

## Evidence on the Amenity Value of Wetlands in a Rural Setting

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**Abstract:** This study uses a hedonic property price method to estimate how the proximity and size of the nearest wetland affects residential property values in a rural area. The study uses wetland inventory data coupled with extensive property sales records between January 2000 and September 2004 from Carteret County, North Carolina. Our results indicate that closer proximity and larger size of the nearest wetland is associated with lower residential property values regardless of wetland type. These results contrast with previous hedonic studies using data from urban areas, which found positive associations between wetlands and property values. The amenity value of wetlands appears to depend at least as much on the characteristics of the area being considered as it does on the characteristic of the wetlands.

*Key Words:* wetlands, rural area, hedonic prices, housing market.

**JEL Classifications:** D12, Q24, Q26, R21.

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## **Introduction**

Wetlands may provide valuable ecosystem services, such as habitat for fish and wildlife, flood protection, water quality improvement, opportunities for recreation, education and research, and aesthetics. Many of these ecosystem services have characteristics of public goods whose benefits are shared by a large number of people. Though wetlands may provide valuable ecosystem services to society as a whole, it is not clear that wetlands provide positive net benefits to nearby landowners. Some of the ecosystem services mentioned above may provide amenities for nearby residents (e.g., open space, aesthetics, flood protection, opportunities to watch wildlife). Conversely, wetlands may produce disamenities for nearby residents by providing breeding grounds for insects that may be vectors for disease (e.g., mosquitoes and West Nile Virus). Wetlands may limit easy mobility across terrain or inhibit economically productive activities like farming on their property (Schultz and Taff, 2004). In general, whether wetlands generate positive or negative net benefits for nearby residents is an empirical question.

Estimating the value of wetland amenities and disamenities requires the use of non-market valuation techniques because virtually all of the amenities and disamenities provided by wetlands are not directly traded in markets. The hedonic property price method uses observations on property values to infer values for non-traded goods and services such as those generated by wetlands. Observing how property values change as the level of various attributes change, such as proximity to wetlands or size of wetlands, provides a way of estimating the marginal value of these attributes to property owners.

In this paper, we use the hedonic property price method to estimate the amenity or disamenity value of proximity and size of nearest wetland in a rural area. Virtually all prior hedonic studies have been done in urban areas. We use data from Carteret County, which is a

rural county located on the Atlantic Coast in eastern North Carolina with numerous wetlands. Carteret County contains no city or town with a population over 8000. The results of the hedonic model indicate that closer proximity to wetlands is associated with lower property values. Evaluated at the sample mean (766 feet), decreasing the distance to the nearest wetland by 25% lowers a property's value by \$993 for a house with an average property value of \$157,839. Increasing the size of the nearest wetland also is associated with lower property values. Evaluated at the observed mean value (57 acres), increasing the nearest wetland size by 25% yields an estimate of \$306 in decreased property values. Both the proximity and size effects are statistically significant at the five percent level of significance.

These results contrast with result of previous hedonic studies on wetlands using data from urban areas. In urban areas, hedonic studies have generally shown that closer proximity and increased size of wetlands increases nearby property values. Lupi, Graham-Tomasi, and Taff (1991) and Doss and Taff (1996) used data from the Twin Cities metropolitan area in Minnesota and found that proximity to wetlands increases nearby residential property values. Lupi, Graham-Tomasi, and Taff (1991) found that wetlands were relatively more valuable in areas with relatively few wetlands. Doss and Taff (1996) assessed the value of different types of wetlands and found a preference for scrub-shrub and open water wetlands over forested and emergent-vegetation types of wetlands. Mahan, Polasky, and Adams (2000), used data from Portland, Oregon and found that decreasing the distance to the nearest wetland and increasing the size of the nearest wetland increased property values. In their study they did not find a clear preference for particular types of wetlands. Earnhart (2001) combined a hedonic analysis with conjoint analysis to study the value of wetlands in Fairfield, Connecticut. This study found that restored wetlands generated large positive increases in nearby property values. Proximity to

disturbed wetlands, on the other hand, generated decreases in property values. Woodward and Wui (2001) and Boyer and Polasky (2004) provide recent reviews of empirical valuation studies of wetlands including both hedonic and non-hedonic studies.

There has been little prior research applying the hedonic property price method to wetlands valuation outside of urban areas. Reynolds and Regalado (2002) found mixed results on the impact of wetlands on nearby residential property values; wooded and emergent vegetation wetlands had a negative impact on property values while open water and scrub shrub wetlands had a positive value. Shultz and Taff (2004) found negative values for wetlands on land in production agriculture, where wetlands may restrict production and profitability. There is no such effect for residential properties. In our results for rural residential properties we find that proximity to wetlands lowers property values regardless of wetland type. For Carteret County, NC, a rural area with numerous wetlands, it appears that wetlands generate negative net amenities for residential property owners.

### **Study Area and Data**

Carteret County is a rural county located on the coast of the Atlantic Ocean in eastern North Carolina. It has a total population of 59,383. The largest town in the county, Morehead City, has a population of 7,691. Historically, a large percentage of the county was wetlands. The North Carolina Division of Coastal Management (NCDCM) reports that Carteret County has about 180,000 wetland acres, which comprise about 54 percent of the total land area (NCDCM, 1999a). They estimate, however, that almost half of the original wetland acreage in eastern North Carolina has been converted to other uses. Agricultural conversion has been the largest contributor to wetland loss, but recent losses are largely due to draining and filling wetlands for

development projects. The Coastal Area Management Act of 1974 offers stringent protection for coastal wetlands in North Carolina while inland wetlands have not been specifically protected under North Carolina law (NCDCM, 1999b).<sup>1</sup> Figure 1 provides the map of Carteret County which shows the property parcels and wetlands in the county. As shown in figure 1, wetlands are plentiful and located throughout the county.

This study uses multiple data sources: property parcel data from Carteret County Tax Office; wetland inventory data from NCDCM; county boundary with the coastline data from North Carolina Center for Geographic Information and Analysis; digital flood maps from North Carolina Flood Mapping Program supported by the Federal Emergency Management Agency (FEMA); and 2000 U.S census data. Data from these sources are combined so that the attributes of the nearest wetland are attached to each property sales record along with its structural and neighborhood attributes.

The Carteret County Tax Office maintains property parcel records on all properties in the County. We use a total of 2,379 single-family residential property sales records from January 2000 to September 2004 in this study. Part of the County is on coastal barrier islands that form the Outer Banks of North Carolina. The barrier islands are primarily a vacation and resort area with many rental properties. The housing market on the barrier islands appears to be quite different from that of the mainland. Property sales data from the barrier islands are not included in this study.<sup>2</sup> Sales prices were adjusted to report figures in September 2004 dollars using a Consumer Price Index for housing. The average sales price for properties in the data set was \$157,839. The property sales data also include a series of structural attributes including the number of bathrooms, the age of the house, the square footage of the house, perimeter of the lot, and whether the property is sold within a year of being built.

The explanatory variables we are most interested in involve the effect of proximity to and size of the nearest wetland on property values. NCDCM maintains wetland inventory data for twenty coastal counties as one component of the Wetlands Conservation Plan implemented in 1992. Location, size and vegetation type of wetlands are recorded in a Geographic Information System. The data include a total of 4,833 wetlands in Carteret County. Wetlands vary widely from primarily open water wetlands to forests and grasslands that are wet only part of the year. Different types of wetlands may provide different amenities and disamenities and be valued differently. In this study, we use four categories of wetlands based upon whether it is a coastal or inland wetland and dominant vegetation type: coastal emergent vegetation, inland emergent vegetation, and inland scrub shrub, and inland forested wetlands. Coastal wetlands are occasionally flooded by tides. Such wetlands buffer storms, slow shoreline erosion, and also provide food and habitat for clams, crabs, and juvenile fish, as well as offering shelter and nesting sites for several species of migratory waterfowl. All coastal wetlands in our study area fall into the category of emergent vegetation wetlands. Emergent vegetation wetlands are usually dominated by perennial plants which are present only during the growing season, and include marsh, meadow, fen, and slough. Inland wetlands are common on floodplains along rivers and streams, and in other low-lying areas. Inland wetlands can be differentiated by their dominant vegetation: emergent vegetation wetlands, scrub shrub wetlands, and forested wetlands. Scrub shrub wetlands are dominated by woody vegetation less than 20 feet tall. Forested wetlands are characterized by woody vegetation that is 20 feet tall or taller. A total of 740 wetlands are classified as coastal wetlands and 4,093 are inland wetlands. Among the inland wetlands, 119 wetlands are classified as emergent vegetation wetlands, 1,653 are scrub shrub wetlands, and 2,321 are forested wetlands. Table 1 shows the distribution of wetland types and

the percent of land in County. Distance to the nearest wetland for each residential property is measured in feet from the centroid of the property to the edge of the nearest wetland. The average distance to the nearest wetland is 766 feet. The average size of a wetland is 57 acres. About 17% of residential properties in the data set have coastal emergent vegetation wetlands as the nearest wetland type, 5% have inland emergent vegetation, 49% have scrub shrub, and 30 % have forested wetlands as the nearest type.

The mainland part of the county is separated from the barrier islands by Pamlico Sound and other intracoastal waterways (hereafter referred to collectively as “the sound”). Close proximity to the sound is highly desirable. We measure the distance to the sound for each residential property using GIS information on the county coastline that delineates the boundary of the sound. The average distance to the sound for the properties is about one mile (5,197 feet). We also have information on whether a property is located within a floodplain or not. Digital flood maps created with the support from the FEMA are used to identify the properties within the floodplains that would flood in a 100-year flood event (i.e., areas with a 1.0 percent chance of flooding in a year). One might expect properties within floodplains to sell at a discount reflecting the additional risk. Bin and Polasky (2004) find a discount for floodplain location in a nearby county in eastern North Carolina. About 9% of houses in our data set are located in a floodplain.

In addition, we calculate the distance of each property to regional business centers (New Bern and Jacksonville, NC), nearest highway, railroad, regional airport, as well as the nearest park or preserve area (forest and game preserves). Distances to these features are measured as the Euclidean distance in feet from the centroid of the property to the nearest edge of a feature. We control for unobserved heterogeneity across townships using a set of dummy variables

representing the fifteen townships in the county. We also control for whether the property is located within a municipality or not. Finally, we include the percent of owner occupied properties by census track from the 2000 U.S. census data and mean travel time to work in minutes by census track. Palmquist, Roka, and Vukina (1997) also used commute time by census track in their hedonic study of the effects of hog operation on property values in eastern North Carolina. Table 2 provides the definition and description of the variables used in this study. Summary statistics are presented in table 3.

## Methodology

This study uses the hedonic property price method to estimate the effects of the proximity to and size of the nearest wetland on property values. Since Rosen (1974), numerous studies have applied hedonic property price models to estimate the value of various environmental amenities or disamenities (see Palmquist, 2004 for a summary).

Let  $S_i$  represent a vector of structural characteristics of the  $i^{\text{th}}$  house, such as age, square footage, and number of bathrooms. Let  $N_i$  represent a vector of neighborhood characteristics of the  $i^{\text{th}}$  house, such as distance to business center, and commute time to work. Let  $W_i$  represent a vector of environmental characteristics for the  $i^{\text{th}}$  house, such as the distance to and size of the nearest wetland. The housing market is assumed to be in equilibrium, which requires that households optimize their residential choice based on the prices of alternative locations. The hedonic price function can be written as:

$$P_i = P_i(S_i, N_i, W_i). \quad (1)$$

We estimate the following hedonic price function,

$$\ln P = \alpha + \sum_i \beta_i S_i + \sum_j \gamma_j N_j + \sum_k \psi_k W_k + \varepsilon, \quad (2)$$

where  $\ln P$  is the log of sales price, and  $\varepsilon$  is an independent random error term. We use the logs of the distance-related variables and the size of nearest wetland to capture diminishing marginal effects. It seems reasonable to expect that the effect of distance on property value will decline with distance rather than being constant. Given our specification, the coefficient estimates for log transformed variables represent elasticities. We use quadratic specifications for non-dichotomous structural variables such as total structure square footage and age of house. We experimented with several alternative specifications and found that the primary results are robust to alternative functional forms. White's method is used to obtain a consistent estimator of the covariance matrix to get estimates of the standard error corrected for potential heteroskedasticity (White, 1980).

We estimate two hedonic price models in this study. First, we estimate the model without distinguishing the type of the nearest wetland. It is implicitly assumed that what matters to property values is the proximity and size of the nearest wetland regardless of its type. Second, we allow for heterogeneity across the wetland types through the slope-shifting dummy variables. Interaction terms of the wetland types with both the distance and the size of the nearest wetland are included in the regression. This model shows whether the effect of distance and size of the nearest wetland differs across wetland types.

In the following section, we report the estimation results and the marginal effects of the explanatory variables on property values. The marginal effect for the dummy variables is equal to price times the coefficient. For distance related variables, which are log-transformed, the marginal effect is price times the distance coefficient divided by the distance. All marginal effects are evaluated at the observed mean values. For distance related variables, marginal

effects are evaluated as the distance increases by the range between 10% and 50% from the sample mean.

### **Estimation Results**

We present estimation results in tables 4 and 5. The results for the model in which we do not distinguish between types of the nearest wetland are shown in table 4. As shown in table 4, most variables are statistically significant, and signs of most coefficients are consistent with common findings in the hedonic price literature. The estimation results suggest that closer proximity to the nearest wetland lowers property value. The coefficient on proximity is statistically significant at any conventional level of significance ( $p\text{-value} < 0.0001$ ). Note that for distance-related variables, a positive (negative) relationship to the dependent variable means that closer proximity to the features decreases (increases) property value. Estimated marginal effects show that, evaluated at the mean value (766 feet), decreasing distance to the nearest wetland by 25% (192 feet) lowers the property value by \$993 for a house with an average property value. If the distance to the nearest wetland decreases by the range between 10% and 50%, the reduction in property values would range from \$397 to \$1,987. The coefficient for the size of the nearest wetland is also statistically significant and has a negative sign. Evaluated at the mean value (57 acres), increasing the nearest wetland size by 25% (14 acres) yields an estimate of \$306 in decreased property value. Again, if the size of the nearest wetland increases by the range between 10% and 50%, the reduction in property values would range from \$123 to \$613.

The estimation results in table 5 are similar to those of table 4. The specification used to generate the results in table 5 is identical to the specification used to generate table 4 with the exception of allowing for heterogeneity across wetland types through the slope-shifting dummy

variables. All the slope-shifting dummy variables for the distance to the nearest wetland are not significantly different from that of the base category (coastal emergent vegetation wetlands). The estimation results indicate that proximity to the nearest wetland lowers property values, but the type of the nearest wetland does not affect the property values. However, the slope-shifting dummy variables for the size of the nearest wetland are significantly different from that of the base category (coastal emergent vegetation wetlands) except for forested wetlands. It is interesting to note that increasing the size of the nearest scrub shrub wetland is viewed more positively than for other wetland types. Previous studies have found a preference by homeowners for scrub shrub wetlands over forested and emergent vegetation wetland types (Doss and Taff, 1996; Reynolds and Regalado, 2002).

As shown in tables 4 and 5, there is a very large premium for proximity to the sound. Decreasing the distance to the sound or the intracoastal waterways by 25% (a quarter mile) from the mean value (about one mile) raises a property's value nearly \$6,000, which represents about 3.8% of the average property value. Milon, Gressel, and Mulkey (1984) estimated a large positive value from being close to the shore. They found that property values declined 36% in moving 500 feet from the Gulf of Mexico. Other studies have also found positive though smaller values from being close to the ocean (Shabman and Bertelson, 1979; and Earnhart, 2001).

A possible reason for the negative value of wetlands is that proximity to wetlands might be related to higher risk of flooding. Prior literature on flood hazards has found that a house located within a floodplain has a lower market value than an equivalent house located outside the floodplain.<sup>3</sup> In a recent study using data from Pitt County, NC, Bin and Polasky (2004) found a statistically significant price discount for floodplain location, one that increased substantially after Hurricane Floyd in September 1999. In this study, we do not find a statistically significant

effect of location within a floodplain on property values in this study. A relatively small number of properties were located in floodplains (9%). While Pitt County suffered massive flooding during Hurricane Floyd, Carteret County did not. Bin and Polasky (2004) suggest that the risk premiums for flood hazards are closely tied to the recent experience of flooding. Controlling for flood risk by incorporating a variable about whether a property is located within a floodplain does not change the negative association between property values and wetlands in our data.

Tables 4 and 5 also show the effect of structural variables on property values. Most coefficients have the expected signs and are statistically significant. Evaluated at the average house value, our results indicate that house price increases by about \$88 per additional square foot. An additional year of age of a house lowers the estimated sales price by \$1,299 evaluated at the observed mean values. Having an additional bathroom increases estimated sales price by \$16,311. A new house sold within a year after construction lowers estimated sales price by \$6,766 (excluding the effect of age of house). Many new homes in Carteret County are sold without landscaping. Houses that are two or three years old may command a higher price because they are likely to have complete landscaping.

Most of the effects of neighborhood characteristics, shown in tables 4 and 5, have the expected sign. Location within a municipality substantially raises property value in the study area. The results indicate that proximity to the highways and regional airports lowers property value. Proximity to these features may generate greater noise, congestion, and traffic. However, proximity to railroads increased property value. Reducing the distance to Jacksonville, NC increases property values while the distance to New Bern was not statistically significant. Coefficient for the distance to parks has the expected sign but is not statistically significant. A higher percentage of owner occupied property in a neighborhood increases property values. A

one percentage point increase in the percent of owner occupied properties results in over \$600 increase in property values. Our results also suggest that commute time to work is a significant factor in home purchase decision. Given the average commute time in our data (22 minutes), increasing the commute time by one standard deviation (3.86 minutes) results in a \$7,878 decrease in property values.

## **Conclusions**

This study estimates the amenity value of wetlands to nearby residential property using data from Carteret County, North Carolina. The estimation results indicate that proximity to wetlands lowers property values, regardless of wetland type. The size of the nearest wetland is also negatively related to property values. Our results on the amenity value of wetlands provide an interesting contrast to the earlier hedonic studies in urban areas that have generally found a positive association between proximity to wetlands and property values (Lupi, Graham-Tomasi, and Taff, 1991; Doss and Taff, 1996; Mahan, Polasky and Adams 2000; Earnhart, 2001). In urban areas, both open space and wetlands may be in short supply. However, Carteret County is a rural county with lots of open space and literally thousands of wetlands. There is no shortage of either open space or wetlands. Rural landowners, therefore, may view wetlands as more of a nuisance than as an attractive (scarce) resource. Combined with the results of previous studies, our results raise the plausible hypothesis that local scarcity of an environmental resource plays a large role in determining its value. The amenity value of wetlands may depend at least as much on the characteristics of the area being considered as it does on the characteristic of the wetlands.

While the hedonic property price method has many attractive features, such as using market generated data, there are important limitations of applying this method to estimating the

value of wetlands or other environmental features. Most importantly, the hedonic property price method provides only a limited measure of total economic benefits. The estimates in this study measure only the amenity value of proximity to wetlands as perceived by nearby residential property owners. Wetlands provide many other services to society, such as water quality improvements, biodiversity, and wildlife habitat. The value of these services may not be fully reflected in property values if either they are not fully perceived by property owners, or the services are public goods. Therefore, the estimates of value generated in a hedonic study such as this typically capture only a subset of values and will not represent the full value of the amenities provided by wetlands or other environmental resources. Because many of the ecosystem services provided by wetlands are public goods to some degree, a low or negative amenity value of wetlands in a hedonic property price study is not sufficient evidence to conclude that wetlands need not be protected. However, a negative value from a hedonic study is a clear signal that nearby property owners will not have the incentive to protect wetlands. Therefore, wetlands conservation in rural areas such as Carteret County will likely have to be made on grounds other than appeals to increased property value from environmental protection. Other studies, including combined ecological and economic studies of wetland function and the production of ecosystem service, along with studies of the value of these ecosystem services, using contingent valuation or other valuation methods, are clearly necessary to provide a more complete picture on the total economic value of wetlands.

## **Endnotes**

1. Coastal wetlands are designated Areas of Environmental Concern which typically require permits for development. Areas of Environmental Concern include the estuarine and ocean system, public water supplies, and natural and cultural resource areas.
2. The structural difference between two housing markets is statistically significant. The wetland variables in the barrier island housing market are mostly insignificant, suggesting that the presence or absence of wetlands may be inconsequential for a vacation community centered on ocean and beach recreation.
3. Several previous studies have documented price reductions from location in a floodplain (Shilling, Benjamin, and Sirmans, 1985; MacDonald, Murdoch, and White, 1987; Harrison, Smersh, and Schwartz, 2001; Bin and Polasky, 2004). A common finding in these studies is that location within a floodplain lowers property values anywhere from four to twelve percent.

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**Table 1**  
**Distribution of Wetland Types in Carteret County, North Carolina**

Wetland Type	Observations	Area (square miles)	Percent of County
Coastal Wetlands			
Emergent Vegetation	740	82.30	15.83%
Inlands Wetlands			
Emergent Vegetation	119	0.71	0.14%
Scrub Shrub	1,653	92.37	17.76%
Forested	2,321	57.29	11.02%
<b>TOTAL</b>	<b>4,833</b>	<b>232.67</b>	<b>44.74%</b>

Notes: Percent of County is based upon the total land area of Carteret County (520 square miles) from 2000 U.S. census data. Wetlands that are partially drained, disturbed, and cleared are not included in this study.

**Table 2**  
**Definition and Description of the Variables**

Variable	Description
PRICE	House sales price adjusted to September 2004 dollars
TOWN1	Dummy variable for a township (1 if Atlantic, 0 otherwise)
TOWN2	Dummy variable for a township (1 if Cedar Island, 0 otherwise)
TOWN3	Dummy variable for a township (1 if Davis, 0 otherwise)
TOWN4	Dummy variable for a township (1 if Harkers Island, 0 otherwise)
TOWN5	Dummy variable for a township (1 if Harlowe, 0 otherwise)
TOWN6	Dummy variable for a township (1 if Marshallberg, 0 otherwise)
TOWN7	Dummy variable for a township (1 if Merrimon, 0 otherwise)
TOWN8	Dummy variable for a township (1 if Morehead, 0 otherwise)
TOWN9	Dummy variable for a township (1 if Newport, 0 otherwise)
TOWN10	Dummy variable for a township (1 if Sea Level, 0 otherwise)
TOWN11	Dummy variable for a township (1 if Smyrna, 0 otherwise)
TOWN12	Dummy variable for a township (1 if Stacy, 0 otherwise)
TOWN13	Dummy variable for a township (1 if Straits, 0 otherwise)
TOWN14	Dummy variable for a township (1 if White Oak, 0 otherwise)
TOWN15	Dummy variable for a township (1 if Beaufort (County Seat), 0 otherwise)
MUNICIPAL	Dummy variable for municipality (1 if within a municipality, 0 otherwise)
NEWHOME	Dummy variable for new home (1 if sold within a year after built, 0 otherwise)
BATHRM	Number of bathrooms
AGE	Year house was built subtracted from 2004
SQFT	Total structure square footage
PERIM	Perimeter of property in feet
CBD1	Distance in feet to a northbound business center (New Bern, NC)
CBD2	Distance in feet to a southbound business center (Jacksonville, NC)
HIGHWAY	Distance in feet to nearest highway
RAILRD	Distance in feet to nearest railroad
AIRPORT	Distance in feet to nearest airport
PARK	Distance in feet to nearest park, forest, and game land
OWNER	Percent of owner-occupied homes by census tract
COMMUTE	Mean travel time to work in minutes by census tract
FLOOD	Dummy variable for house within a floodplain (1 if floodplain, 0 otherwise)
SOUND	Distance in feet to sound or intracoastal waterways
WTLDDIST	Distance in feet to nearest wetland
WTLDSIZE	Acreage of nearest wetland
CSTEMG	Dummy variable for nearest wetland type (1 if coastal emergent, 0 otherwise)
INDEMG	Dummy variable for nearest wetland type (1 if inland emergent, 0 otherwise)
SCRSHB	Dummy variable for nearest wetland type (1 if scrub shrub, 0 otherwise)
FOREST	Dummy variable for nearest wetland type (1 if forested, 0 otherwise)

**Table 3**  
**Summary Statistics of the Variables**

Variable	Mean	Std. Dev.	Minimum	Maximum
PRICE	157839.42	104419.90	15000.00	1100000.00
TOWN1	0.01	0.10	0.00	1.00
TOWN2	3.78e-03	0.06	0.00	1.00
TOWN3	4.62e-03	0.07	0.00	1.00
TOWN4	0.01	0.12	0.00	1.00
TOWN5	0.02	0.14	0.00	1.00
TOWN6	0.01	0.08	0.00	1.00
TOWN7	0.01	0.07	0.00	1.00
TOWN8	0.43	0.50	0.00	1.00
TOWN9	0.15	0.36	0.00	1.00
TOWN10	2.52e-03	0.05	0.00	1.00
TOWN11	0.01	0.08	0.00	1.00
TOWN12	2.10e-03	0.05	0.00	1.00
TOWN13	0.03	0.17	0.00	1.00
TOWN14	0.20	0.40	0.00	1.00
TOWN15	0.11	0.31	0.00	1.00
MUNICIPAL	0.42	0.49	0.00	1.00
NEWHOME	0.18	0.38	0.00	1.00
BATHRM	2.02	0.59	1.00	6.00
AGE	20.48	20.88	0.00	103.00
SQFT	1705.91	580.07	288.00	6108.00
PERIM	661.04	362.61	174.24	5092.13
CBD1	155515.92	22374.02	111845.48	227417.46
CBD2	111742.57	44185.18	27273.86	289445.31
HIGHWAY	6165.16	6179.43	54.50	57446.34
RAILRD	20069.54	22617.83	39.00	141249.30
AIRPORT	45976.24	26126.89	2298.90	106592.69
PARK	9984.89	7552.02	4.02	41835.47
OWNER	79.60	9.42	34.60	92.66
COMMUTE	22.27	3.86	18.90	61.80
FLOOD	0.09	0.29	0.00	1.00
SOUND	5196.58	7842.94	2.11	36762.16
WTLDDIST	766.15	647.54	0.14	3945.44
WTLDSIZE	56.86	171.97	0.00	1276.03
CSTEMG	0.17	0.37	0.00	1.00
INDEMG	0.05	0.21	0.00	1.00
SCRSHB	0.49	0.50	0.00	1.00
FOREST	0.30	0.46	0.00	1.00

Note: Number of observations is 2379.

**Table 4**  
**Estimation Results of the Hedonic Price Function**

Variable	Coefficient	Standard Error	p-value	Marginal Effect
INTERCEPT	11.541	2.798	0.0000	
TOWN1	-0.213	0.083	0.0103	-\$33,693.61
TOWN2	-0.136	0.243	0.5763	-\$21,463.89
TOWN3	-0.529	0.152	0.0005	-\$83,448.40
TOWN4	-0.144	0.098	0.1445	-\$22,677.57
TOWN5	-0.391	0.087	0.0000	-\$61,689.77
TOWN6	-0.282	0.151	0.0622	-\$44,457.10
TOWN7	-0.337	0.182	0.0649	-\$53,160.34
TOWN8	-0.273	0.076	0.0004	-\$43,025.37
TOWN9	-0.066	0.100	0.5138	-\$10,344.52
TOWN10	0.084	0.359	0.8149	\$13,280.05
TOWN11	-0.301	0.137	0.0283	-\$47,466.35
TOWN12	-0.063	0.197	0.7478	-\$9,988.03
TOWN13	-0.406	0.076	0.0000	-\$64,030.00
TOWN14	-0.393	0.095	0.0000	-\$62,038.16
MUNICIPAL	0.072	0.017	0.0000	\$11,333.11
NEWHOME	-0.043	0.016	0.0069	-\$6,765.98
BATHRM	0.180	0.056	0.0013	\$16,311.48
BATHRM <sup>2</sup>	-0.019	0.011	0.0880	
AGE	-0.012	0.001	0.0000	-\$1,299.13
AGE <sup>2</sup>	9.76e-05	1.63e-05	0.0000	
SQFT	0.001	5.40e-05	0.0000	\$87.70
SQFT <sup>2</sup>	-8.99e-08	1.20e-08	0.0000	
PERIM	3.84e-04	6.64e-05	0.0000	\$49.11
PERIM <sup>2</sup>	-5.48e-08	1.95e-08	0.0050	
<i>ln</i> (CBD1)	0.130	0.201	0.5168	\$5,132.48
<i>ln</i> (CBD2)	-0.191	0.075	0.0112	-\$7,527.48
<i>ln</i> (HIGHWAY)	0.023	0.008	0.0032	\$917.38
<i>ln</i> (RAILRD)	-0.044	0.008	0.0000	-\$1,724.57
<i>ln</i> (AIRPORT)	0.085	0.035	0.0148	\$3,342.56
<i>ln</i> (PARK)	-0.008	0.008	0.3000	-\$333.78
OWNER	0.004	0.001	0.0002	\$603.05
COMMUTE	-0.013	0.007	0.0539	-\$2,040.91
FLOOD	0.009	0.041	0.8315	\$1,363.42
<i>ln</i> (SOUND)	-0.152	0.008	0.0000	-\$5,998.37
<i>ln</i> (WTLDDIST)	0.025	0.005	0.0000	\$993.49
<i>ln</i> (WTLDSIZE)	-0.008	0.003	0.0097	-\$306.39
Adjusted R <sup>2</sup>	0.7388			
F-Statistic	187.86			

Notes: Dependent variable is the log of sales price. Standard errors and p-values are based on the robust, heteroskedasticity corrected covariance matrix. Marginal effects are evaluated at the sample means. For the log transformed variables, marginal effects are evaluated as the distance increases by 25% from the sample means. Category omitted for township is Beaufort (County Seat).

**Table 5**  
**Estimation Results of the Hedonic Price Function (wetland type interaction terms)**

Variable	Coefficient	Standard Error	p-value	Marg. Effect
INTERCEPT	12.896	2.851	0.0000	
TOWN1	-0.193	0.085	0.0226	-\$30,471.15
TOWN2	-0.035	0.264	0.8940	-\$5,549.02
TOWN3	-0.488	0.152	0.0013	-\$77,035.05
TOWN4	-0.091	0.101	0.3676	-\$14,421.47
TOWN5	-0.378	0.088	0.0000	-\$59,627.43
TOWN6	-0.201	0.157	0.2018	-\$31,677.60
TOWN7	-0.322	0.185	0.0810	-\$50,887.81
TOWN8	-0.258	0.079	0.0011	-\$40,758.83
TOWN9	-0.061	0.103	0.5560	-\$9,551.14
TOWN10	0.157	0.395	0.6906	\$24,840.84
TOWN11	-0.236	0.146	0.1055	-\$37,183.88
TOWN12	-0.008	0.215	0.9701	-\$1,272.20
TOWN13	-0.361	0.076	0.0000	-\$57,040.48
TOWN14	-0.391	0.097	0.0001	-\$61,691.04
MUNICIPAL	0.073	0.018	0.0000	\$11,501.73
NEWHOME	-0.044	0.016	0.0057	-\$6,896.82
BATHRM	0.179	0.055	0.0011	\$16,538.34
BATHRM <sup>2</sup>	-0.018	0.011	0.0916	
AGE	-0.012	0.001	0.0000	-\$1,322.60
AGE <sup>2</sup>	9.87e-05	1.62e-05	0.0000	
SQFT	0.001	5.34e-05	0.0000	\$87.60
SQFT <sup>2</sup>	-9.07e-08	1.19e-08	0.0000	
PERIM	3.95e-04	6.74e-05	0.0000	\$50.32
PERIM <sup>2</sup>	-5.74e-08	2.00e-08	0.0042	
<i>ln</i> (CBD1)	0.105	0.203	0.6047	\$4,146.41
<i>ln</i> (CBD2)	-0.243	0.078	0.0019	-\$9,580.64
<i>ln</i> (HIGHWAY)	0.021	0.008	0.0083	\$830.68
<i>ln</i> (RAILRD)	-0.041	0.008	0.0000	-\$1,635.85
<i>ln</i> (AIRPORT)	0.050	0.036	0.1693	\$1,956.70
<i>ln</i> (PARK)	-0.010	0.008	0.2283	-\$396.36
OWNER	0.004	0.001	0.0007	\$562.77
COMMUTE	-0.015	0.007	0.0464	-\$2,340.96
FLOOD	0.023	0.041	0.5832	\$3,575.00
<i>ln</i> (SOUND)	-0.156	0.009	0.0000	-\$6,157.50
<i>ln</i> (WTLDDIST)	0.026	0.007	0.0005	\$1,007.49
<i>ln</i> (WTLDDIST)*INDEMG	-0.009	0.007	0.1849	\$648.75
<i>ln</i> (WTLDDIST)*SCRSHB	-0.002	0.006	0.7581	\$933.38
<i>ln</i> (WTLDDIST)*FOREST	0.001	0.006	0.9112	\$1,033.71
<i>ln</i> (WTLDSIZE)	-0.023	0.010	0.0192	-\$923.47
<i>ln</i> (WTLDSIZE)*INDEMG	-0.073	0.027	0.0070	-\$3,794.17

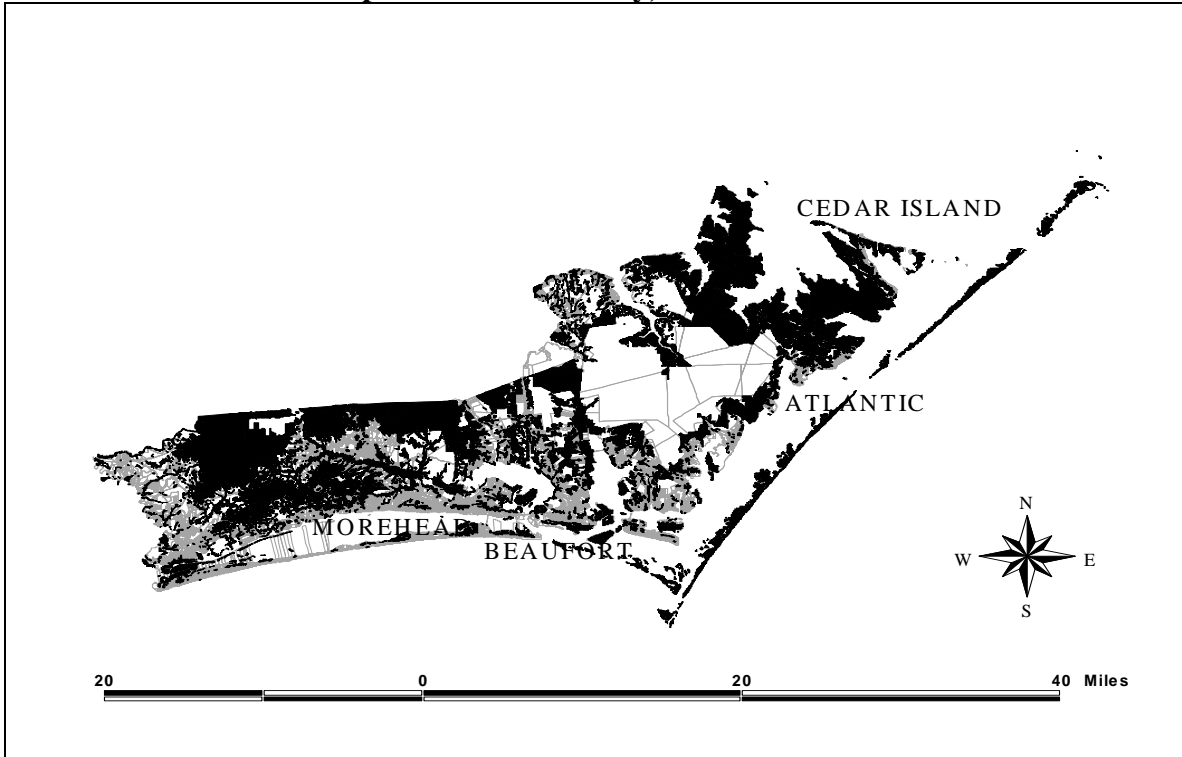
**Table 5 - continued**

**Estimation Results of the Hedonic Price Function (wetland type interaction terms)**

Variable	Coefficient	Standard Error	p-value	Marg. Effect
$\ln(\text{WTLDSIZE}) * \text{SCRSHB}$	0.025	0.011	0.0174	\$80.95
$\ln(\text{WTLDSIZE}) * \text{FOREST}$	0.014	0.011	0.2135	-\$387.30
Adjusted R <sup>2</sup>	0.7406			
F-Statistic	162.66			

Notes: Dependent variable is the log of sales price. Standard errors and p-values are based on the robust, heteroskedasticity corrected covariance matrix. Marginal effects are evaluated at the sample means. For the log transformed variables, marginal effects are evaluated as the distance increases by 25% from the sample means. Marginal effects for the wetland-related variables represent for the effects of coastal emergent, inland emergent, scrub shrub, and forested wetlands, respectively. Category omitted for township is Beaufort (County Seat).

**Figure 1**  
**Map of Carteret County, North Carolina**



Notes: Lighter shading area represents property parcels. Wetlands are located throughout Carteret County and represented by dark shading areas.