In: Urbanization and the Global Environment
Editors: Elen Turunen and Anton Koskinen, pp. -
ISBN: 978-1-61470-127-9

Chapter 6

MODELING THE IMPACT OF CHANGES IN LAND USE AND SOCIO-CULTURAL PATTERNS FROM URBANIZATION ON RECREATIONAL FISHING

Neelam C. Poudyal[1*], J. M. Bowker[2], Gary. T. Green[3] and Donald G. Hodges[4]

[1] Assistant Professor; Warnell School of Forestry & Natural Resources
University of Georgia, Athens, GA 30602
[2] Research Social Scientist; USDA Forest Service
Southern Research Station; Athens, GA.
[3] Associate Professor; Warnell School of Forestry & Natural Resources
University of Georgia; Athens, GA 30602.
[4] Professor; Department of Forestry, Wildlife & Fisheries
University of Tennessee; Knoxville, TN 37996.

ABSTRACT

Urbanization is changing both the ecological and socio-cultural characteristics of landscape. Population growth and structural shifts in demography, combined with change in land use and water resources, could largely influence how our society interacts with the natural environment, particularly during recreation activities. This study investigates the demand for recreational fishing in the broader context of public use of the natural environment in a region facing rapid urbanization and demographic change. Model results indicate that elements of urbanization, such as population growth, increasing minority populations in urbanizing areas, increasing average commuting time due to urban sprawl, and decline in fishable water resources due to land use change, are significantly and negatively contributing to the decline of public participation in fishing. While a number of socio-cultural factors are perhaps beyond-the-control of concerned agencies in terms of their ability to take any immediate action, this study offers some valuable insights regarding planning and preparing for the predicted consequences of increasing urbanization on natural resources and related recreational activities. Findings

* Tel: (706).583-8930; Email: npoudyal@warnell.uga.edu

also suggest that agencies interested in managing fishing as a recreation and economic activity may see benefits in implementing programs to conserve and restore fishable waters in developing landscapes. The promotion of the ‘acculturation’ of fishing among youth and minority populations in urban areas facing cultural transition may also be worth considering.

Keywords: urbanization, demographic change, landscape change, fishing demand.

1. INTRODUCTION

Rapid urbanization has changed both the ecological and socio-cultural characteristics and patterns of our landscapes. Katz (2002) earlier argued that urbanization gradually changes the social and cultural characteristics of rural communities. Elements of urbanization, including population growth, change in land use and water resources, structural shifts in demographic patterns, urbanization of population and lifestyles, and spatial patterns of development, may influence how people in our society interact, individually and collectively, with the natural environment. Human-nature interaction is important for a variety of reasons. For example, Louv (2005) asserts that the lack of human contact with the natural environment is affecting children’s physical and psychological health in urban and urbanizing areas. To understand how factors related to urbanization impact human engagement in the natural environment, this study investigates the demand for fishing in a broader context of human use of the natural environment in a region that is facing a number of socio-economic and natural resource changes associated with urbanization.

Recreational fishing was chosen as a representative activity because this is likely to be affected by urbanization in many ways. First, rapid land use changes, such as development of marginal lands, residential expansion around major water bodies, and drainage of wetlands have resulted in the decline of both the quantity and quality of fishable water resources. Second, activities like fishing and hunting are traditional sports typically more popular in rural landscapes. However, changing lifestyles of adults and their children, in urbanizing areas, are impacting the intergenerational transfer of such traditions (Brown, Decker, Siemer & Enck, 2000). Third, major metropolitan areas with plenty of economic opportunities experience structural shifts in demographics such as increases in their share of immigrants and minority populations who may not engage in traditional outdoor activities. Further, a number of other concerns including single family homes, commute time of parents, demand on children from school and other organized events, concerns about children’s safety etc., are often considered to affect outdoor participation among children.

Recreational fishing has long been a major nature-based leisure activity in the United States. The USDI Fish and Wildlife Service (2007) estimated that 13% of the U. S. population 16 years old and older participated fishing in 2006. Bowker & Askew (2011), using results from the National Survey on Recreation and the Environment, estimate the percent of U.S. adults fishing to be as high as 31%. In addition to its recreational benefits, fishing provides a significant economic contribution to the national economy. For instance, nearly 30 million anglers nationwide, spent more than $40 billion on fishing licenses, equipment and other trip related items in 2006 (US Fish and Wildlife Service, 2007). The multiplier effect of these expenditures holds significant impact for regional as well as local economies.

Nevertheless, recent studies have indicated that public use of natural resources for recreational pursuits like fishing, hunting etc. has declined substantially (Brown et al., 2000; Cordell & Super, 2000; Walls, Darley & Siikamaki, 2009). For example, the USDI Fish and Wildlife Service (2007) recent survey indicated there was a 15% decline in anglers nationwide between 1996 and 2006. This decline was even bigger (about 12%) between 2001 and 2006. A social implication of this decline is that the role of fishing as a human-nature interaction and platform to bring people together that preserves social, cultural, and traditional values might be limited in the long run. In addition, the direct economic implication of this decline is immediate with budget shortfalls for state agencies due to the drop in license revenues, which are used primarily by agencies for conservation education, wildlife management, and related programs (Teisl, Boyle, & Record, 1999).

While the decline in public participation in fishing is worrisome from various perspectives, it is important to understand two questions related to this decline. First, what factors affect the demand for fishing licenses or demand for fishing as a leisure activity? Second, how will the demand for fishing look in the foreseeable future if the current circumstances continue? Hence, the modeling of the impacts of social and ecological factors of urbanization and demand projections should be of interest to conservation agencies as it may help them identify measures to ensure both public support for fishing and the flow of revenue from license sales.

2.0. LITERATURE REVIEW

A number of studies have examined the effects of urbanization- related factors on recreational use of natural resources. For example, Poudyal, Cho & Hodges (2008a) investigated the impact of urban sprawl on hunting. Poudyal et al. found that counties experiencing rapid urbanization as measured by habitat fragmentation, increases in commute time to work, and increases in the share of urban population demonstrated significant declines in hunting participation. Manfredo & Zinn (1996); Heberlein & Thomson (1996), and Brown et al. (2000) also suggested a negative impact of growth in the urban share of county population on hunting demand. Similarly, Heberlein & Ericson (2005) have argued that whether or not an individual grew up in rural setting is a key factor in determining one’s willingness to engage in nature-based activities. Similarly, changing land and water-based environments around rural areas have been suggested to be another factor influencing outdoor recreation behavior. For example, Poudyal, Cho, & Bowker (2008b) projected a significant decline in hunting demand due to the expected rate of future deforestation.

Some other demographic patterns such as changes in education and income levels, and structural shifts in urban populations and cultures may also be considered responsible factors affecting nature-based recreation demand. For example, as education levels rise in urban areas and people are engaged in full time employment, they may be less likely to allocate time for longer, field-based recreation activities like fishing. Rising incomes also raises the opportunity cost higher for people to participate in such activities. Other non-traditional, higher status outdoor activities, such as golf, may also become more affordable and appealing to urban residents. In addition, racial shifts within the population, i.e., increased shares of minorities and non-natives in urban populations may also affect the overall public interest in outdoor activities like fishing.

Several studies have examined factors influencing fishing demand. For instance, Greene, Moss, & Spreen (1997); Floyd & Lee (2002), and Arlinghaus (2006) surveyed the general public asking whether or not they bought fishing license and then explored the effect of their demographic, economic, and residential characteristics on fishing participation. Alternatively, Teis, Boyle, & Record (1999) and Snyder, Stavins, & Wagner (2003) explained the number of licenses sold as a function of demographic, economic, and some water resource related factors of the study area. Overall, these studies found that fishing demand is in general, influenced by demographic factors such as age, race, education levels; and economic factors such as license price, income, and employment status; as well as ecological factors such as climatic conditions and availability of fishable water resources.

While these studies might provide insights into what constitutes a good fishing demand model, forecasting license demand has not been a focus. Earlier studies by Loomis & Ditton (1988) and Murdock , Loomis, Ditton & Hoque (1996) attempted to make projections of fishing demand, but the continuous decline of fishing in the recent decade contrasts with their projected path; probably because their projections were solely based on age-cohorts and did not control for other socioeconomic and ecological factors that influence both the public interest to fish and opportunities for fishing. Hence, there is a need for new projections based on a more informed demand model, richer data, and more robust econometric analysis.

3.0. Objectives

This study aims to fill this gap by using an economic demand model of fishing, in which the demand for fishing licenses is modeled as a function of several factors characterizing the socio-demographic and environmental forces of urbanization. The first step in this process involved developing a cross-sectional econometric model of demand using county level demand for fishing and other variables from nine states in the southeastern United States. The second step involved forecasting the future fishing demand in the region by combining the estimated parameters with the projected change in socio-demographic and water resources variables because of expected urbanization in the future.

4. Methods

4.1. Model Specification and Estimation Methods

We assume the number of fishing licenses sold in a county represents the county's total adult demand for fishing. It should be noted that unlike hunting, kids can and do fish a lot without licenses until they are age 16. Our measure of demand does not include this component due to lack of data. Following Teisl, Boyle, & Record (1999) and Snyder, Stavins, & Wagner (2005), demand for fishing can be expressed as:

$$\ln Y_i = \beta_0 + \sum \beta_k X_{ik} + \varepsilon_i \quad (1)$$

where, ln Y_i is the natural logarithm of number of licenses sold in the ith county; X_{ik} is value of the kth explanatory variable in the ith county. The last term, ε_i , captures the random error. Estimating eq (1) using Ordinary Least Squares (OLS) regression assumes that variance of the error term is constant. This assumption of homoscedasticity is often violated with county-level data as the size of the error terms are often functionally related to one or more of the model's variables rendering OLS estimation inefficient. We apply White's test for heteroscedasticity to the error terms and then employ White's robust standard error estimator as a mitigation procedure (White, 1980). Another issue common to county-level data is a high level of collinearity among explanatory variables (e.g., income and education). We use the Variance Inflation Factor (VIF) calculation to check for multicollinearity between variables included in the model (Greene, 2002).

4.2. Data Sources and Variables

County-level sales for all types of resident fishing licenses in 2000 were the basis for the analysis. License sales by individual for each county were summed and the natural logarithm of this sum was taken to derive the dependent variable. License sales data were obtained from the state agencies responsible for maintaining sales records. Counties from nine states including Alabama, Arkansas, Georgia, Kentucky, Louisiana (parishes), South Carolina, Tennessee, Texas and Virginia were included. A few counties in Georgia and Texas were dropped because they did not sell any licenses in 2000. Counties in Florida, Mississippi and North Carolina were missing because either the sales data were not available at the county level for 2000, or we failed to receive them. Counties from these states were however included in the regional projection of future fishing demand. The total number of counties used in the regression analysis was 965, however 297 were excluded or missing.

Table 1 presents the definition and descriptive statistics of variables. Variables characterizing the socioeconomic forces of urbanization included total population, education, employment, income, commute time to work, race, and population share in different age cohorts such as youth and adult. Due to large variations in county population; the natural log of county population was used to minimize outlier effects. The percent of county residents with a college degree was included hypothesizing that education level is negatively related with fishing demand because of the opportunity cost of time. Since urbanization often brings jobs and economic opportunities, the percentage of full-time employed individuals and average per capita income were used to estimate the effect of employment status and economic status on fishing. We hypothesized that counties with larger percentages of people with full time employment or higher education would be less likely to fish. Conversely, those counties with greater proportions of lower income residents would be more likely to fish.

Urban expansion in the form of urban sprawl and traffic congestion increases people's commute time to work. The average commute time to work in the county captures the spatial pattern of employment and intensity of development, i.e., where people live and where they work (Gordon, Kumar, & Richardson, 1989; Song 1996; Bento, Cropper, Bokarak, & Vinha, 2005). Commute time may affect an individual's outdoor engagement because of the availability of discrete time. We hypothesized that longer commute times negatively affect fishing demand. We included the percentage of Whites in the total county population in the model, based on Floyd & Lee, (2002). Rural counties that are typically characterized by a large majority of White population can undergo structural shifts in demography following urban development and growth of a variety of low and high skilled jobs. These changes can increase the county's share of the minority populations. Two different age cohort variables including youth (16-34) and adult (35-64) were included to see the age-wise difference in public engagement in fishing. Data on socio-demographic and economic variables were obtained from the U.S. Census 2000 (US Census Bureau, 2000).

Table 1. Variable Definition and Descriptive Statistics

Variable	Description	Mean	Standard Deviation
Dependent Variable			
Resident Licenses	Total number of resident fishing licenses sold within the county	6650.922	11184.880
Independent Variables			
Socio-economic and water resource variables related to urbanization			
Population	Total population of the county	60927.750	172862.700
Education	College graduates as a percentage of county population	11.909	4.822
Employment	Percentage of people in the county holding full time job positions	43.339	6.983
Income	Average per capita income of county residents	16445.500	3453.269
Commute time	Average commute time in minutes to work	25.836	5.355
Race	White population as a percentage of county total	78.460	16.734
Youth population (%)	Percentage of county population between 16 and 34 years	21.911	3.939
Adult population (%)	Percentage of county population between 35 and 64 years	38.588	2.996
Fishable water area (large)	Total acres of bigger water bodies (greater than 40 acres or wider than 660 feet), as a percentage of county total area	2.551	5.075
Fishable water area (small)	Total acres of smaller water bodies (smaller than 40 acres or narrower than 660 feet), as a percentage of county area	0.901	0.662
Other variables influencing fishing demand			
License fee	Per angler capita expenditure on license fees in the state	12.521	4.898
Coastal	Dummy variable, 1 if the county is coastal, 0 otherwise	0.091	0.287
Fishing parks	Number of national forest and state parks with fishing available	0.443	0.675
Temperature	Average annual temperature	61.763	4.930

Counties facing urbanization can observe a gradual change in land use and water resource base environments that provide opportunities for fishing and other outdoor activities. Since, the availability of fishing opportunities in the county depends on the abundance of water resources (Snyder, Stavins, & Wagner, 2003; Arlinghaus, 2006), bigger and smaller water areas as a percentage of total county area were included in the model.

There is no unitary fishing license fee available because the types of licenses greatly vary across the states. Researchers have thus used proxies like a complex index (Snyder, Stavins,

& Wagner, 2003) or a hypothetical price (Sutton, Stoll, & Ditton, 2001) to describe fishing license cost. Following Poudyal, Cho & Bowker (2008b), an average state license fee, obtained by dividing the total revenue of statewide license sales by total number of anglers, was used as a proxy for the license fee because of the inconsistent types of licenses issued.

A dummy variable indicating whether or not the county is coastal was included to control for the availability of fishing resources along coastal counties. The number of national forest and state park units with fishing available was also included to capture the human-made fishing facilities in the county. Water resources, parks with fishing available and coastal dummy variables were obtained from the National Outdoor Recreation Supply Information System (NORSIS). The NORSIS maintains the periodic inventory of outdoor recreation resources at the county level in the United States (Cordell & Betz, 1997). Since fishing is a typical outdoor activity, average annual temperature of the county was also included to control for the climatic effect on the fishing license demand (Teisl, Boyle, & Record, 1999). Based on long-term observations, the National Oceanic and Atmospheric Administration (NOAA) originally developed this variable, which we obtained from the USDA-ERS (McGranahan, 1999).

4.3. Demand Forecasting

Parameters estimated for the demand model were used to project future demand for fishing licenses in the region under a number of assumptions about future changes in explanatory variables. Following Bowker et al. (2006) and Poudyal, Cho & Bowker (2008b), projected values of the explanatory variables at county level were combined with the regression parameters from the demand model to estimate the future demand of fishing licenses in the Southeast over five-year intervals from 2000-2030.

Since the estimated demand model was log-linear in nature, recovering the correct predicted value of the dependent variable was more complicated than with a strictly linear model. We followed Wooldridge (2003, p. 203) to accurately predict the value. This method starts with creating a new variable ($\hat{m}_i$) which is just an exponential of the fitted value obtained from eq. 1 (i.e., $\hat{y}_i$). Then, the original value of dependent variable (y_i) was regressed through origin against $\hat{m}_i$ only. The resulting coefficient (α_0) was then used in the following equation to recover the predicted value of the dependent variable.

$$\hat{y}_i = \hat{\alpha}_0 \exp(\ln \hat{y}_i) \tag{2}$$

The projected changes in county's socio-economic and water resources conditions were obtained from the available literature and databases. For those variables whose projected changes were not available, the values were estimated using interpolation and extrapolation techniques. Projected changes in demographic variables were obtained from the U.S. Census Bureau's projection report (US Census Bureau, 2005). For instance, the Census Bureau projected that the population will grow in the region by 46% between 2000 and 2030. Similarly, the share of white population will decrease from 78 % to 65 % in the same period.

Projected total population and percentage share of Whites at a given county for a given future year was calculated using that information.

Projected growth rates for the entire nation were used as proxies for the employment, population share in youth and adult age cohorts and college graduates, because the projections were not available exclusively for the Southeast region. Following Hussar & Bailey (2006), the population of college graduates for the counties was extrapolated. Population shares in youth and adult age cohorts were based on Day (1996). The percentages for the share of each age cohort in intermediate years were obtained by linear interpolation.

The annual growth rate of employment was obtained from the Bureau of Labor Statistics and used to compute the percentage of county population with full time employment in a given future year (Saunders, 2005). The annual growth rate of income was obtained from the Bureau of Economic Analysis (BEA, 2007).

The US Fish and Wildlife Service (2007) reported that the average expenditure by anglers on fishing licenses increased by 1.7 % between 1991 and 2006. This growth rate was used to project the license fee up to 2030. County level data on commute time to work from the 1990 and 2000 census (US Census, 1990; 2000) were used to compute an annual growth rate, which was used to extrapolate a county's average commute time for a future date. The projected values of bigger and smaller water bodies were computed using the national rate of inland wetland loss in recent decades. The USDI Fish and Wildlife Service report indicated 2.5 % of inland wetlands were lost in a Nine year period during the 1980s (Dahl & Johnson, 1991). Even though this rate could have been slowed down in recent years due to increasing implementation of federal and state government efforts to restore and conserve wetlands, we use this rate also to account for the effects of decreasing public access to water resources; and also the degrading aquatic habitat quality with increasing water pollution due to expected urban development around water bodies in the region (Cordell & Super, 2000). Since, the average temperature variable was created based on nearly a half century of observations, significant change was not assumed for this variable. The coastal status of the counties was kept constant. We assumed the number of National Forests, National Parks, and state parks with fishing units available in the counties would also remain constant.

The above-discussed scenario is the base-line case, which will later be compared with scenarios of alternative futures for selected variables. First, the future condition of each county along with projected demographic condition, socioeconomic characteristics, and water resource availability were simulated. Then, the projected values of those variables and regression parameters were plugged into the demand equation to predict the dependent variable (natural log of total license demand) for a given county in a given future year. The prediction for the number of fishing licenses sold for each county was obtained by transforming this logarithmic value into an integer as suggested by Wooldridge, (2003). Summing up the projected county-level demand or licenses sold in any given year yields the total demand for the southeastern region. For the projected demand in counties with missing observations, the mean value of projected demand from included counties was applied. Therefore, our projected demand figure includes the demand for Florida, Mississippi and North Carolina counties as well even though these counties were not included in the model estimation due to data unavailability. For projection purposes, we explicitly assumed that these counties share similar characteristics and may not have dramatically different demand from the projected average of all the other counties in the same region.

5. RESULTS

5.1. Regression Analysis

White's test of heteroscedasticity suggested rejecting the null hypothesis of constant error variance across the sample (Chi- square Statistic = 216.28, 118 df and $p<0.0001$). Therefore, we estimated the robust standard errors (White, 1980). Demand function coefficients and robust standard errors are presented in Table 2. The estimated adjusted R-square value of 0.81 reveals a relatively good fit of the model to the data. Out of 14 variables, coefficients for 10 variables were statistically significant at the 5 percent level, 2 variables at the 10 percent level, all with expected signs.

Of the demographic and socioeconomic variables, population, education, income, commute time, race, and 35-64 population shares were found to be statistically significant at the one-percent level. Similarly, full-time employment was also marginally significant at the ten percent level. Coefficients for overall population and income were positive and are consistent with Teisl, Boyle, & Record (1999) and Floyd & Lee (2002). Examining the elasticity between population and license sales (% change in license sales / %change in population) one finds that a one percent increase in population leads to a 0.99 percent increase in license sales. An important implication of this observation is that the growth of population with rapid urbanization in the area may well increase the demand for fishing and probably help offset the negative effect of other factors on demand. The negative coefficient for college or higher-level education corroborates the findings of Arlinghaus (2006), who found a negative relationship between education level and fishing demand. Our results indicated that counties with a higher percentage of population with higher education levels would have lower demand for fishing, perhaps because of the opportunity cost of time.

The income elasticity of demand for fishing was 0.63. This indicates that a one percent increase in per capita income of residents increases the demand for fishing by 0.63 percent, suggesting that fishing might be a normal good. Duda et al. (2003) argued that increasing income levels might help mitigate some of the decline in license sales in urban areas. Counties with higher proportion of full-time employees were less likely to have greater demand for fishing licenses, perhaps because of the time factor (Bockstael, Strand, & Hanemann, 1987). As economic opportunities increase with urbanization in the region, more people are likely to have full-time jobs which may further constrain fishing demand.

Average commute time to work negatively affects license sales. This variable was expected to capture an important dimension of urbanization, the spatial pattern of residential locations and employment centers (where people live and where they work) which largely can determine the discretionary time. Earlier, Brown et al., (2000) and Heberlein & Ericsson (2005) suggested discretionary time considerably impacts wildlife related recreation. Poudyal et al. (2008a) found longer commute times negatively affect hunting participation. The percentage of White population in the county had a positive effect significant at the one percent level. It reveals that the counties with higher proportions of White population are likely to have a greater demand for fishing. This is consistent with the finding of Floyd & Lee (2002). With this observation in view, the increasing share of non-white and Hispanic population around major urbanizing metropolitan areas in the region may have significant negative effects on demand for fishing in the future (Duda et al., 2003). While the number of anglers may increase in general due to high population growth, per capita participation in fishing may decline over the time because of expected decline in the share of Whites in the population.

Table 2. Regression Parameter Estimates from Demand Model (Dependent Variable- ln(Resident Licenses)

Variables	Coefficient (White's robust standard errors)	VIF
Intercept	-9.436*** (2.330)	---
Socio-economic and water resource variables related to urbanization		
Population	0.991*** (0.030)	2.160
Education	-0.047*** (0.009)	3.630
Employment	-0.007* (0.004)	1.830
ln(Income)	0.634*** (0.253)	4.860
Commute time	-0.007*** (0.003)	1.430
Race	0.011*** (0.001)	1.400
16-34 population (%)	0.008 (0.134)	2.200
35-64 population (%)	0.041*** (0.013)	3.080
Fishable water area (large)	0.032*** (0.006)	1.490
Fishable water area (small)	-0.000 (0.033)	1.340
Other variables influencing fishing demand		
ln(License fee	-0.540** (0.058)	1.440
Coastal	0.132* (0.075)	1.550
Fishing parks	0.121*** (0.027)	1.170
Temperature	0.014** (0.006)	1.600
F-Statistic	239.640***	
Adj. R- Square	0.81	
Number of Observations	965	

Note: ***, ** and * indicates statistical significance of parameter at α=0.01, 0.05, 0.10 levels respectively. The numbers in parenthesis are the standard errors. VIF exceeding 10 causes multicollinearity.

We found a significantly different demand between the population share of 16-34 age cohort and 35-64 age cohort. The coefficient was positive and significant at the one percent level for the adult population share, but statistically insignificant for the youth population share. This result may indicate that counties with a higher adult population share are more likely to have a greater demand of fishing but those with a higher 16-34 age cohort population share are less likely to have a demand for fishing. The contrasting evidence among these age cohorts confirms the declining popularity of fishing among youth. This result may mean that there could be a significant shift in interest among youth in choosing their leisure activities. With urbanization of rural culture and change in people's lifestyles, anglers are probably as likely to pass on fishing and outdoor interests to their children (Purdy, Decker, & Brown, 1989; Brown et al., 2000). Furthermore, with the growing dominance of urban culture, the younger generation is exposed to alternative leisure activities as substitutes, e.g., electronic media, TV, gaming, organized sports; and perhaps is losing interest in traditional outdoor sports like fishing (Brown et al., 2000). State agencies may see some benefit from focusing on younger age groups when promoting fishing.

The presence of larger water areas (area of large water bodies as a percentage of county area) had a positive influence of license sales, suggesting the quantity of fishable water areas also affect fishing demand. This result corroborates the findings from previous studies (Snyder, Stavins, & Wagner 2003; Arlinghaus, 2006). Smaller water bodies do not appear to affect demand. However, this result might be explained by the fact that this category may include very small creeks and wetlands that may have limited or no fishing opportunities to offer. Because of the amenity benefits associated with living close to water areas, many of the recent residential expansions in the nation have occurred in the proximity of water areas. This development pattern has resulted in the decline of both the quality and quantity of fishable water bodies. In addition, many of the traditionally popular fishing lakes and rivers are suffering from the industrial pollution and waste disposal associated with urbanization and residential development (Minnerick, 2001). Since urbanization is expected to bring significant change in land use and water resources, it may also have an impact on the availability of fishing areas in the future. Therefore availability of fishable water resources in terms of both quantity and quality may be an issue of concern in regards to maintaining fishing in a region.

Among the other variables in the model, the average license fee was found to have a negative and significant effect on license demand. The price elasticity of -0.54 indicates a relatively inelastic demand in license price. Snyder, Stavins, & Wagner (2003) also found an elasticity of –0.20 for the resident fishing license for the United States. Teisl, Boyle, & Record (1999) found that the price elasticity of fishing related licenses varied from –0.05 to –1.33 among the resident anglers in Maine. Nevertheless, our result suggests that decreasing the price of fishing licenses alone may not increase license sales or encourage people to fish, because a one percent decrease in price will increase the license sales by far less than that.

A dummy variable indicating whether or not the county is coastal had a positive effect on license sales. The number of national forests and state parks with fishing availability also had a positive effect on demand. This result suggests that developing such facilities may be one strategy to help supply more fishing opportunities in the counties, and conceivably increase license sales. Counter to our expectation, the effect of average annual temperature was positive. A possible explanation however, is that a higher average temperature might be associated with the more the more pleasant weather conditions of spring, summer, and fall, when most fishing activity takes place.

5.2. Demand Forecasting

Projected demand for fishing licenses up to 2030 under alternative future scenarios is plotted in Figure 1. Under the baseline scenario, the projected demand is 7.4 % less than the region's actual sales of fishing licenses in 2000, indicating a slight under-prediction. Our projection indicates the southeast region will see a considerable decline in fishing license demand by 2030. This is in line with the nationwide trend of fishing license sales in recent years. The region will have a demand of 8.45 million fishing licenses in 2030. This is about a 14% decline from 2000, when the region sold 9.84 million licenses. This projection also supports the notion that public participation is declining in consumptive outdoor recreation such as fishing, hunting etc (Kelly & Warnick, 1999; Brown et al., 2000). Cordell et al. (2004) summarized the fishing participation in the United States from1960-2000 and found that the number of people who fished increased only very slightly while the percentage of population who fished remained the same during that period. A recent assessment by USDI Fish and Wildlife Service (2007), however reported that the nation experienced a 15% decline in number of anglers during 1996-2006; and a 12% decline between 2001 and 2006. However, it is reasonable to expect a smaller decline in the southeast because of the rural traditions and cultural values of outdoor recreation activities in the region. Nevertheless, our analysis of recent license sales records indicate that the decline of public participation in the fishing might have just started in the region.

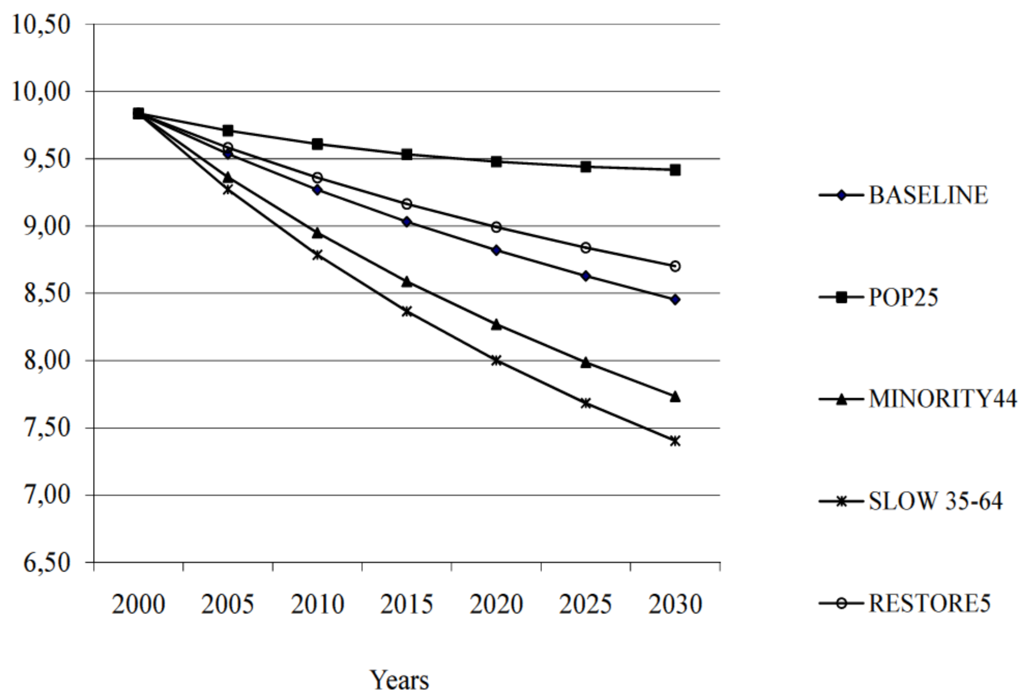

Figure 1. Projected Sales of Fishing Licenses in Millions in the Southeast USA under Various Assumptions.

The annual decline in the rate of demand in the southeast region as projected in our analysis is very comparable with the recent license sales trend in the region. For instance, our projection of roughly 14% decline over a 30 year period indicates an average annual decline rate of 0.46%. Recent sales data for this region indicates that total fishing license permits sold in the southeast region declined by 5.16% between 1995 and 2003 (USDI Fish and Wildlife Services, 2003), suggesting a 0.64% average decline annually.

Even though the region will see a significant population growth from 2000-2030 due to expected urbanization, the demand for fishing may decrease substantially. Our analysis indicates that demographic factors will be the reasons behind this trend. In particular, the share of the population that is currently positively related with fishing license demand (ages 35-64 years) will decline in the projection period because this age cohort is expected to decrease by 18% over the period of 2000-2030. This will cause the percentage share of this age cohort to decrease from 38% in 2000 to 30% in 2030. Furthermore, by 2030, the age cohort (65 and older) will comprise about 45% of total population, and are less likely to be anglers when compared to those in other age cohorts (Loomis & Ditton, 1988). Also, the population belonging to the share of the younger age class (below 20 years) at which most of the likely anglers start fishing is projected to continuously decline during the same period (Duda et al., 2003).

Fishing demand in the region will also be significantly affected by the projected change in racial composition in the region's population. From 2000 to 2030, the US Census Bureau projects the share of the White population to decline from 78 % to 65%, whereas the proportion Hispanics, Black and Asian populations will increase substantially. Our regression analysis indicates, importantly, that the share of the white population is currently positively related to license demand in the region. Similarly, the population share of college graduates that is currently negatively related with the fishing demand is expected to increase slightly over the projection period. The effect of the expected change in the college graduate share in the region's population however, will be minor when compared with the effects of projected change in age and race.

Fishing demand in the future will also be affected by the availability of fishable areas. Even though there were some federal and state government programs in recent years that have sought to conserve or restore water bodies and wetlands, access to those resources will still constrain fishing activities. Cordell & Super (2000) argued that increasing housing development and urbanization around water bodies would decrease the public opportunities for water-based recreation in the U.S. South. Also, pollution of water bodies and degradation of aquatic habitat quality will influence anglers' recreation experiences leading to an overall decline in fishing. So, further decline in fishing demand can be expected.

Alternative rates of change were assumed for some of the explanatory variables to simulate potential differences in terms of future demographic characteristics and water resource conditions. The base-line scenario (BASELINE) discussed above was a best guess based on projected reports and literature. The first alternative future (POP25) assumes a population growth rate that is 25% greater than the base-line rate. We assumed a proportionate change in the other variables. The second alternative scenario (MINORITY44) makes an alternative assumption about the expected racial/ethnic transformation in the region due to increased economic opportunities, and spatial pattern of development resulting from urbanization. This assumes the white population will grow 50% slower than assumed in the base-line, thus yielding a higher minority share in the regional population. In this alternative scenario, the mean county level share of white population will be 56% by 2030 instead of 65% as projected in the base case.

The third alternative (SLOW35-64) assumes an increased share of youth and senior populations resulting from a faster growth rate of youth (<34 years) and senior populations (> 65 years) and thus a smaller growth rate in the 35-64 cohort. Keeping everything else the same as in the base-line, this scenario assumes the 35-64 cohort will grow at a rate that is half of that in the base-line scenario. The final alternative (RESTORE5) is the restoration of fishable water areas, which assumes the region will see a modest (5%) increase in fishable water bodies which are positively related with fishing demand in our analysis. This could occur through either restoration of wetlands and other bodies, or an increase in access to currently unavailable water bodies for public use. Even though rapid urbanization is changing land use, draining wetlands and expanding housing development around major water bodies, there are several federal and state government programs in place that aim to conserve and restore wetlands and other water areas and it is reasonable to expect an increase in wetland and water areas in the future. For instance, Dahl (2005) reported that such programs contributed to a net gain of 32,000 wetland acres nationwide between 1998 and 2004. Evaluating the impact of this scenario will shed light on the potential benefit of such restoration or conservation policies on fishing demand. It should also be noted that some cities and municipalities are looking into building more reservoirs to supply water that also yields fishing opportunities. An example is Bear Creek Reservoir in Jackson County, Georgia (http://www.bearcreekwtp.com/).

Figure 1 compares the projection of future fishing demand across the five scenarios. Projected demands under the various scenarios indicate that fishing in the region will decline through 2030 ranging from a 4% decline in the faster population growth scenario to a 24% decline in the increased share of youth and senior population scenario. Due to higher population growth, POP25 will compensate for the decline that would have occurred in base-line scenario by ten percentage points. The MINORITY44 alternative would see the region's fishing license demand drop by 21%, which is about 7-percentage points more than the base-line scenario decline. With this in mind, a rapidly increasing Hispanic population in the region might have serious implications for fishing license sales and revenue generation fees for local and state agencies.

The third scenario, increased share of youth and senior populations with a slower growth in the more active age cohorts (SLOW35-64) will see the biggest decline in fishing demand. Under this scenario, the license demand in the region will drop by 24% out to 2030, which is an almost 11-percentage point higher than that in the base-line scenario. However, this is understandable because the share of this age cohort will substantially decline from 38% in 2000 to 27% in 2030 under this alternative. This scenario indicates the demand for fishing in the region is likely to be substantially affected by the aging of the population, a demographic transition commonly known as "graying of America" (Kausler & Kausler, 2001). As America continues aging, this observation might be an issue of concern in managing fishing and other outdoor recreation activities. The restoration of water areas scenario (RESTORE5) will see a decline in demand by 11%, which is roughly 3-percentage points less than the decline expected in the base-line scenario. This scenario indicates the future supply of additional fishable waters may increase demand for fishing in the region.

7.0. CONCLUSION

Results from this study imply that urbanization of population and rural landscapes, as measured by the growth in income, employment, structural shifts in demographics, and increases in average commuting time due to sprawling, along with a decline in fishable water resources may significantly and negatively impact public participation in fishing as evidenced by fishing license sales. Demands forecasted under various alternative futures indicate that fishing demand in the region will likely decline through 2030 somewhere between 4% and 24%. Even though the growth in absolute population may help to increase participation, the net demand for fishing will likely drop because of the negative effects coming from structural shifts in population and decline in fishable waters.

Results from this study hold important policy implications for outdoor recreation, leisure studies, and wildlife management along urbanizing landscapes. First, the age and race cohorts most positively correlated with fishing in the region are declining. So, even though the expected change in demographic and social transforms are beyond the direct control of agencies, devising some programs or campaigns to encourage younger and non-white populations to fish might help mitigate some of the forecast decline in fishing license demand. In other words, programs that induce 'acculturation' of fishing among youths and minorities might be needed to maintain fishing as a recreational and economic opportunity in urban areas.

Second, our findings support any policy that would restore or increase water bodies that might supply additional fishing opportunities that may help maintain fishing activities in the region. Specifically, implementing a regional environmental policy to restore water bodies and wetlands areas by five percent could substantially offset the decline projected under baseline or a business as usual scenario. Agencies might see benefits to investing in such programs because the increased revenue from the expected license sales may eventually offset the initial cost of such programs. Findings from this study will be useful for conservation organizations and state game management and outdoor recreation planning agencies. While a number of socio-cultural factors mentioned in this study are perhaps beyond the control of those agencies to take any immediate actions, this study offers some valuable insights in planning and preparing for what may come as possible circumstances in the future. Furthermore, suggested effectiveness of public programs such as water areas restoration policy, youth and minority angler recruitment campaigns, may help secure public and legislative support in saving the social, economic, and ecological benefits of fishing in areas that are changing every day with urbanization.

REFERENCES

Arlinghaus, R. (2006). Understanding recreational angling participation in Germany: Preparing for demographic change. *Human Dimensions of Wildlife* (11), 229-40.

BEA. (2007). State personal income 2006: News release. Bureau of Economic Analysis. US Department of Commerce. Retrieved from http://www.bea.gov/newsreleases/regional/spi/spi_newsrelease.htm

Bento, A. M., Cropper, M. L., Bokarak, A. M., & Vinha K.(2005). The effects of urban spatial structure on travel demand in the United States. *Review of Economics and Statistics* 87 (3), 466-478.

Bockstael, N. E.,Strand, I. E., & Hanemann, W. M. (1987). Time and the recreational demand model. *American Journal of Agricultural Economics,* 69(2), 293-302.

Bowker, J.M., & Askew, A. (2011). U.S. Outdoor Recreation Participation Projections 2010 to 2060. In, Cordell, H. K. ed. Outdoor Recreation Trends and Futures. *Gen. Tech. Rep* SRS-XXX. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. (in press)

Bowker, J. M., Murphy, D., Cordell, H. K., English, D. B. K., Bergstrom, J. C., Starbuck, C. M. Betz, C. J., & Green, G. T.(2006). Wilderness and primitive area recreation participation and consumption: an examination of demographic and spatial factors. *Journal of Agricultural and Applied Economics.* 38(2), 317-26.

Brown, T. L., Decker, D. J., Siemer, W. F., & Enck. J. W. (2000). Trends in hunting participation and implications for management of game species. In W.C. Gartner & D.W. Lime (Eds.), *Trends in Outdoor Recreation, Leisure, and Tourism*. New York: CABI Publishing.

Cordell, H. K., & Betz, C. J. (2000). Trends in outdoor recreation supply on public and private lands in the U.S. In: Gartner, D.C., and Lime, D.W., (Eds.), *Trends in Outdoor Recreation,Leisure, and Tourism* (pp. 75-89). New York, NY: CABI Publishing.

Cordell, H. K., & Super, G. R. (2000). Trends in American's Outdoor Recreation. In Gartner, W. C., and D.W. Lime, D. W., (Eds.), *Trends in Outdoor Recreation, Leisure and Tourism* (pp. 133-144). New York: CABI Publishing.

Cordell, H.K., & Betz, C. J. (1997). NORSIS 1997: Codebook and documentation. USDA, Forest Service, Southern Research Station. Retried from www.srs.fs.usda.gov/trends/norsiscode.pdf

Cordell, H.K., Betz, C. J., Green, G. T., Mou, S. H. Leeworthy, V. R., Wiley, P. C., Barry, J. J. & Hellerstein. 2004. *Outdoor Recreation for 21st Century America.* State College, PA: Venture Publishing.

Dahl, T. E. & Johnson, C. E. (1991). Wetlands: Status and trends in the conterminous United States mid-1970s to mid-1980s. US Department of Interior, Fish and Wildlife Service, Washington, D. C.

Dahl. T. E. (2005). Status and trends of wetlands in the conterminous United States 1998 to 2004. US Department of Interior, Fish and Wildlife Service, Washington, D. C.

Day, J. C. (1996). *Population projections of the United States by age, sex, race and hispanic origin: 1995 to 2050.* US Bureau of Census, Current Population Reports (pp. 25-1130). Washington, D.C.: US Government Printing Office.

Duda, M., Michele, D., Zurawski, C., Jones, M. , Yoder, J., Testerman, W., Lanier, A. , Bissell, S. , Wang, P., Herrick, J., & Marshall, J.(2003). *Factors related to hunting and fishing participation among the nation's youth*. Phase V: Final Report. Harrisonburg, VA: Responsive Management.

Floyd, M. F. & Lee, I. (2002). Who buys fishing and hunting licenses in Texas? Results from a statewide household survey. *Human Dimensions of Wildlife.* 7, 91-106.

Gordon, P., Kumar, A., & Richardson, H. W. (1989). The influence of metropolitan spatial structure on commuting time. *Journal of Urban Economics.* 26: 138-151.

Greene, G., Moss, C., & Spreen, T. H. (1997). Demand for recreational fishing in Tampa Bay Florida: A random utility approach. *Marine Resource Economics.* 12, 293-305.

Greene, W. H. (2002). *Econometric Analysis* (5th ed.). Upper Saddle River, NJ: Prentice Hall, Inc.

Heberlein, T. A., & Ericson, G.(2005). Ties to the countryside: accounting for urbanites attitudes toward hunting, wolves and wildlife. *Human Dimensions of Wildlife*. 10, 213-27.

Heberlein, T., & Thomson, E.(1996). Changes in US hunting participation, 1980-90. *Human Dimensions of Wildlife,* 1(1), 85-86.

Hussar, W. J., and T. Bailey. 2006. *Projections of education statistics to 2015 (NCES 2006-084)* (34^{th} ed.). US Department of Education, National Center for Education Statistics. Washington, DC: Government Printing Office.

Katz, B. (2002).Smart growth: The future of the American metropolis. Center for Analysis of Social Exclusion. London School of Economics, London, UK, 32p.

Kausler, D. H., & Kausler, B. C. (2001). T*he graying of America: An encyclopedia of aging, health, mind and behavior.* Second Edition. University of Illinois Press, Urbana and Chicago, Illinois.

Kelly, J. R., & Warnick, R. B.(1999). *Recreation trends and markets: the 21st century*. Champion, IL: Sagamore.

Lamar, M. & Donnell, R. (1987). *Hunting: the southern tradition*. Taylor Publishing, Dallas, TX.

Loomis, D. K., & Ditton, R. B. (1988). Technique for projecting the future growth and distribution of marine recreational fishing demand. *North American Journal of Fisheries Management.* 8, 259-63.

Louv, R. (2005). *Last child in the woods: Saving our children from nature-deficit disorder*. Algonquin Books.

Manfredo, M. J., & Zinn, C.(1996). Population change and its implications for wildlife management in the new west: A case study of Colorado. *Human Dimensions of Wildlife.* 1(3), 62-74.

McGranahan, D. (1999). *Natural amenities drive rural population change*. Agricultural Economics Report No. (AER: 781). USDA, Economic Research Service.

Minnerick, R. J. (2001). Effects of residential development on the water quality of Higgins Lake, Michigan 1995-99. Water-Resources Investigations Report 01-4055. U.S. Department of Interior and U.S. Department of Geological Survey, Lansing, MI.

Murdock, S. H., Loomis, D. K. , Ditton, R. B. & Hoque, N. (1996). The implications of demographic change for recreational fisheries management in the United States. *Human Dimensions of Wildlife.* 1 (4), 14-37.

Poudyal, N. C., Cho, S., & Bowker, M. (2008b). Demand for resident hunting in the southeastern United States. *Human Dimensions of Wildlife*. 13(3), 158-74.

Poudyal, N. C., Cho, S. & Hodges, D. G. (2008a). Effect of urban sprawl on hunting participation in the southeastern United States. *Southern Journal of Applied Forestry.* 32(3), 134-138.

Purdy, K. G., Decker, D. J., & Brown, T. L. (1989). New York's new hunters: Influences from beginning to end. HDRU series 89-3, Department of Natural Resources, Cornell University, Ithaca, NY. 25p.

Reynolds, J. E. (2001). Landuse change and competition in the south. *Journal of Agricultural and Applied Economics.* 33(2), 271-281.

Saunders, N. C. (2005). *Employment outlook: 2004-2014. A Summary of BLS Projections to 2014. Monthly Labor Review*, November 2005, 3-9.

Snyder, L. D., Stavins, R. N., & Wagner, A. F. (2003). Private options to use public goods: Exploring revealed preferences to estimate environmental benefits. *Resources for the Future,* Washington, D. C.

Song, S. (1996). Some tests of alternative accessibility measure: A population density approach. *Land Economics.* 72(4), 474-482.

Sutton, S. G., Stoll, J. R., & Ditton, R. B. (2001). Understanding angler's willingness to pay increased fishing license fees. *Human Dimensions of Wildlife.* 6, 115-30.

Teisl, M. F., Boyle, K. J., & Record, R. E. (1999). Licenses Sales Revenues: Understanding angler and hunters reactions to changes in price changes. *Human Dimension of Wildlife,* 4, 1-17.

U.S. Census Bureau. (1990). United States Census Bureau. Available online at http://www.census.gov. Date Accessed 05/20/2007.

U.S. Census Bureau. (2000). United States Census Bureau. Available online at http://www.census.gov. Date Accessed 06/15/2007.

US Census Bureau. (2005). *Interim state population projections*. US Census Bureau, Population Division.

US Department of Interior Fish and Wildlife Service. (2003). *Historical hunting license data for1958 to 2003*. Available online at www.wsfrprograms.fws.gov.

US Department of Interior Fish and Wildlife Service. (2007). *2006 National survey of fishing, hunting and wildlife-associated recreation, national overview*. US Department of Interior, US Fish and Wildlife Service. Washington, D.C.

Walls, M., Darley, S., Siikamaki, J. (2009). The state of the Great Outdoors: America/s Parks, Public Lands, and Recreation Resources. *Resources for the Future.* Washington, DC. 97p.

Walsh, R. G., John, K. H. , McKean, J. R., & Hof, J. H. (1992). Effect of price on forecasts of participation in fish and wildlife recreation: An aggregate demand model. *Journal of Leisure Research*, 24(2), 140-56.

White, H. (1980). A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity. *Econometrica.* 48 (4), 847-38.

Wooldridge, J. (2003). *Introductory econometrics: a modern approach* (2nd ed.). Cincinnati, OH: Thompson and Southwestern Publisher.

Yin, M. & Sun, J. (2007). The impacts of state growth management program on urban sprawl in the 1990s. *Journal Urban Affairs.* 29(2), 146-179.

This manuscript was reviewed by Dr. Mark J. Fly (Professor, University of Tennessee) and Dr. Anwar Hussain (Research Assistant Professor, Auburn University). Authors appreciate the comments and suggestions of these reviewers.