Willingness to pay for fish biodiversity preservation in the Smoky Hill river basin

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ABSTRACT

The purpose of this thesis is to evaluate factors impacting residents' willingness to support local fish species preservation, through discovering how someone's beliefs or values impact their commitment to pay for conservation efforts. The study gauges community members' willingness to support and pay for a policy for conservation efforts to preserve and restore native fish populations to local rivers and streams in the Smoky Hills River region in Central Kanas. In addition, the thesis examines factors, such as demographics, knowledge of local environmental issues, and various economic factors, to assess their impact on the decision to support the proposed policy.

Data was obtained from a survey conducted by Kansas State University and distributed to residents of the Smoky Hill Basin area. The survey asked a variety of questions including: social economics, environmental engagement levels, and perceptions of conservation issues that may impact residents. Econometric regression analysis is then used to understand what level of support residents would potentially be willing to give to conservation efforts to restore local fish populations and which factors significantly influence residents' decisions to support the identified proposal. Policymakers and members of academia can use this research to further understand residents' motivations and which factors impact people's support for environmental policy.

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ACKNOWLEDGMENTS

I want to acknowledge my grandparents Thelma (TD) and Bill Peterson. Thank you for the memories at Jeffrey Lake and the Lake Street house. I would also like to thank my dad, for letting me tag along to fish early in the morning and showing me how to hook minnows and worms. Thanks to my mom for being an example of the importance of education and professionalism. Finally, I would like to thank Rachel, Atticus, Simone, and Sophia Haake for bearing with me. Thank you!

CHAPTER I: INTRODUCTION

1.1 Motivation

A trend in biodiversity conservation is to focus on evaluating community opinions about environmental policy using evidence-based research (Bennett et al. 2016). Discovering what impacts a person's decision to support an environmental policy can be useful in understanding how best present and communicate various policies. Using data analysis increases the ability of conservationists to understand community opinions about environmental issues and which policies are more likely to garner support.

Globally, there is a heightened awareness and concern for environmental issues such as climate change. In the Smoky Hill River Basin in Kansas, climate change has led to increased scarcity and competition for water and placed certain aquatic species at risk (Sanderson et al. 2017). Some environmental issues associated with this include drought, high fluctuations in precipitation, competition for water, changes in streamflow, and land use by farmers and the general public, which all have an impacted fish biodiversity in Kansas (Sanderson et al. 2017).

1.2 Clients

This research is relevant to local policymakers who want to measure levels of community support and to members of academia conducting biodiversity research. The need to increase species diversity is one of the most crucial environmental concerns in our society (Jakobsson et al. 2000). Ndebele et al. (2014) illustrate how contingent valuation approaches can help to inform and assist decision-makers so that they can improve upon and help to develop more effective strategies for ecosystem and biodiversity management. Proponents contend evidence-based conservation is more effective in representing local

support (Bennett et al. 2016). Biodiversity valuation studies amplify environmental information and convey the importance of ecosystem services (Ndebele et al. 2014). Studies that focus on specific communities can be used to inform the public about environmental concerns that affect their area. Moreover, academic research can provide information about what factors may result in barriers to support biodiversity efforts such as environmental values, specific demographics, and costs of the policy.

Conservation research is vital to private, scientific, and political communities for a variety of reasons, including prevention of loss of habitat and environmental damage. For instance, community members may be concerned about protecting their water quality, or how global warming is increasing natural disasters in their area. Others may use outdoor areas for recreational use and want to see those areas protected for future use. Farmers are concerned about soil and water quality, along with sustainability of crop growth (Sanderson et. al 2017). These objectives could cause conflict in local communities where there are different conservation goals and purposes across stakeholder groups. Recognizing potential problems and sources of differences in views is important in meeting overall community needs and implementing effective policy.

1.3 Research Objectives

The primary objective of this thesis is to determine levels of support among local citizens for a policy to restore and preserve fish populations in the Smoky Hill River Basin Kansas. Regression analysis is used to measure which factors impact support. Factors include demographics, knowledge of environmental issues, and values and beliefs of residents. Results shed light on what similarities and differences exist across residents' support for biodiversity-focused policies.

1.4 Framework

This study is focused on specific questions from a survey of residents in the Smoky Hill River Watershed in Kansas administered by an interdisciplinary group of scientists at Kansas State University. Using responses to specific questions in the survey, this thesis conducts an econometric analysis of what key factors are most likely to impact support for policies to protect fish diversity and populations in the study area. The significance of different factors is examined and how these factors shape residents' support and willingness to pay for preservation policies for local fish species. Some factors examined include environmental engagement, various demographics, economic conditions, and political factors.

CHAPTER II: LITERATURE REVIEW

Nonmarket valuation and related approaches are a tools that can aid in understanding community members' level of concern about conservation. Moreover, these tools can serve as a resource to determine the willingness of participants to contribute financially to different environmental matters and support policy monetarily. A community member's particular regard for environmental protection and willingness to pay for it is derived from non-value uses including intrinsic beliefs about conservation and use values including activities such as hunting, fishing, and boating. Jackobsson et al. (2001) acknowledge this postulate, "the total economic value of a species may consist of a combination of both use value and non-use value" (212).

2.1 Contingent Valuation Methods

Contingent Valuation analysis is one method of estimating the worth a person places on an idea or item. This study uses a contingent valuation approach to determine levels of interest and willingness to pay to supporting fish species restoration and a readiness to pay for initiatives that will help provide biodiversity protection. Jackobsson et al. (2001) adds: "In conventional economic terms, the contingent valuation approach has emerged as a robust approach to estimating values for species" (224). Additionally, there is a shift in more recent surveys to understand a broader scope of beliefs and values, overall knowledge of various local environmental issues, and a desire to pay for corresponding policy measures (Jackobsson et al. 2001).

2.2 Factors Influencing Willingness to Support for Biodiversity

Contingent valuation studies are often used to estimate willingness to pay for a particular policy or objective. Serge et al. (2009) researched the value of forests in France for recreational use and how a community places value on biodiversity using this method.

Their objective was to see if households were willing to pay for practices to increase the biodiversity of the forest (Serge et al. 2009). The results show the likelihood of accepting the proposal depends negatively on the value proposed. Additionally, outcomes also varied greatly depending on the region surveyed, negatively if they lived in the city, but only if they didn't use local forests recreationally (Serge et al. 2009). This research additionally reaffirms many factors that affect an inclination to pay based on a variety of factors such as age, income level, and concern for protection (Serge et al. 2009). Other results from the study show a forest visitor is more likely to pay a higher amount for protection measures, as are those with higher incomes (Serge et al. 2009).

Understanding an individual's willingness to support biodiversity projects is possible through understanding what variables impact decision-making. For example, looking at economic factors such as, household income and size, the cost of the policy, and how it is paid for (i.e. payment mechanism) are all potential considerations. Other variables that aid in the understanding of support include, knowledge of local environmental issues and if they use the areas recreationally for fishing or other activities. Other factors to consider include various demographics, from education levels, race, marital status, etc. (Sanderson et al. 2017; Serge et al.. 2009).

Another premise used in research is the Value-Belief-Norm (VBN) theory which helps to understand the social-psychological framework of environmental decision-making (Sanderson et al. 2017). VBN theory is based on human values – which are firmly held and developed early in life to determine a person's decisions about what is right and wrong (Sanderson et al. 2017). Particularly relevant to environmental decisions are values and core beliefs, such as self-interest, altruism towards humans, altruism toward other species

and the environment, openness to different ideas, and how many traditional values a person holds. Finally, their environmental worldview or how a person believes humans and the environment relate are included (Sanderson et al. 2017). These belief variables are used in research to understand environmental decision-making. Pro-environmental behavior is influenced by these values and therefore impact support on conservation and sustainability policy (Sanderson et al. 2017).

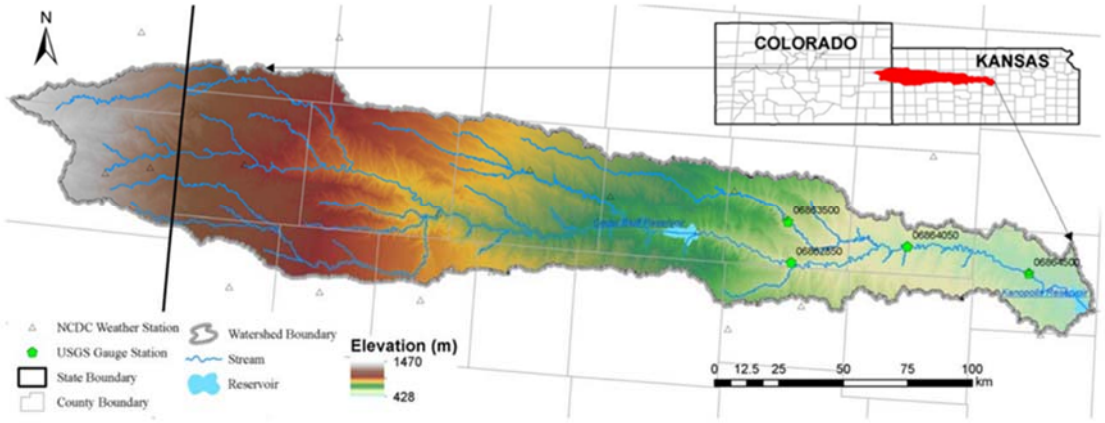
Sanderson et al. (2017), explains "the purpose of using the VBN framework is to hypothesize support for conservation policies is an outcome of environmental decision-making processes linking environmental values to ecological worldview beliefs and perceptions of ecosystem vulnerability" (Sanderson et al. 2017, 4). Support for environmental policies is interwoven with environmental values and beliefs, which are a relevant predictor for policy support (Sanderson et al. 2017).

CHAPTER III: DATA AND METHODS

3.1 Survey and Data

The Smoky Hill River Basin in Kansas is a semiarid zone with significant amounts of land used for agricultural purposes (Figure 3.1). The study covers 23 out of 105 counties in Kansas, including all counties within the Smoky Hill Watershed and all counties bordering the area. The survey questionnaire used for data collection was sent out from July 2015 to January 2016 through Kansas State University. It was distributed in three ways, handed out at county fairs in the study region, direct mail to agricultural producers, and mailed based on a probability-weighted sampling of residents from the county population. Further details on survey data collection can be found in Sanderson et al. (2017).

Figure 3.1 Smoky Hill River Basin



The dependent variable asks residents if they are willing to support a conservation policy to increase the fee on fishing licenses by adding a conserve fee in order to restore local and native fish populations in rivers and streams in the basin. Two additional questions in the survey that serve as independent variables asking if residents would support the fee if it went towards sport and game fish populations or non-sport fish species in order to assess the

impact on how the funds could be spent. Other questions in the survey include knowledge of local wildlife, understanding of water issues in the area, and how people interact with their environment through various activities. Additionally, respondents were asked about their perspectives of local environmental issues and policies, political ideologies, and several demographics.

Based on several survey questions, the dependent and twenty-seven independent variables were defined to examine respondents' support of the fish population perservation and restoration. The dependent and independent variables are summarized below in Table 3.1. The willingness to pay variable, which represented an increase in the cost of a fishing license due to the addition of a conservation fee, was randomly varied from $5.00 to $25.00 in $5.00 increments and randomly assigned across survey respondents following standard contingent valuation methods. Included in the table is the mean of each variable and associated standard deviation. The values and belief variables were all standardized with the mean centered at zero following Sanderson et al. (2017).

Table 3.1 Descriptive Statistics (N = 1237)

Variable	*Description - Variable Definition*	*Mean*	*Std. Dev.*
Dependent Variable			
Willingness to support	Dependent variable - Willingness to support the proposed fish biodiversity policy	0.35	0.48
Independent Variables			
Would support it if the fee went towards conserving sport & game fish species	The Likert additive index measuring the level of support from 1 to 5 if > 4, 1	0.45	0.50
Would support the fee if it went towards non-sport fish species	Likert additive index measuring the level of support from 1 to 5 if > 4, 1	0.38	0.49
Environmental Values and Beliefs:[a]			
Altruism towards humans (alth_v)	Factor score, z-standardized	0	0.83
Altruism towards environmental issues (altb_v)	Factor score, z-standardized	0	0.90
Traditional values (trad_v)	Factor score, z-standardized	0	0.85
Self-interest values (self_v)	Factor score, z-standardized	0	0.77
Openness to change (open_v)	Factor score, z-standardized	0	0.88
Environmental worldview (nep_v)	Factor score, z-standardized	0	0.85
Environmental Knowledge:			
Local environmental knowledge -	Environment knowledge > 75% correct = 1	0.69	0.46
Identification of fish species	Asked to ID pictures of indigenous and non-indigenous fish species	0.93	0.26
Recreation (environmental engagement):			
Boats or Swims	Binary variable: 1 if supported the policy and = 0 otherwise	0.41	0.49
Uses state parks	Binary variable: 1 if supported the policy and = 0 otherwise	0.64	0.48

Has a Park permit	Binary variable: 1 if supported the policy and = 0 otherwise	0.19	0.39
Purchases fishing license	Binary variable: 1 if supported the policy and = 0 otherwise	0.36	0.48
Fishes	Binary variable: 1 if supported this policy direction and = 0 otherwise	0.48	0.50
Fishes in local reservoirs	Binary variable: 1 if supported this policy direction and = 0 otherwise	0.36	0.48
Perceived vulnerability of Smoky Hill River	Likert additive index measuring level of considered vulnerability from 1-7. 1 is highly vulnerable, 7 is thriving. If respondents chose 1 or 2, then 1 for yes they perceive it vulnerable	0.46	0.50
Perceived vulnerability of local streams	Likert additive index measuring level of considered vulnerability from 1-7. 1 is highly vulnerable, 7 is thriving. If respondents chose 1 or 2, then 1 for yes they consider it vulnerable	0.51	0.50
Perceived vulnerability of Kanolpolis Reservoir	Likert additive index measuring level of considered vulnerability from 1-7. 1 is highly vulnerable, 7 is thriving. If respondents chose 1 or 2, then 1 for yes they perceive Kanopolis Reservoir as vulnerable	0.33	0.47
Perceived vulnerability of Cedar Bluff Reservoir	Likert additive index measuring level of considered vulnerability from 1-7. 1 is highly vulnerable, 7 is thriving. If respondents chose 1 or 2, then yes they perceive Cedar Bluff Reservoir as vulnerable	0.40	0.49
Perceived vulnerability of Wilson Lake	Likert additive index measuring level of considered vulnerability from 1-7. 1 is highly vulnerable, 7 is thriving. If respondents chose 1 or 2, then yes they perceive Wilson Lake as vulnerable	0.40	0.49
Perceived vulnerability of native fish populations	Likert additive index measuring level of considered vulnerability from 1-7, 1 is highly vulnerable, and 7 is thriving. If respondents chose 1 or 2, then yes the native fish populations vulnerable	0.07	0.25
Demographics			
Rancher or Farmer	Binary variable: 1 if supported the policy and = 0 otherwise	0.28	0.45
Urban resident	Binary variable: 1 if supported the policy and = 0 otherwise	0.61	0.49
Age	Age range	58	213.22

Sex	Binary variable 1 if yes for female	0.32	0.47
Marital Status	Binary variable 1 if yes for single	0.47	0.50
Race	Binary variable Non-Caucasian = 1	0.06	0.24
Education Level	Binary variable if the resident has an associate's degree or higher = 1	0.70	0.46
Income levels	A817 - Estimated income	70,912.25	63041.39
Political preferences	Binary variable 1 if democrat or independent	0.40	0.49

[a]*Environmental values* and beliefs are *defined* and used following *Sanderson et. al.* (*2017*). The variables are also standardized with the mean centered at 0.

Overall support of the conservation policy given the associated fee was 35 percent. Support was higher if the fee went towards conserving sport and game fish species, than if the fee went toward non-sporting or game fish species. Local environmental knowledge was fairly strong at 0.69, especially in identifying fish species at 0.93. The descriptive statistics results show altruism towards humans and environmental issues vary across the survey population. This was also observed for traditional values and self-interest values, indicating considerable heterogeneity. General openness and environmental worldview also had higher standard deviations.

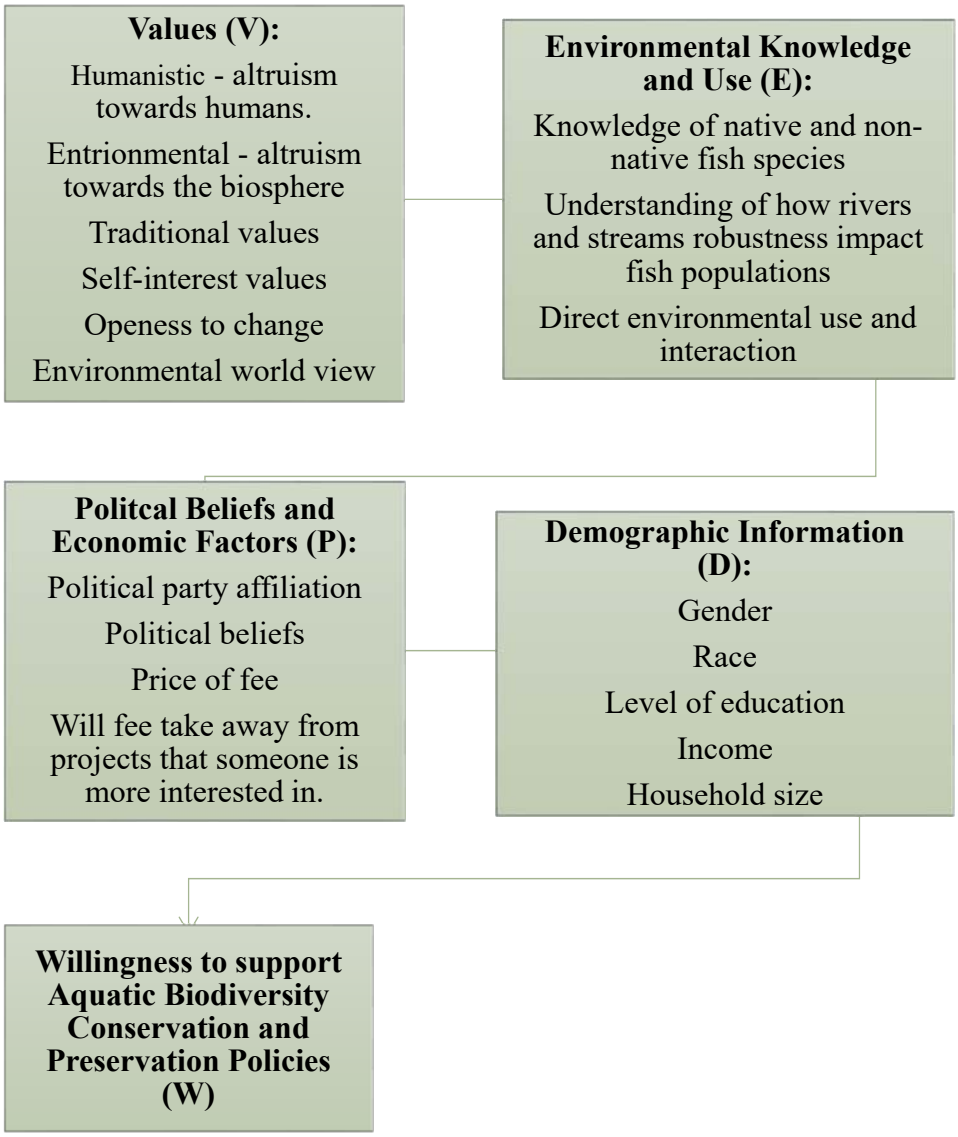
Mean levels of environmental engagement varied with 41 percent of respondents boating and swimming in local waters and 64 percent using state parks. On the low end is having a park permit at 19 percent of respondents compared with purchasing a fishing license, which is higher at 36 percent of respondents. Forty-eight percent of the residents indicated they fish, while those who fish in local reservoirs specifically is lower at 36 percent and those who fish in local streams and rivers is 30 percent. There is a slightly below-average awareness of the environmental vulnerability of local reservoirs and lakes ranging from 33 to 50 percent, and perceived problems for native fish species were extremely low only recognized by 7 percent of respondents.

In terms of demographics, the majority of respondents in the surveys are male and the average age was 58 years old. Roughly half were married and lived in an urban location, and almost all respondents are Caucasian. The average income level is approximately $70,000 per year; less than half are Democrats or independents; and 70 percent have an associate's degree or higher.

3.2 Model

A conceptual model is presented in Figure 3.2. The dependent variable or willingness to support the fish conservation policy in the Smoky Hill River Basin is seen as a function of different sets of independent variables that impact residents' decisions. VBN theory was incorporated to understand if a respondent's values and beliefs help determine if these influence and shape a respondent's willingness to support the policy. Additionally, knowledge of local environmental issues and levels of environmental engagement variables were included. Finally, several demographic factors were incorporated, such as political beliefs, age, race, and gender.

Figure 3.2 Conceptual Model



The data from the survey was used to operationalize the conceptual model to create a regression model. Willingness to support the conservation policy is a function of the individual's values and beliefs (**V**), local environmental knowledge and engagement

(E), demographic information (**D**), and political leanings and economic factors (**P)**. That is, for the *i*th individual, conceptually:

$$\mathbf{W}_i = \alpha'_{W,0} + \alpha'_{W,1}\mathbf{V_i} + \alpha'_{W,2}\,\mathbf{E_i} + \alpha'_{W,3}\,\mathbf{D_i} + \alpha'_{W,4} + \mathbf{P_i} + \mu_{W,j},$$

where ($\alpha'_{W,0}, \alpha'_{W,1}, \alpha'_{W,2}, \alpha'_{W,3}, \alpha'_{W,4}$) are parameters to be estimated: $\mathbf{V}_i$ is a vector of the values explanatory variable (humanist, traditional, self-interest, self-interest, openness to change values); $\mathbf{E_i}$ is a vector of knowledge of local environmental issues and engagement variables (identification of indigenous and non-indigenous fish species, engagement with land recreationally, and perceived vulnerability of local water sources and fish species); $\mathbf{D}_i$ is a vector of demographic information (level of education, race, income, marital status, household size); $\mathbf{P_i}$ are variables relating to political and economic issues (cost of project, funding priorities, political party affiliation). $\mu_{W,j}$ is a mean zero IID error term. Given that the $\mathbf{W}_i$ is a binary variable and assuming $\mu_{W,j}$ follows an extreme value distribution, the proposed regression model is appropriately estimated as a binary logistic regression model (Greene, 2012).

CHAPTER IV – RESULTS

4.1 Results

Table 4.1 provides the estimation results for the logistic binary regression model for the fish conservation policy support. Variables that focused on beliefs, demographics, how people interacted with their environment, and knowledge of local fish species were included in the regression analysis to see how the independent variables affected respondents' policy support.

Table 4.1 Logistic Regression Estimation Results (n=1030)

Variables	Coefficient	Std Error	p-value	
Const	-1.528	0.0503903	0.0024	***
Conservation Fee	-0.067	0.123842	6.66E-08	***
alth_v	2.893	1.64157	0.078	*
altb_v	4.111	2.42793	0.078	*
trad_v	-0.328	0.124526	0.0085	***
self_v	-0.082	0.119676	0.4948	
open_v	0.201	0.108881	0.0644	*
nep_v	0.140	0.115656	0.2257	
Local environmental knowledge	0.020	0.187229	0.9168	
Identify local fish species	0.073	0.373597	0.8458	
Fishes	0.070	0.221956	0.7595	
Boats or swims	−0.169522	0.191781	0.3767	
Use state parks	−0.104204	0.190366	0.5841	
Has park permit	−0.591784	0.224135	0.0083	***
Is a farmer or rancher	0.153	0.216733	0.4795	
Is an urban resident	0.154	0.188592	0.4136	
Has fishing license	0.390	0.241858	0.1065	
Fishes in local reservoirs	−0.295562	0.251588	0.2401	
Fishes in local streams or rivers	0.496	0.214922	0.0209	**
Support fee for sport/ game species	1.511	0.184466	2.64E-16	***
Support fee for non-game/sport species	0.889	0.182897	1.16E-06	***
Considers SH River vul	0.108	0.225653	0.6308	
Consider local stream vul	−0.0949536	0.221032	0.6675	
Considers Kanopolis res vul	0.133	0.246133	0.588	
Considers Cedar Bluff res vul	0.297	0.242766	0.2206	
Considers Wilson Lake vul	−0.302443	0.221473	0.1721	
Considers native fish vul	0.238	0.356302	0.5034	
Non - Caucasian	0.140	0.375207	0.7098	
Has assoc degree or higher	0.202	0.189124	0.2846	
Income levels	0.000	1.46E-06	0.0066	***
Is Ind or Democrat	−0.0593156	0.171637	0.7297	
McFadden R-squared	0.25423			
Log-likelihood	0.25423			
Number of cases 'correctly predicted' = 769 (74.7%)				
Likelihood ratio test: Chi-square(31) = 342.843 [0.0000]				
Number of Observations: 1237				
***: significant at 1%: ** significant at 5%, *significant at 10%				

The fit of the regression model can be assessed examining the McFadden Pseudo R^2 and the correct number of predictions. Both provide evidence that the regression is

reliable. Out of 1,237 useable responses, 427 said they would support the policy regardless of the fee amount. The level of the conservation fee or increase in the cost of a fishing licenses for conservation purposes (Conservation Fee), is strongly related to support for the policy and statistically significant at the 1% level. This result is in line with previous research that predicts the higher the fee, the less likely people will be willing to support the policy (Sanderson et al. 2017, Serge et al. 2009). The fee allocation toward sport fish species and non-sport species impacted support, with higher support for funds going to sport fish populations. However, both sport and non-sport species showed positive support for the policy and were statistically significant.

In terms of the VBN variables, greater leanings toward altruism towards humans (alth_v) and altruism towards the environment (altb_v) had a positive and statistically significant impact on policy support at the 10% level of significance. Traditional values (trad_v) had a negative impact and was significant at the 1% level, aligning with the theory that if a person has more traditional values they are less inclined to support biodiversity conservation. Having a park permit was another fact tor that negatively impacted policy support. Openness to change (open_v) was positive and significant at the 1% level, reflecting that people who base their decisions on being open are more likely to support conservation policies. These results support the idea that the beliefs someone carries with them throughout their lives impact their concern for biodiversity and conservation issues (Sanderson et al. 2017).

Variables that were not statistically significant included: knowledge of local environmental issues, being able to identify fish species in the region, if they have fished, boated, or swam in local areas, and if respondents used state parks. Additionally, if the

person was a farmer or an urban resident, had a fishing license, or if they fished in local streams or rivers, then this did not have a statistically significant influence on support. Finally, concerns or awareness of ecological issues related to local streams, reservoirs, lakes, or fish species, were not significant indicators of support. Other demographic variables that didn't impact the dependent variable are if they are non-Caucasian, residents with higher educations, or if they are independent or Democrat.

CHAPTER V: CONCLUSIONS

The purpose of this study was to understand how various factors affect a person's willingness to support a fish conservation initiative to restore and preserve local fish populations in the Smoky Hill River Basin in Kansas. Specific questions from a survey administered in the region was used for data collection, including questions on how respondents personal beliefs; environmental values and knowledge; uses of waterways in the area; and demographics. For this study, variables were combined into different categories including values, represented by the VBN theory, environmental knowledge and engagement with outdoor areas, political beliefs and various economic factors, and finally demographics such as gender, race, and household size to assess the impact of these factors on support for the policy. Data was statistically analyzed using a binary logistic regression model.

The strongest predictor for conservation support is the economic value of the policy. As the level of financial obligation increases, willingness to support decreases. Other economic factors that predicted support included higher levels of income. Economic variables have proven to be an important component in biodiversity support across a multitude of related studies. Sanderson et. al., (2017) found that economic factors are a strong predictor of support.

Another significant predictor of support is a person's core values. Altruism towards humans, the environment, traditional values, and openness to change all indicate how someone's personal values heavily influence their disposition towards environmental issues. This study showed residents with grater traditional values had a negative impact on policy support, while altruism towards the environment and openness to change had a

positive influence. Interestingly, environmental worldview was not a significant predictor of support in this study as it has been shown to be in past studies.

Understanding the general values and opinions of people in an area can help shape decision-making related choices for fish conservation. Knowing what a community values can guide conservationists and policy makers towards presenting issues that have a higher probability of being successful. Ultimately, long-term support can also be increased by incorporating environmental education and the importance of understanding biodiversity at a young age. Finally, we can take away the knowledge that the values someone grows up with will influence their level of concern for environmental issues. If the goal is to increase concern for environmentalism, then exposing people to environmental education at a young age may lead to future support.

Some potential limitations of the study are it focused on a comparatively small area and therefore, it may be only generally applicable to this region. However, the results are similar to what other studies have shown. Furthermore, the particular beliefs that someone carries directly affects their willingness to support. For example, while this study reflects opinions and values associated with the Midwest and a more conservative area, it may not be appropriate for comparison to other areas in the county or the world. Other limitations include the specific policy focus and mechanisms to increase fish conservation efforts, which may not be seen the same in other areas, as well as the impact of other related and conflicting policies that were not considered directly in this study.

Further research opportunities include, studying other areas in the United States or parts of the world, to see if values change based on location. Researching protection fees for different plant and animal species is additional area of study. Compiling these studies

into a larger framework could be done to see how consistent the results are overall, or if some regions have different results and why. Studying different cultures, varying types of environmental engagement, political leanings, etc. could vary in other parts of the country or world and be compared to local data.

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