Proportion} = \Phi[(\beta'X)/\sigma]$$

Taken together, the revenue Equation (2) captures two separate effects from increasing the parking fee. A higher fee will generate more revenue, obviously, but as the fee increases, people will reduce the number of visits to the island and some people will stop visiting the island entirely. Estimates of revenues and benefits are reported in the next section.

Comparing Costs and Benefits

The costs of a nourishment project can be estimated on the basis of the 1990 nourishment project at Sea Island, GA. Located 8 miles north of Jekyll, details of the project are described in Oertel, Foster, and Graham. The nourishment initially cost $7 million for a project covering 2 miles of beach, and annual maintenance costs were $125,000. We assume that such projects last for about 10 years before the eroded sand is replenished by another project. To maintain comparability with the relocation option, it is assumed that nourishment would be carried on for 30 years, so a project

Table 3. Summary of Financial Analyses for Two Policies for Obtaining Beach Improvements, Under Two Financing Methods, Jekyll Island, Georgia.

	Beach Nourishment Policy	Relocation Policy
General-revenue financing		
Annual WTP ($ million)	6.7	6.6
Total WTP[a] ($ million)	120.6	118.6
Project costs[a] ($ million)	27.4	14.5
Net benefits[a] ($ million)	93.2	104.1
User-fee financing		
Project costs[a] ($ million)	27.4	14.5
Break-even parking fee	$4.16/car/day	$2.97/car/day
Annual revenue ($ million)	1.5	0.8
Annual WTP of users ($ million)	6.1	6.4
Total WTP[a] ($ million)	110.4	114.3
Net benefits ($ million)	83.0	99.8

[a] Indicates a present value calculated with a 4% discount rate for the project life.

conducted in 1998 would be followed by one in 2008 and again in 2018. Finally, assuming that costs would increase linearly for the 2.9 miles of Jekyll that require nourishment, then the present value of the costs over 30 years, calculated at a 4% real discount rate, would be about $27.4 million, as reported in Table 3. On Tybee, the costs of beach nourishment for the 2.0 miles of shore would be about $18.9 million, and this is reported in Table 4.

The four-category framework proposed by Parsons and Powell is used to categorize the costs of a relocation policy. GIS-based inventories of properties on both of the islands were employed. On Tybee Island, we identified 243 properties on 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. These buildings were valued at $32.6 million by the county tax assessor, and this is labeled the capital loss in the Parsons and Powell framework. Jekyll Island was less developed, and the buildings in-

Table 4. Summary of Financial Analyses for Two Policies for Obtaining Beach Improvements, Under Two Financing Methods, Tybee Island, Georgia.

	Beach Nourishment Policy	Relocation Policy
General-revenue financing		
Annual WTP ($ million)	13.3	7.8
Total WTP[a] ($ million)	240.0	141.0
Project costs[a] ($ million)	18.9	61.5
Net benefits[a] ($ million)	221.1	79.5
User-fee financing		
Project costs[a] ($ million)	18.9	61.5
Break-even parking fee	$5.65/car/day	$7.63/car/day
Annual revenue ($ million)	1.1	3.4
Annual WTP of users ($ million)	13.1	5.6
Total WTP[a] ($ million)	236.4	131.9
Net benefits ($ million)	217.5	70.4

[a] Indicates a present value calculated with a 4% discount rate for the project life.

side the erosion hazard area represented a capital loss of $2.3 million.

The second category from Parsons and Powell is the land loss. From a societal stance, the value of land lost from a relocation policy is not the value of waterfront land. This is because the relocation 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. Therefore, the loss of land value is from the land with the least amount of the beach-related amenities. The county tax assessor had reported separate valuations for the buildings and the land, so we identified a set of properties located far from the beach, estimated their mean per-acre value to be $506,000, and applied this to the estimated acreage lost. On Tybee Island, it was estimated that 43.82 acres of land would be lost to the sea. Therefore, the land loss would be approximately $22 million. Applying this same technique to Jekyll Island, approximately 31.6 acres of land would be lost with an average, amenity-free value of $287,000 per acre, for a land loss of $9 million.

The other costs of a relocation policy would include the demolition of the buildings. This cost may be as much as 15% of the buildings' value. On Tybee, this cost would be $4.9 million, while it would be $0.3 million at Jekyll. Finally, 2.0 miles of existing rock revetments would be demolished on Tybee and 2.9 miles would be removed on Jekyll. This may cost as much as $1 million per mile. These transition costs (the third cost category) total $6.9 million on Tybee and $3.2 million on Jekyll.

The final cost category considered by Parsons and Powell is the proximity loss, i.e., the loss that results when the relocation policy encourages people to build farther from the shore than they would if the beach were periodically renourished. We do not include proximity loss in our estimates. For Jekyll Island, redevelopment is not a legal option, while Tybee Island is fully developed. It is possible that future redevelopment on Tybee may take place further from the shoreline, but this is an option we do not consider. Summing the capital loss, the transition loss, and the value of lost land together produces the cost of a beach improvement project that would result from a relocation policy. For Jekyll, the costs would be $14.5 million, while for Tybee Island, the costs would be $61.5 million, as reported in Tables 3 and 4. Given the historical erosion rate, the beach improvements from the relocation policy should last for 30 years, and this is the relevant period for discounting the WTP estimates that are reported below.

A final note about the relocation option is that compensation would probably be paid to the displaced owners. From a private stance, the market value of land should be accurately reflected in the tax assessor's valuation. For Tybee Island, the land that may be lost was valued at $63.3 million. This represents the total compensation that might be paid to property owners. On Jekyll Island, there are special circumstances because all land is owned by the state government. Home owners pay the state $1/year for their land lease, and the value of land has been capitalized into the house's structural value. The tax assessor separates improvement value from land value, and this amounts to a $10.2-million-dollar land loss. Thus, if compensation is to be paid, the costs will be higher.

A benefit–cost analysis can be conducted to determine which of the two policies, nourishment or relocation, would generate higher net benefits under general-revenue financing. The two sets of benefit estimates are made by alternatively evaluating Equation (1) with nourishment = 1 and with relocation = 1. On Jekyll, a nourishment policy would be valued at $8.70/household/day (or $6.7 million/year for the number of trips predicted). Discounting these benefits for 30 years at a 4% real interest rate yields a total present value of $120.6 million. Subtracting the nourishment costs of $27.4 million yields net benefits of $93.2 million. For Tybee, the nourishment alternative is valued at $8.18/household/day, or $13.3 million/year for the expected number of visitors at the improved beach. The present value of these benefits is $240.0 million. Given the estimated nourishment costs of $18.9 million over the 30-year period, the net benefits of $221.1 million are much larger than at Jekyll.

For the relocation option, this process is repeated. On Jekyll, total benefits would be $7.68/household/day (or $6.6 million/year), for a present value of $118.6 million. After subtracting the relocation costs of $14.5 million, there are net benefits of $104.1 million. For Tybee, the benefits from a relocation policy are $5.65/household/day ($7.8 million/year) for a present value of $141 million over 30 years. With project costs of $61.5 million, the net benefits would be $79.5 million.

These benefit and cost figures for general-revenue financing are reported in Table 3 for Jekyll Island and Table 4 for Tybee Island. One interesting result is that a nourishment policy is much more highly valued on Tybee than a relocation policy, while the valuations of nourishment and relocation are very similar on Jekyll. This might be due to Tybee's long experience with nourishment, causing people to regard it more favorably than the uncertainties that are involved with a relocation policy. It may also be that respondents are doing their own informal benefit–cost analysis and weighing the financial and political costs associated with the relocation policies in responding to the valuation question. Relocation is estimated to cost more than three times as much on Tybee as nourishment, and net benefits from the nourishment policy are also far larger. Jekyll, with its smaller housing stock and longer coastline, has the opposite situation, with nourishment estimated to cost about twice as much as relocation. The net benefits of the two policies are similar.

Overall, the value that beachgoers place on improved beach quality is estimated to be far larger than the costs of providing improved beaches, and any of the scenarios produce very large net benefits. However, there may be circumstances where it is politically infeasible to undertake these projects with general revenues raised at the local, state, or federal levels. Legislators may feel that this would be a project that primarily benefits a single county's economy and that the host county should therefore pay for it. A similar problem could arise within the host county. Inland residents may resent their tax dollars being used to benefit out-of-town visitors and the owners of homes and businesses on an island. An alternative in this case is to finance the beach improvement project through increased fees to beachgoers.

The next question is whether these communities could go it alone and finance the beach improvement alternatives by charging user fees. Again, the decision rule is that expected parking revenues should be sufficient to cover the project's cost (Randall). The project costs would be the same as they were in the case of general-revenue financing, as reported in Table 3 for Jekyll Island and Table 4 for Tybee. As before, these costs are for 30-year project lifetimes discounted at a 4% real interest rate.

By alternatively evaluating Equation (3) with nourishment = 1 and = 0 and with relocation = 0 and = 1, two sets of increased parking fee revenues were estimated. For Jekyll Island, a daily fee increase of $2.16 (to a total parking fee of $4.16 per day), discounted at 4% over 30 years, would raise the additional revenue needed to finance beach nourishment. To finance the relocation policy, a daily fee increase of $0.97 (or a $2.97 total fee), would generate $14.5 million, which would cover the costs. For Tybee Island, the nourishment policy would require a fee increase of $0.65 (or $5.65 per day total) while the relocation policy would require a $2.63 fee increase, discounted over 30 years at 4%.

Therefore, user-fee financing via a modest increase to the existing parking fee is a viable alternative on both islands. We now examine how the net benefits of the projects are affected by user-fee financing. Both islands currently collect parking fees, so that part of costs does not change under either method. The beach improvements will be the same under either financing method, so people will have the same WTP. Benefits will be lower under user-fee financing because trips taken under the old fee structure whose value is less than the new parking fee will now not be made. The question is how large this effect is and how it influences net benefit measures.

The estimated tobit equations allow us to determine how much user trips will drop for any given fee. We use the same mean WTP for beach trips that we used to evaluate general-revenue financing above. This introduces a downward bias in our benefit estimates because excluding the lowest valuations should increase mean WTP for the remaining population. For Jekyll, aggregate benefits, discounted at 4% over 30 years, are $110.4 million under nourishment and $114.3 million under relocation. The discounted net benefits are $83.0 million and $99.8, respectively. These are only slightly smaller than the general-revenue estimates. This results from the fact that the parking fee estimates are not large enough to cause a significant drop in the number of trips taken.

For Tybee, user-fee financing under nourishment results in aggregate benefits of $236.4 million and net benefits of 217.5 million—again, very similar to those for general-revenue financing. The additional $0.65 has only a slight downward effect on user numbers. For relocation, the aggregate benefits of $131.9 million and net benefits of $70.4 million show a somewhat larger reduction from general-revenue financing, but still does not significantly change the economic viability of the project.

Conclusions

This analysis has compared two very different barrier island communities in order to gain additional insight into the feasibility of community-based solutions to the problems of coastal management. The question of user-fee financing viability is answered unambiguously in the affirmative for both Jekyll and Tybee. The drops in usage resulting from necessary fee increases are relatively small, and the net benefits of the projects are of similar magnitude under both financing schemes for all cases analyzed. Care should be taken in generalizing these results—in particular, coastal locations that have nearby substitutes may find much larger drops in usage from fee increases. However, our results indicate that such an approach should be economically feasible on the Georgia coast.

The preceding analysis allows us to draw some conclusions about the nourishment versus relocation debate. At Jekyll Island, a community where there is a tradition of public management of coastal land and relatively low development density, the two management options show very similar net benefits. This occurs because the slightly higher valuation that beachgoers put on a nourished beach is made up for by the lower predicted costs of implementing the relocation option. On Tybee, the differences between the two options are huge—both because beachgoers' valuation of a nourished beach is 45% higher than for the relocation option and because the management costs are more than three times as large.[3] All of this suggests that relocation will be a more viable option in less densely developed areas and locations where beachgoers do not have strong reactions to anticipated political and equity costs of implementing a relocation policy.

Finally, our results indicate that beachgoers place a high value on better-quality beaches and that this value is significantly larger than the estimated costs of achieving improved beach quality under either nourishment or relocation management. Investing in better beaches is an economically attractive use of resources on the Georgia coast.

To what extent are these results applicable to other beach communities? While it remains an empirical question, we suspect that the magnitude of beachgoer's WTP for improved beach quality is sufficiently large that the majority of beach resort communities suffering

[3] We note that these conclusions differ from Landry, Keeler, and Kriesel primarily because of different methods. The analysis of Landry, Keeler, and Kriesel (i) uses a different approach for estimating WTP of beach users, (ii) employs simulation methods to estimate the benefits and costs of relocation, and (iii) utilizes different cost estimates. In particular, the simulation approach to analyzing relocation allows for changes in the value of the housing stock on Tybee Island, which alters the resulting costs and benefit of relocation significantly. Given the limitations of the *ex ante* hedonic price model for predicting *ex post* benefit and costs, losses are lower-bound estimates. Last, the predicted number of structures lost under a relocation scenario may be downward biased in this analysis, as it was based on a random sample of single-family homes, ignoring condominiums and other types of multifamily dwellings.

from erosion would find it economically viable to improve their beaches. Whether relocation or nourishment is a better strategy has ecological and political dimensions that are likely to be at least as important as net-benefit measures. We can tentatively draw two conclusions that bear on this larger debate. First, the economic attractiveness of nourishment versus relocation depends heavily on the size and quality of the affected housing stock. Second, whether it is preferred to nourishment or not, relocation may well show substantial net benefits relative to no action.

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