Some Consumer Surplus Estimates for North Carolina Beaches

RUNNING TITLE: Consumer Surplus for NC Beaches

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Abstract *We estimate consumer surplus of a beach day using the single-site travel cost method. On-site visitation data for seven North Carolina beaches were collected between July and November of 2003. A pooled count data model corrected for endogenous stratification is estimated to account for bias stemming from on-site sampling. We allow for heterogeneity across sites through intercept-shifting and demand slope-shifting dummy variables. The estimated net benefit of a day at a beach in North Carolina ranges between $21 and $72, depending upon the site. These estimates are of the same order of magnitude as the results from earlier studies using travel cost methods but are considerably larger than the previous findings based upon stated preference methods.*

Key words Travel cost, consumer surplus, beach access.

JEL Classification Codes D12, D63, H31, Q26.

Introduction

Ocean beaches are threatened resources. Erosion is actively occurring along 80-90 percent of the eastern U.S. coastline, with estimates at approximately one meter of beach width lost, on average, on developed shorelines each year (Galgano and Douglas, 2000). North Carolina's coast has experienced beach erosion due to both sea level rise and coastal storms. Ironically, it is coastal development that disrupts the fragile balance of nature; static land use configurations do not allow sufficient flexibility within the dynamic coastal zone. The Cape Hatteras Lighthouse provides evidence of the dynamics of the North Carolina coast. The lighthouse stood about 1,500 feet back from the waves when it was erected in 1870, but by 1999 that distance had been reduced to less than 200 feet (http://whyfiles.org/091beach/index.html). The lighthouse was subsequently moved a quarter mile back from the ocean, a response which was enabled by the lack of development on Cape Hatteras National Seashore. Due to the density of development, this type of response is not available in the typical beachfront community.

Many coastal communities in North Carolina, such as Wrightsville, Carolina, and Kure beaches, have implemented beach nourishment projects in order to preserve beaches and coastal development. According to a recent report by North Carolina Sea Grant, from 1965 to 1998 the Carolina Beach program has cost $26.3 million and the Wrightsville program has cost $16.7 million (NC Sea Grant, 2000). While the costs of such projects are substantial, with millions of dollars from public funds, there is a dearth of scientific research on the value of beach resources. Freeman (1995) notes (i) the lack of studies which provide estimates of the value of access to beach resources and (ii) a paucity of information on how values change with site quality. In light of the potential for sea level rise, the former values appear fundamental in devising an optimal policy response. How much money should be spent on preserving beaches depends upon their value as recreational resources, what people are willing to pay to preserve beaches for future generations, as well as any non-use values related to ecosystem integrity or habitat preservation. It is difficult to justify the use of scarce public resources in protecting beaches without some knowledge of the value such beaches provide.

This study provides some empirical estimates of the value of a beach day for the average visitor within a travel cost method framework. Ocean beaches are unique resources found on the coastal fringe. The Atlantic and Gulf regions of the United States have approximately 4,300 miles of ocean coastline, most of which exhibits sandy beaches. The wide appeal of coastal beaches is made apparent when one considers how far many households will travel to spend time at the beach. Beaches are the leading tourist destination, with historic sites and state and national parks a distant second. Approximately 180 million Americans visit the beach each year, making about 2 billion visits, almost double the trips to national and state parks and other wilderness areas (Houston, 1996). The time and money that households expend in traveling to beaches are a signal of the value of these resources. The travel cost model (TCM) makes use of this basic idea, applying the basics of demand theory to recreational resources. Such models can be used to estimate the value of a beach day, as well as to value changes in exogenous factors that affect the recreational experience, such as site quality and congestion.

Data were gathered on-site at seven ocean beaches in North Carolina. In order to obtain a stronger representation of beach visitation including both peak and non-peak beach seasons, the survey was administered from July to November of 2003. While on-site sampling is a cost-effective sampling strategy, especially when a small percentage of the population may visit the particular site of interest, avid users are more likely to be included in the sample than occasional users; this is the problem of endogenous stratification. We estimate a pooled count data model that is corrected for endogenous stratification (Shaw, 1988). Our results indicate net benefits per person per beach day range between $21 and $72, depending upon the site. These estimates are comparable to the results of a previous study that examined the value of a beach day in Florida, but somewhat larger than results for New Jersey beaches derived from a stated preference approach.

On the Value of Beaches

While earlier studies have focused on estimating the value of a change in beach quality, such as beach width or water quality, less attention in the literature has been given to examining the value of access to beach. In this paper, we provide some consumer surplus estimates for access to seven North Carolina beaches utilizing pooled travel cost data. We use the framework of the single-site model, but pool data for seven different sites allowing for heterogeneity in the intercept and slope of the demand curve. Consumer surplus is offered as an approximation of willingness to pay for access. Surprisingly, to our knowledge there is only one other paper in the literature that utilizes the single-site TCM to value a beach day. Using the single-site model, Bell and Leeworthy (1990) estimate the value of a beach day in Florida at $34 (1984 U.S. dollars (USD)) for those households traveling great distances.[1]

An alternative approach is to consider household site selection via the random utility model (RUM). The RUM allows for a consideration of multiple recreation sites in a single model. The RUM is often used to estimate the value of quality changes across different sites. Feenberg and Mills (1980) and Bockstael, Hanneman, and Kling (1987) use a RUM to estimate the value of decreasing water pollutants at Boston-area beaches. Feenberg and Mills estimate that a 10% decrease in oil, color, and bacteria produces benefits of $1.17 per person per year

(1974 USD). Bockstael, Hanneman, and Kling find that the compensating variation estimate of a 30% reduction in oil, turbidity, chemical oxygen demand, and fecal coliform is $12.04 per season for all Boston beach areas and $6.13 per season for downtown Boston beaches (both values in 1974 USD). Parsons, Massey, and Tomasi (1999) use a RUM to model beach visitation decisions in the Northeast U.S. They estimate value of lost beach width at $5.78 - $10.94 per person, per trip (1997 USD). McConnell and Tseng (2000) use a random parameters logit model to estimate the value of increased fecal coliform counts at Chesapeake Bay beaches. Doubling fecal coliform counts engendered losses of $1.12 per individual per trip for one site and $8.79 per individual per trip for all 10 sites in their model (1984 USD). Murray, Sohngen, and Pendleton (2001) use a RUM to estimate the value of reducing water quality advisories at Lake Erie beaches in Ohio. They find that the benefit of reducing one advisory is about $28 per person per year (1998 USD).

While the RUM is most often used to estimate the value of changes in site quality, it can also be used to estimate the monetary value that would compensate the average household for elimination of a site from their choice set—this is roughly equivalent to the value of access derived from the single-site TCM. Parsons, Massey, and Tomasi (1999) estimate the impact of beach closures range from $0.00 - $16.85 per person per trip across six sites (1997 USD). McConnell and Tseng (2000) estimate the value of lost beach sites at $1.94 and $3.55 per individual per trip, depending upon the site.

Other researchers have used the stated preference approach to value some aspect of beaches. This method utilizes hypothetical market data to estimate benefits. For example, McConnell (1977) uses the stated preference approach to examine how recreational benefits vary with beach congestion and applies his results in an estimation of optimal crowding at five Rhode

Island beaches. Bell (1986) conducts a telephone survey of Florida households and asks them to state their willingness to pay for the right to use Florida beaches. His results suggest the average Florida resident is willing to pay $1.41 -$1.71 (1984 USD)[2], depending upon congestion. Smith, Zhang, and Palmquist (1997) estimate willingness to pay (WTP) to cleanup marine debris on beaches in North Carolina.

The stated preference method has been used to estimate the value of improved beach width. Landry, Keeler, and Kriesel (2003) estimate WTP for improved beach width at $6.75 - $9.92 (1996 USD) per household per day on Tybee Island, Georgia. They find WTP increases with beach width and varies with the policy implemented to increase beach width. Similar results are found in Kriesel, Keeler, and Landry (2004): $6.06 - $7.71 (1998 USD) per household per day for improved beach width on Jekyll Island, Georgia.[3] Shivlani, Letson and Theis (2003) estimate mean WTP for increases in beach width at $1.69 (1999 USD) per household per visit in Florida. Willingness to pay increases to $2.12 per household per visit (1999 USD) when sea turtles are identified as additional beneficiaries of the beach nourishment project. Silberman and Klock (1988) estimate WTP for a day at the beach before and after a beach nourishment project in New Jersey. Mean daily WTP before nourishment is $3.60; mean daily WTP afterward is $3.90 (1985 USD). They find a larger effect on visitation rather than benefits per day, suggesting that the TCM could play a central role in benefit estimation. Building upon this idea, Hanley, Bell, and Alvarez-Farizo (2003) use a random effects negative binomial model with revealed and stated trips to British beaches under different water quality conditions to estimate the value of improvements. Consumer surplus per individual per year after improvements was 5 pounds, 81 pence (year not specified).

While the literature on the value of beach resources has grown since Freeman (1995), the growth has been rather modest. Most of the recent additions to the literature value changes in site quality. Given the interest in hypothetical site quality changes, most of the recent literature utilizes stated preference methods. The rationale for this focus is clear—site quality can be controlled through policy measures. Thus, valuation of changes in site quality is directly applicable to policy analysis. While certainly useful, care must be taken with this method, as it is prone to some noted sources of bias (Mitchell and Carson, 1989).

Estimates of the value of access to beach sites may become increasingly important as sea level rise threatens developed ocean beaches. The value of beach access is perhaps a more fundamental concept that should provide guidance in decisions regarding beach management under sea level rise. Existing estimates for Florida beaches relate to residents (Bell, 1986) or visitors (Bell and Leeworthy, 1990), but are somewhat outdated. The stated preference estimates for New Jersey beaches from Silberman and Klock (1988) are also rather old. Parsons, Massey, and Tomasi (1999) and McConnell and Tseng (2000) provide estimates of the losses engendered by eliminating beach sites for the Northeast U.S. and Chesapeake Bay, respectively. This is a surprisingly small set of results for an apparently very valuable resource that is likely to become increasingly threatened in the future. Our objective is to provide more evidence on the value of beaches, and to do so in a geographic region for which the value of access has not been estimated.

Data

This study uses visitation data from seven North Carolina beaches collected on-site between July 2, 2003 and November 2, 2003. The survey was performed at Cape Lookout National Seashore, Hatteras Island, Fort Macon State Park, and Pea Island National Wildlife Refuge, the Rachel Carson National Estuarine Research Reserve, Topsail Island, and Wrightsville Beach. These locations were selected because they represent a cross-section of North Carolina beaches, with variation in geographical distribution and beach characteristics, including the number of visitors present during peak beach season, beach population density, level of development/commercialization, presence of lifeguards, wave energy, presence of visible wildlife, accessibility, and on-site facilities. Figure 1 shows the geographical distribution of these seven beach areas.

The data were collected on-site via a self-reported survey questionnaire. Efforts were made to sample at different times and on different days of the week to acquire the most representative sample possible. During the sampling period, each beach was surveyed at least once every third week on alternating days of the week. Data were collected approximately ten days per month. The questionnaire addressed several questions relating to the distance traveled and the number of visits for this beach in the past year as well as demographic information such as race, marital status, and income. Table 1 provides summary statistics for the variables used in this study.

Item-nonresponse to the income question was somewhat high, about 12%. A regression equation was used to predict the logarithm of household income as a function of education, race, marital status, age, and region. The predicted value was used for those households that did not report income, and the dummy variable MISSINC was set to one. The results are given below, with standard errors in parentheses.

$$\ln(\text{INCOME}) = \underset{(0.305)}{7.802} + \underset{(0.214)}{0.210}*\text{HSCHOOL} + \underset{(0.214)}{0.520}*\text{BACHELOR} + \underset{(0.217)}{0.528}*\text{POSTBAC}$$

$$- \underset{(0.091)}{0.206}*\text{NONWHITE} + \underset{(0.059)}{0.594}*\text{MARRIED} + \underset{(0.012)}{0.103}*\text{AGE} - \underset{(0.0001)}{0.001}*\text{AGE}^2$$

$$+ \underset{(0.094)}{0.058}*\text{NORTH} + \underset{(0.064)}{0.195}*\text{MIDATL} + \underset{(0.108)}{0.009}*\text{MIDWEST} \quad [1]$$

$R^2 = 0.4383$; F-stat = 41.66; P-value for F-stat < 0.0001.

The baseline region is the southeast U.S.

While most variables were based on what beach visitors reported, we estimated the trip costs based on an objective measurement of distance from the respondent's home to the beach site. Distance to the site is calculated using the visitor's hometown zip code and each beach's zip code. We use 35 cents times the round trip distance to the site as an estimate of travel costs, which reflects fuel and vehicle maintenance costs. Opportunity costs of the travel time are estimated as a fraction of annual income. Previous studies have put that fraction at somewhere from one third of wage rate to the full wage. We use one third of annual income divided by 2080 as a proxy for an individual's hourly wage. Assuming the average travel speed of 55 miles per hour, we divide the round-trip distance by 55 and multiply it with the opportunity cost of time to measure the value of travel time. There are no access fees to any of the beach areas that were included in this study. Average distance traveled was 419 miles at an estimated round-trip cost of $455. Travel costs to the substitute sites were measured in a similar way. Substitute sites were identified in the survey data. However, not all respondents indicated a substitute site. These households were assigned a substitute site based on their city/state cohort, and the ASSIGN dummy variable was set to one. We restrict our analysis to those households traveling less than 1000 miles and those households that do not own property on-site.

Methods

This study estimates the consumer surplus of seven beaches in North Carolina using the travel cost method which is based on the simple idea that visitors who live far away from desirable sites pay high travel costs (price) and take fewer trips (quantity) than visitors who live closer, *ceteris paribus*. Combining the travel costs and the number of trips enables researchers to estimate the demand function for recreational use of the sites.

Suppose that the consumer's utility function depends on the number of visits to a recreational site, x, and the quantity of composite good, q. The round-trip travel cost associated with a visit to the site is given as p. With the price of the composite good normalized to equal one, the consumer's budget constraint is given by $px + q \le y$, where y is income. The consumer's optimization problem is to maximize her utility function, $U(x, q)$, subject to the budget constraint. Utility maximization with interior solutions leads to the standard Marshallian demand function for recreational use of the site: $x = f(p, y)$. Often this demand function is estimated with the travel costs to substitute sites and other demographic factors that shift the demand curve as well as the travel costs to own site and income.

The dependent variable in travel cost models is associated with a data generating process for non-negative integers, known as count data process. A simple count data model that satisfies the discrete probability density function and non-negative integers is the Poisson model. The Poisson probability density function is given by

$$f(X = x) = \frac{e^{-\lambda}\lambda^{x}}{x!}, \quad x = 0, 1, 2, \cdots \qquad [2]$$

where the parameter λ is both the mean and the variance of the random variable X, trips to the site, and takes strictly positive values. Because $\lambda > 0$, it is common to model the conditional mean as an exponential function: $\lambda = \exp(\boldsymbol{z\beta})$ where $\boldsymbol{z}$ is the vector of demand arguments and $\boldsymbol{\beta}$ is the vector of parameters. These parameters are estimated by the method of maximum likelihood estimation.

In estimating the Poisson model, we correct for selection bias resulting from on-site sampling. When the sample is drawn from an on-site survey, more frequent users are more likely to be drawn. This problem is known as endogenous stratification and causes bias and inconsistency in the estimates of λ_i and β_j (Shaw, 1988). To correct for endogenous stratification in the Poisson model, one simply runs the standard Poisson regression utilizing x-1 instead of x as the dependent variable. The means in Table 1 are corrected for endogenous stratification by weighting by the inverse of the expected value.

The Poisson model assumes that the conditional mean and the variance are equal, which can be a strong assumption and a potential source of misspecification for many recreational demand model data sets. The variance is often larger than the conditional mean in these data sets (i.e., overdispersion). The negative binomial model is an alternative to Poisson that allows for overdispersion of the conditional mean. Englin and Shonkwiler (1995) provide the likelihood function for this model. To allow for overdispersion, we also estimated the negative binomial model, but fail to reject the null hypothesis that the coefficient for the overdispersion parameter is equal to zero. Thus, our results suggest that the Poisson model is the preferred specification.

Given the limited data, we pool all seven sites in one model. We account for site heterogeneity through intercept-shifting dummy variables and slope-shifting dummy variable (for own travel cost coefficient only). The baseline case is Cape Lookout. We assume all other covariate effects are equal across sites—an assumption that cannot be tested with the data. The estimated Poisson model included all continuous covariates expressed as logarithms. This form provided the best fit to the data. Welfare estimates were robust to the alternative specifications. In our case, consumer surplus for access to the site is given by:

$$CS_i = -\frac{\tilde{\lambda}_i}{\tilde{\beta}_j} \times p_{ij} \qquad [3]$$

where CS_i denotes the estimated consumer surplus for individual *i*, $\tilde{\lambda}_i$ is expected number of visit for individual *i*, $\tilde{\beta}_j$ is the estimated slope of the demand curve for site *j*, and p_{ij} is travel cost for individual *i* to site *j*.

Results

Estimation results for the endogenous stratified Poisson model are shown in Table 2. Given our specification, the coefficient estimates for the continuous variables are elasticities. Most of the variables are significant and consistent with prior expectations. The negative and significant coefficient for own travel costs indicates that the number of trips is inversely related to own travel costs, implying a downward sloping demand curve. The slope coefficients for most sites are significantly different from that of the base category (Cape Lookout), with the exception of Topsail Island. For Cape Lookout, the estimate indicates that a 1% increase in travel costs results in a 0.86% decrease in the number of trips. The marginal effect, evaluated at the observed means, shows that a \$100 increase in travel costs results in a decrease of 0.46 trips per year. The coefficient estimate for Rachel Carson National Estuarine Research Reserve indicates an inelastic demand, ε_p^{Carson} = 0.475. The rest of the coefficients indicate elastic demand, ranging from 1.035 (Wrightsville Beach) to 1.995 (Fort Macon).

The coefficients for the travel costs to substitute sites are, as expected, positive and significant which suggests that those households with higher travel costs to substitute sites make more trips, *ceteris paribus*. A 1% increase in travel costs to a substitute site causes about 0.1% increase in the number of trips to the sites of interest. The effect of income on the number of trips is positive and significant which is consistent with our expectations. Beach recreation at the study sites is a normal good, *ceteris paribus*. The binary variable for visitors with a high income above $100,000 is statistically insignificant; this variable was included to control for censoring of income for those households with income greater than the highest income category. The negative coefficient on the missing income variable suggests that people who did not report their income make fewer beach trips.

The effects of education on the number of trips are somewhat less pronounced. While people with a post-baccalaureate degree tend to make more trips than people with a high school degree, people with a college degree do not differ from people with a high school degree. Male respondents are less likely to visit beaches, while members of any environmental or conservation groups are more likely to visit. Evaluated at the observed means, male respondents tend to take 1.19 fewer trips than female respondents, and members of any environmental or conservation groups take 0.63 more trip in a year than others. Ethnicity and marital status do not seem to affect demand for beach trips.

The Poisson model is used to estimate consumer surplus for the seven North Carolina beaches via equation [3]. The elasticity (β_j) used in calculating [3] is site-specific, as suggested above. Table 3 presents consumer surplus estimates expressed as value (in 2003 USD) per person per day. Means are calculated using the inverse of the expected number of trips as a weight in order to correct for endogenous stratification (Shaw, 1988). Consumer surplus is an approximation of the net benefits of a day at the beach. Our estimates of consumer surplus range from $21 to $72 per person per day. Mean consumer surplus per person per day is $20.59 for

Fort Macon State Park, $28.31 for Hatteras Island, $43.13 for Wrightsville Beach, $43.18 for Pea Island National Wildlife Refuge, $56.86 for Topsail Island, $71.71 for Cape Lookout National Seashore, and $72.35 for the Rachel Carson National Estuarine Research Reserve.

Ideally, we would like to have accounted for quality differences in the beach sites in demand estimation, but information was limited, and what information was available has little explanatory power. One important site characteristic is beach congestion (i.e. number of persons per unit area), as this can impact the quality of the recreational experience. The literature on outdoor recreation suggests a consistent but weak relationship between use levels and congestion measures of experiential quality. For example, Stewart and Cole (2001) found that Grand Canyon backpackers were negatively affected by encountering more groups, but the resultant effect was small. While many of these studies concluded that increasing numbers of encounters lead to lower satisfaction with the overall experience (Graefe et al., 1984; Manning, Valliere, Minteer, Wang & Jacobi, 2000), other studies suggest that, depending on the setting and individual expectations, higher numbers of people can actually increase visitor satisfaction (Ditton, Fedler, & Graefe, 1983). In situations where people are expecting, if not desiring, crowds as a part of their experience, congestion can be a positive factor.

The only information available in this study regarding congestion was a count of the number of people in sight of our surveyor while administering the survey. Our surveyors counted the number of people in their near vicinity every hour. Average congestion levels at each site are included in Table 3. While we would like to account for this quality attribute in modeling demand, observed congestion at one point in time clearly cannot be linked to the number of trips that a household makes in a year. Congestion at any point in time is a random observation that may not be representative of the site at other times, and the overall level of congestion that the household experiences during their times at the beach may vary substantially over the course of one trip and over the course of a year.

Without a good proxy for the household's experience with congestion while on-site, we are forced to use secondary measures to examine the relationship between recreational value and congestion. We use the Spearman Rank-Order Correlation Test (see Siegel and Castellan, 1988). We rank each site by mean consumer surplus, with the site with highest estimated surplus receiving a rank of '1' and so forth. Next, we rank each site by availability of space. Thus, the site with least congestion receives a rank of '1' and so forth. The Spearman Rank-Order test looks for correlation among the ranks, the null hypothesis being that the two measures are independent. Our estimated rank correlation coefficient is 0.3214, which is less than the critical value associated with seven observations, a confidence level of 0.05, and a one-sided alternative—0.714. Hence, we fail to reject the hypothesis that consumer surplus and personal space are independent. Note, however, we are not controlling for other sources of site heterogeneity in this non-parametric test.

Although the travel cost method used in this study has the advantage of estimating net value based on observed behavior, it provides only a limited measure of the total benefits from beaches. Many natural resources, including beaches, can exhibit significant non-use values. People may value beaches for their role in providing wildlife habitat and protecting coastal properties from storm damage, and may be willing to pay to preserve beaches for the option of future use for themselves and perhaps others. However, these components of beach values are not reflected in our estimates, and our estimates represent only use values of current users.

Conclusions

This study provides estimates of consumer surplus for seven beaches in North Carolina. To this end, we use the travel cost model with data pooled over the seven sites. The endogenously stratified Poisson regression model is used to account for avidity bias stemming from on-site sampling. We find the net benefits of a day at a North Carolina beach range from $21 and $72, depending upon the site. These estimates are of the same order of magnitude as previous results for visitors in Florida traveling from long distances and for beach site in the Northeastern U.S. Our estimates are somewhat larger than the estimated loss from elimination of a beach site on the Chesapeake Bay, and are considerably larger than the previous findings derived from stated preference methods for New Jersey beach users and local users of Florida beaches. We hope these results provide information for practitioners and policy makers who must deal with beach preservation decisions.

Unfortunately, we were not able to fully examine the effect of site characteristics on net benefits. Results of a non-parametric ranking test (Spearman Rank-Order Correlation test) suggest that mean consumer surplus and average personal space are not positively correlated. However, our measure of congestion (presumably inversely related to personal space) is imperfect; it was based solely on an "eyeball" count of persons on the beach at the time of the interview, and it is not standardized as a measure per unit area. Thus, our conclusions regarding personal space are not based on a very powerful test. However, even with data well-suited for the purpose, we might not be able to find a clear correlation between personal space and net benefits. The reason is that visitors may exhibit heterogeneous preferences for personal space. Some visitors may desire congested beaches for the social atmosphere that they offer, while others may desire more personal space. Since the level of congestion is something that can be affected through policies (both beach nourishment and changes in access), this is an area for future research.

Footnotes

1. In their sample, the typical air traveler came from 1300 miles away, while the typical auto traveler came from 900 miles away.
2. The first measure is associated with average congestion (66.3 sqft/person) and the later associated with "optimal" congestion (115 sqft/person).
3. Both sets of estimates varied across type of policy used to improve beaches. Interestingly, beach nourishment engendered greater benefits on Tybee Island, while a policy of shoreline retreat (moving building to allow for coastal recession) exhibited a higher value on Jekyll Island.

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Table 1
Summary Statistics of the Variables

Variable	Definition	Mean	Std. Dev.
TRIP	The number of visits to the beach in the past year	2.48	4.02
DAYS	The number of days at the beach	4.68	4.37
GROUP	The number of people in the group	3.92	2.50
TCOST	Travel cost to the site	455.19	281.87
SUBCOST1	Travel cost to the substitute site 1	377.62	331.11
SUBCOST2	Travel cost to the substitute site 2	325.68	257.22
ASSIGN	Dummy variable: 1 if a substitute site assigned; 0 otherwise	0.26	0.44
INCOME	Annual household income	64936.47	30620.32
HIGHINC	Dummy variable: 1 if annual household income greater than $100,000; 0 otherwise	0.20	0.40
MISSINC	Dummy variable: 1 if annual household income is missing; 0 otherwise	0.12	0.33
BACHELOR	Dummy variable: 1 if the highest level of education is a college degree; 0 otherwise	0.38	0.49
POSTBAC	Dummy variable: 1 if the highest level of education is a post college degree; 0 otherwise	0.24	0.43
MALE	Dummy variable: 1 if male; 0 otherwise	0.53	0.50
NONWHITE	Dummy variable: 1 if racial background is not white or Anglo-American; 0 otherwise	0.08	0.27
MARRIED	Dummy variable: 1 if married; 0 otherwise	0.65	0.48
ENVMEM	Dummy variable: 1 if a member of environmental or conservation groups; 0 otherwise	0.17	0.37
AGE	Age of the survey respondent	42.31	12.63
MULTI	Dummy variable: 1 if a multiple purpose trip; 0 otherwise	0.32	0.47
CARSON	Dummy variable: 1 if Rachel Carson National Estuarine Research Reserve; 0 otherwise	0.05	0.22
HATTERAS	Dummy variable: 1 if Hatteras Island; 0 otherwise	0.19	0.40
LOOKOUT	Dummy variable: 1 if Cape Lookout National Seashore; 0 otherwise	0.07	0.26
MACON	Dummy variable: 1 if Fort Macon State Park; 0 otherwise	0.19	0.39
PEA	Dummy variable: 1 if Pea Island National Wildlife Refuge; 0 otherwise	0.16	0.37
TOPSAIL	Dummy variable: 1 if Topsail Island; 0 otherwise	0.14	0.35
WRIGHTS	Dummy variable: 1 if Wrightsville Beach; 0 otherwise	0.20	0.40

Notes: Number of observations is 416; means are weighted by the inverse of the expected value of trips to control for endogenous stratification.

Table 2
Estimation Results for the Poisson Recreational Beach Demand Model

Site	Coeff. Estimate	Standard Error	p-value
ln(TCOST)	-0.861	0.083	0.000
ln(TCOST)*CARSON	0.386	0.090	0.000
ln(TCOST)*HATTERAS	-0.977	0.178	0.000
ln(TCOST)*MACON	-1.094	0.110	0.000
ln(TCOST)*PEA	-0.450	0.129	0.000
ln(TCOST)*TOPSAIL	-0.139	0.094	0.140
ln(TCOST)*WRIGHTS	-0.174	0.082	0.034
ln(SUBCOST1)	0.111	0.034	0.001
ln(SUBCOST2)	0.088	0.045	0.052
ASSIGN	-0.341	0.079	0.000
ln(INCOME)	0.505	0.063	0.000
HIGHINC	0.047	0.087	0.588
MISSINC	-0.308	0.131	0.018
BACHELOR	-0.107	0.070	0.125
POSTBAC	0.211	0.088	0.017
MALE	-0.482	0.068	0.000
NONWHITE	0.163	0.108	0.133
MARRIED	0.073	0.073	0.321
ENVMEM	0.256	0.085	0.003
ln(AGE)	-0.355	0.100	0.000
MULTI	-0.051	0.075	0.498
CARSON	-2.235	0.364	0.000
HATTERAS	5.509	0.943	0.000
MACON	5.723	0.502	0.000
PEA	1.468	0.601	0.015
TOPSAIL	0.245	0.398	0.538
WRIGHTS	0.336	0.341	0.324
Constant	0.513	0.708	0.469
Log-likelihood	-1361.5861		
Pseudo R^2	0.4104		

Notes: Number of observations is 416; dependent variable is the log of the number of visits to the beach in the past year.

Table 3
Consumer Surplus and Congestion Estimates for Seven North Carolina Beaches

Variable	Observation	Mean(CS)	Average Congestion
FORT MACON	61	20.59	12.63
		(23.90)	(14.45)
HATTERAS	83	28.31	94.16
		(26.08)	(67.41)
WRIGHTSVILLE	73	43.13	127.64
		(42.17)	(119.62)
PEA ISLAND	53	43.18	12.96
		(51.76)	(10.48)
TOPSAIL	66	56.86	74.40
		(66.20)	(66.69)
CAPE LOOKOUT	46	71.71	20.77
		(87.38)	(11.89)
RACHEL CARSON	34	72.35	7.04
		(80.10)	(6.25)

Notes: The consumer surplus estimates are per person per day. Congestion is measured as the number of people on the beach within sight of our surveyor. Standard deviations are given in parentheses.

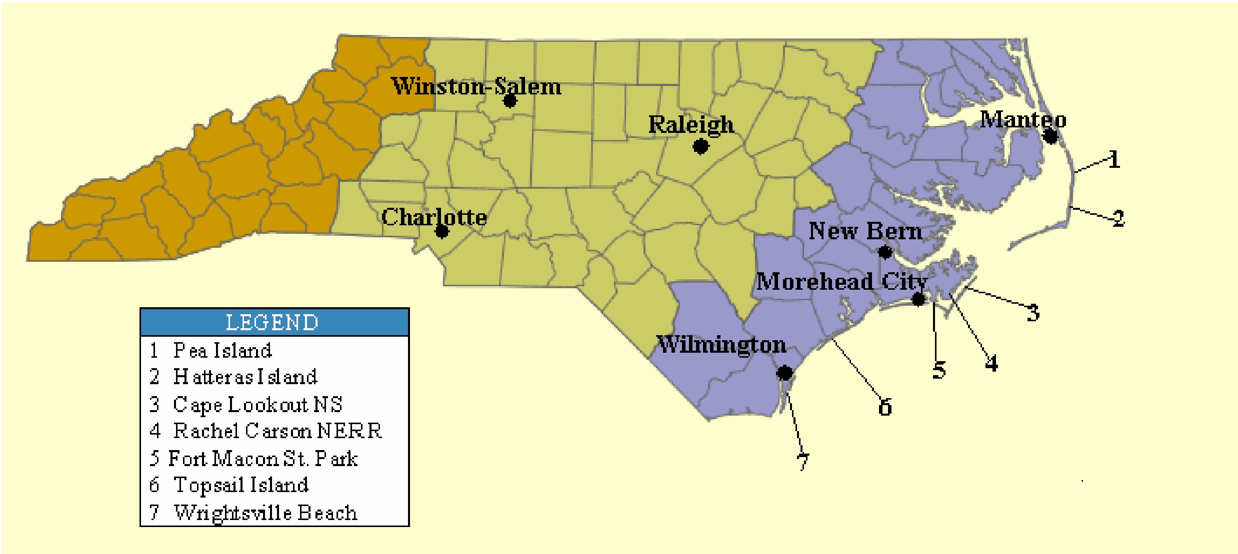

Figure 1. Map of the Seven Beach Areas in North Carolina