The Pennsylvania State University

The Graduate School

SOCIAL VALUE OF BIRD CONSERVATION ON PRIVATE LANDS IN PENNSYLVANIA

A Thesis in

Forest Resources

by

Sadikshya Sharma

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Master of Science

August 2021

The thesis of Sadikshya Sharma was reviewed and approved by the following:

Melissa M. Kreye
Assistant Professor of Forest Resources Management
Thesis Adviser

Margaret C. Brittingham
Professor of Wildlife Resources
Extension Wildlife Specialist

Katherine Y. Zipp
Associate Professor of Environmental and Resource Economics

Bradley J. Cardinale
Department Head and Professor, Ecosystem Science and Management

ABSTRACT

Forest management can enhance ecosystem services and protect species diversity by enhancing habitat for wildlife. The number of birds in North America has fallen by 29% since 1970, mostly because of habitat loss. Most forests in Pennsylvania are privately owned (70%) which implies the need for private lands to maintain the sustainability of bird populations for the foreseeable future. Since most bird conservation benefits will go to the public, it is important to understand public support for bird-friendly forestry on such private lands. However, the public demand for bird-related ecosystem services on private lands is not well understood.

A statewide web survey was used to collect panel responses from 821 households in Pennsylvania. An adjusted sample of 656 observations was used in Chapter 2 and 690 observations in Chapter 3. The survey contained Likert scales to measure relevant conservation attitudes and a choice experiment to measure willingness-to-pay (WTP) for eight different bird conservation programs. Survey questions also measured public knowledge and perceptions of birds and their habitats. Data were analyzed using both mixed logistic regression and descriptive statistics. Respondent scores on the attitude, knowledge, and perception questions were included as co-variants in the regression model.

Findings indicate that many people have limited knowledge about birds, but strong concerns about their future condition. Most respondents also had positive attitudes towards birds, timber harvesting, and landowner assistance programs. The mean annual WTP across all proposed bird forestry programs was found to be $11.83 per household. When this value was extrapolated to 50% of households in PA, statewide demand for bird conservation was estimated to exceed $47 million annually. Overall, the magnitude of demand for bird conservation along with knowledge and attitudinal positions suggests that public investment in bird conservation on private lands is a legitimate strategy for enhancing public welfare and sustaining bird populations.

Keywords: Knowledge and attitudes, Attitude scale, Attitude psychology, Habitat management, Conservation, Willingness to Pay

Table of Contents

List of Figures

List of Tables

DISCLAIMER

Research with humans was approved in advance through the Pennsylvania State University Institutional Review Board (IRB), Submission-ID: STUDY00013358

.

Documents Approved:

Protocol (2), Category: IRB Protocol

Web survey (1), Category: Data Collection Instrument

ACKNOWLEDGEMENTS

I would like to express my profound gratitude towards my principal adviser Dr. Melissa M. Kreye. I thank her for providing the opportunity to pursue an MS degree and for her incredible support, time, guidance, motivation, and patience throughout these years. She has been a true friend and an amazing mentor. Her direction and encouragement have helped me grow both personally and professionally. I am highly indebted to my committee members Drs. Margaret C. Brittingham and Katherine Y. Zipp for their continuous guidance and constructive feedbacks and suggestions throughout the survey design, data collection and analysis, and thesis writing. Additionally, I am very thankful to Dr. Elizabeth W. Boyer and Mr. Ron Rohrbaugh for the timely support, motivation, materials, and guidance throughout this research.

This study was supported by Pennsylvania State University. I gratefully acknowledge the facilities and platform in the master's degree provided by the Department of Ecosystem Science and Management, College of Agricultural Sciences, Pennsylvania State University. My heartfelt acknowledgment goes to Forest Values and Benefits (FVB) Lab for providing logistic and technical support and field assistance. Audubon Pennsylvania and Cornell Lab of Ornithology deserve thanks for the bird pictures and songs/calls used in the research. I am thankful to the graduate students and faculty in the department for their help with the preliminary survey.

My cordial thanks go to Dr. David Munoz for being a great friend to overcome my first-year struggles. I appreciate Mr. Arun Regmi for his unconditional help in the field, suggestions, and discussions during data analysis, and materials and motivation during the MS degree. In addition, I am thankful to Nawa Raj Pokhrel, Pramod Pandey, Jay Paudel, Schmidt Nathaniel, Paris Werner, and Vishnupriya Sankararaman for their continuous help, emotional support, motivation, and love. Thanks! my dear friend and roommate Divya Pant and Moise Airgie, who has shared my longest days, joys, and sorrows. Finally, I thank God for the immense love over years and for being with me through thick and thin. At last, but not least I am deeply indebted to my family whose continuous love encouragement, endurance, and moral support were the unremitting source of inspiration for this study.

CHAPTER 1

Introduction

1.1 Ecosystem Services

The idea of viewing humans as an important component of natural systems, rather than a separate entity, is a recent paradigm shift in conservation science, which has fueled conservation efforts through more "people-centric" activities (i.e., anthropocentric) (Tuanmu et al., 2016). This trend is unsurprising and will continue when we better understand how ecosystems contribute to not only the survival of the human species but also their development by way of spiritual enrichment, cognitive development, recreation, and aesthetic experiences, inspiration, mental development, leisure, and more (De Groot et al., 2012).

Ecosystem Services (ES) are defined as all the products and functions of ecosystems that benefit humans or yield welfare to society (Lele et al., 2014). These services are primarily classified as provisioning (e.g., food, fuel, and fiber); regulating (e.g., water purification and climate regulation); supporting (e.g., photosynthesis); and cultural services (e.g., spiritual, aesthetic, supporting educational and recreational benefits). Ecosystem services can be eroded or enhanced depending on how natural resources are used, exploited, or managed. Many regulating, supporting, and cultural services within the realm of open access and pure public goods[1] (i.e., non-rivalrous, non-excludable) are, however, subject to market failure problems (Chee, 2004), due to uneven and inefficient distribution of goods and services in a free market. Inefficient distributions can lead to unsustainable tradeoffs in human welfare and environmental health. Economic valuation of these important services can help inform the responsible management and

[1] Public Goods are nonrivalry and nonexcludability in consumption. Nonrivalry means that the consumption of one person does not limit the amount available for others to consume. Similarly, nonexcludability indicates that nobody is able to be excluded from enjoying the good or service once it is available (Anomaly, 2015).

sustainable use of the world's natural capital through smart planning and decision-making (Chee, 2004).

The valuation of ecosystem services can help inform the relative importance of ecosystems and their management. There are several ways to understand these values, such as looking into how people allocate their income (i.e., market values), the way people use ecosystems outside of markets (e.g., recreation), and the way people think and understand ecosystems (i.e., attitudes and perceptions, actions, and behaviors). Some policies aim to enhance ecosystem service provision by compensating the producers of conservation outcomes (e.g., forest owners; Loomis et al., 2000). However, compensation-based solutions are often challenging as social values are broad, ardent, and difficult to measure. What is important to people may not always be expressed in their economic choices because of how some ecosystem services help support broader ideas such as identity, justice, education, freedom, and spirituality (Farber et al., 2002). As such, decision-makers need an improved understanding of both economic and social values to develop both economically efficient and fair policy decisions (Figure 1.1).

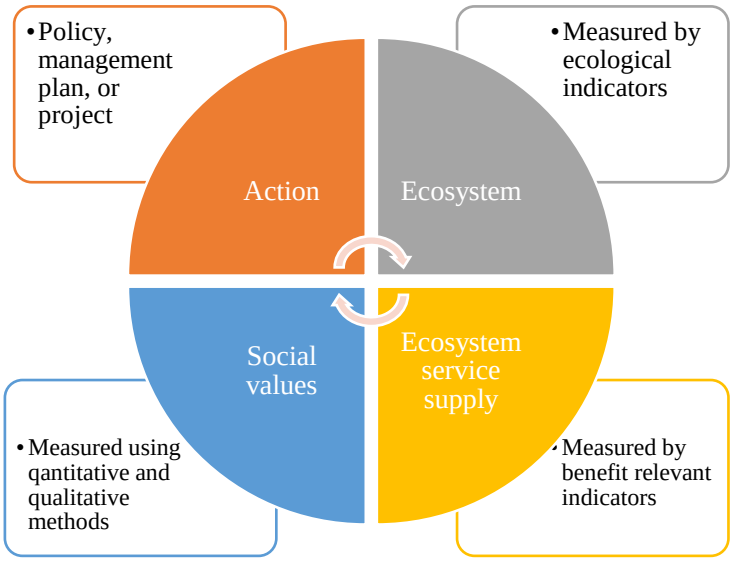


Figure 1.1. Relationship between ecosystems service provision, social values, and policy.

1.2 Forests of Pennsylvania

Forests in Pennsylvania have undergone a significant transition over the last few centuries. Intensive logging with subsequent disturbances (wildfire, flooding), contemporary agriculture, and urbanization have increased, which have imposed pressures on forest structure and

composition, including plant and animal biodiversity, and wildlife habitats (May, 2002; Nowackii & Abrams, 1994). Today private forests in Pennsylvania provide multiple ecosystem services and are more often considered important for timber provision and supporting the timber economy. Pennsylvania is one of the largest producers of hardwoods in the US, with timber revenues that exceed $5.5 billion annually (Albright et al., 2017). Most of the timber comes from private forests where more than 70 percent of the woodlands in Pennsylvania are owned by private citizens (estimated 738,000 owners; Figure 1.2; Metcalf, et al. 2012). More research is needed to understand the feasibility of encouraging private forest owners to provide diverse categories of ecosystem services and how to manage for resiliency against natural or anthropogenic impacts (Ratnadass et al., 2012).

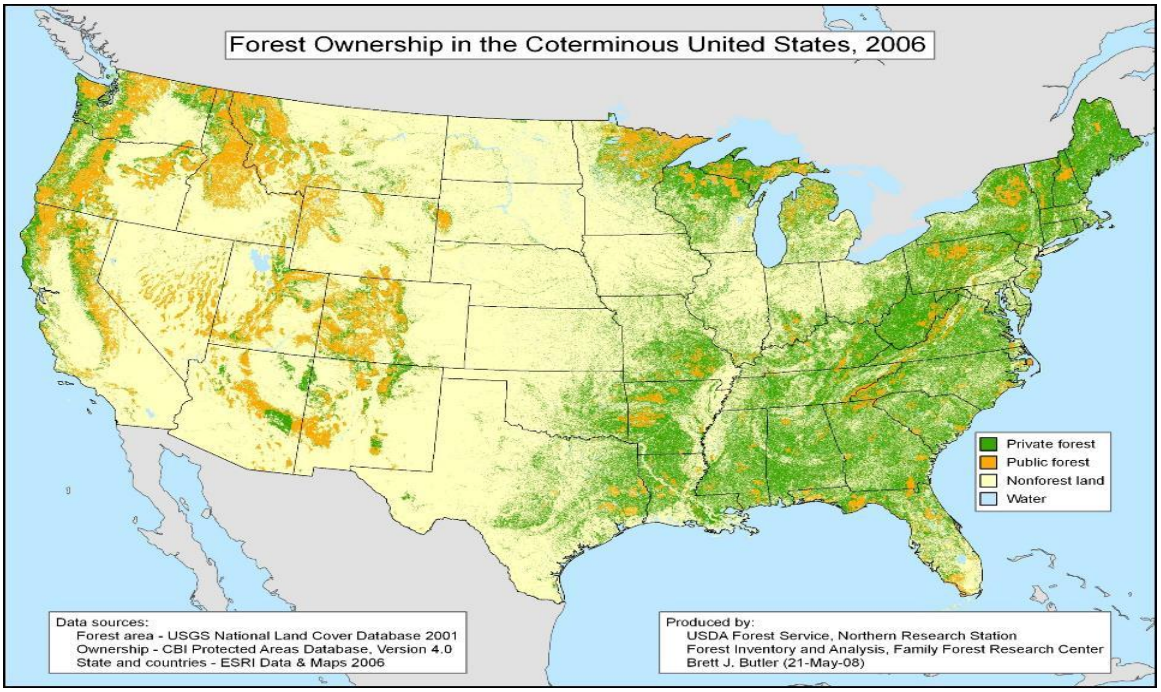


Figure 1.2. Forest Ownership Types in the USA including Pennsylvania (Source*: The Center for Private Forests*, *Penn State*)

1.3 Valuing Wildlife and Ecosystem Services

When it comes to ecosystem services, birds are often associated with many ecosystem services and values. Many of the use-value of birds can be understood by examining related markets (e.g., sale of hunting licenses, recreational passes, and equipment, replacement value techniques). For example, using replacement value techniques, the oak seed disbursal services provided by the Eurasian Jay were estimated to range from $875 to $3,916 per acre (Hougner et al., 2006). Birds

also help with pest control and pollination that allow ecosystems to function and remain healthy (Holmes et al., 1979). Gürlük and Rehber (2008) found birdwatching at national parks often exceeds US$103 million annually. Alternatively, the nonuse value or the value of knowing that wildlife species will exist in the future is also the subject of a growing body of research (Stevens et al., 1991). Together with use and nonuse value make up the total value of a good or service. Non-market valuation methods are currently the only method available for measuring both use and nonuse values associated with conserved ecosystems and wildlife.

To help advance ecosystem conservation it is often more feasible to focus on the value of a few selected species (e.g., endangered species; Edwards and Abivardi, 1998). This can be problematic because in some ecosystems the loss of other rare or less preferred species could reduce biodiversity and impact ecosystem resiliency (Hiron et al., 2018). Negative values towards some species can also occur because they are sometimes seen as a nuisance. For example, Corvid species provide valuable services such as carcass removal and cultural symbols and are viewed more positively in Europe and less positively in the US, where they have often been considered a pest (Clucas et al., 2012). These negative values are becoming less common, however, as public attitudes towards wildlife are evolving towards a more protectionist and less utilitarian perspective (Butler et al., 2003).

Estimates of economic value can help reveal where investment in wildlife protection and conservation may be a priority and how to design fair policies for people. Many forest owners need financial assistance to help with the management costs of wildlife habitats, and they also need assistance in creating cost-efficient management plans (Buffum et al., 2014). Research has also found that economic valuation strategies can also be led to more ecologically sustainable policies by integrating social scholarship in conservation and help reflect real conservation benefits and costs. (Bergstrom & Loomis, 2017). Measures of utility that include dollar values can help to clarify important tradeoffs across different policy alternatives and social, environmental, and economic domains (King et al., 2015).

1.4 Research Approach

I used standard research methods from the fields of economics and psychology and a multistep process to develop a valid and reliable survey tool that measures public knowledge, attitudes, and preferences for bird conservation on private lands (Figure 1.3). The reason for using both economics and psychology as frameworks for investigation is to understand both people's choices about bird conservation and what drives people's choices.

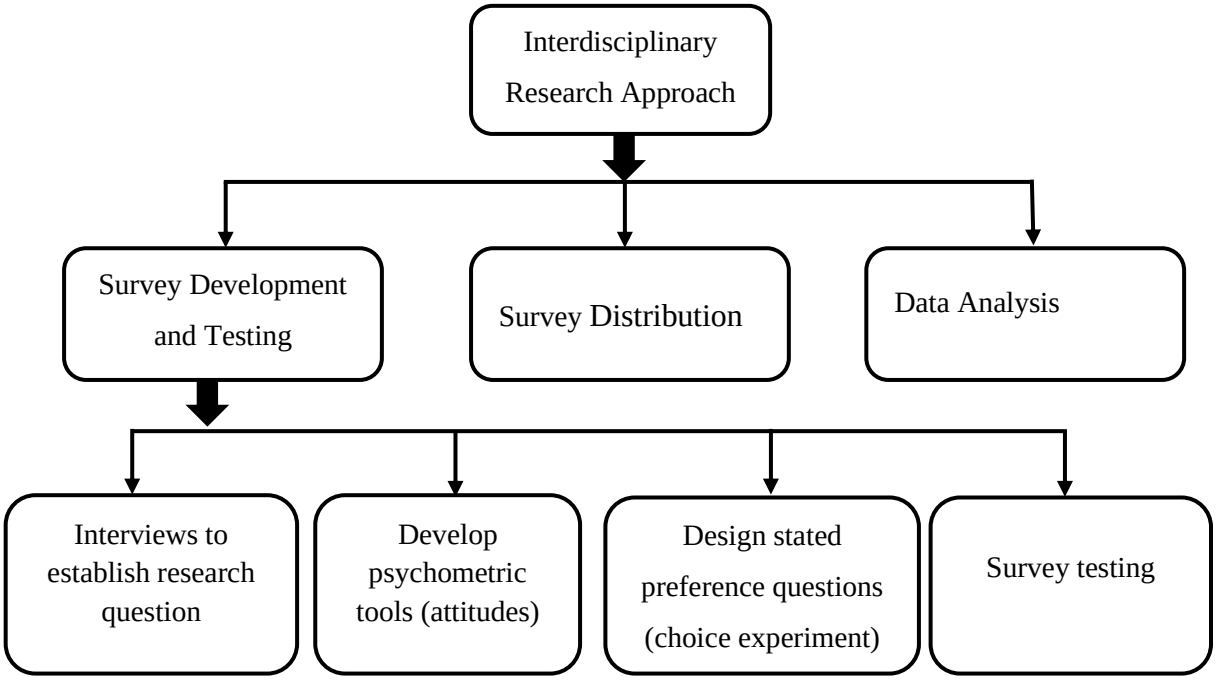


Figure 1.3. Research approach used

Non-Market Valuation

Non-market valuation strategies include both stated and revealed preference methods. The stated preference model is based on the respondent's choice from a series of hypothetical choice sets with multiple attributes (Adamowicz et al., 1994; Brooks & Lusk, 2010). Revealed preference methods draw statistical inferences on values from actual choices people make within markets (Boyle, 2003). Since the focus of this study is on private lands, where the public may have limited access, revealed preference methods may not be a suitable option. Stated preference methods are a preferred strategy because it is the only method available that can measure nonuse values and the potential for enhancing social welfare under alternative policy scenarios. This strategy also allows us to understand the social acceptability of new types of markets that can help enhance the provision of bird habitats (Jenkins et al., 2004).

Stated preference methods are typically conducted using survey questions that ask respondents their willingness to pay (WTP) for a good or service under different policy options. Value estimates can be associated with changes in service provision levels as well as maintaining current levels (protecting future options) using a variety of policy strategies, which is the approach I use here. There exist various uncertainties associated with the environmental decision-making process (Maier et al., 2008). Daniel Bernoulli's expected utility theory predicts that the decision-maker chooses between uncertain scenarios by evaluating the expected utility values of their outcomes to maximize utility (Meijer et al., 2015). While stated preference methods offer many advantages, the primary challenge associated with this methodology is the potential for measurement and response bias. A response bias is a systematic tendency to respond to a range of questionnaire items on some basis other than the specific item content (i.e., what the items were designed to measure). For example, a respondent might choose the option that is the most socially desirable (Paulhus, 1991). The respondent's knowledge of the good and psychological condition can help better explain WTP behaviors (Stevens et al., 1991). A preferred approach used in stated preference (SP) methods, and I use here, involves the generation and the analysis of choice data through the construction of a hypothetical market using a survey (Hoyos, 2010). It consists of several choice sets, each containing a set of mutually exclusive hypothetical alternatives between which respondents are asked to choose their preferred one (Hoyos, 2010).

Psychology of Choice

Economic choices are not just a reflection of the good but are also guided by personal values or principles. This is especially true in the case of environmental goods which are important for the survival and wellbeing of the individual as well as others. Maslow's hierarchy of needs is an example of how decisions about personal wellbeing outcomes and social responsibility are prioritized (Kishi et al., 2012). According to Maslow, air, food, clothing, and shelter are a person's most basic needs called survival or physiologic needs (Kiel, 1999). Higher needs on Maslow's pyramid include safety and security, love and belonging, and self-esteem and self-actualization. This means that a person may consider socially responsible choices, but only when their livelihood and safety needs are met. After this, the need for peer approval and self-actualization can help motivate altruistic behaviors and increase the perceived utility of making sacrifices for the group (Whitehead., 2017).

Another frequently cited model for the prediction of human behavior is the Theory of Planned Behavior (Fishbein and Ajzen, 1975; Ajzen, 1985, 1991). It states that people's choices (including economic choices) are often underpinned by attitudes, subjective norms, and perceived behavioral control (Figure 1.4). Attitudes are the individual's judgment of the behavior, positive or negative, and beliefs about the outcome of adopting the behavior. Subjective norms are the perceived social pressure the individual feels to perform or not to perform the behavior which is derived from normative beliefs (beliefs about what others think about one's performance of behavior) as well as from the individual's motivation to comply with these beliefs. Finally, the third determinant, perceived behavioral control, is the individual's perception of the ease or difficulty of performing the behavior. A person's perceived behavioral control arises from internal control beliefs (information, skills, abilities, emotions, and compulsions) and external control beliefs (opportunity and dependence on others) (Rannie and Craig, 1997). The relative importance of each set of beliefs underpinning attitudes (behavioral, normative, and control) varies for different persons, behaviors, and situations.

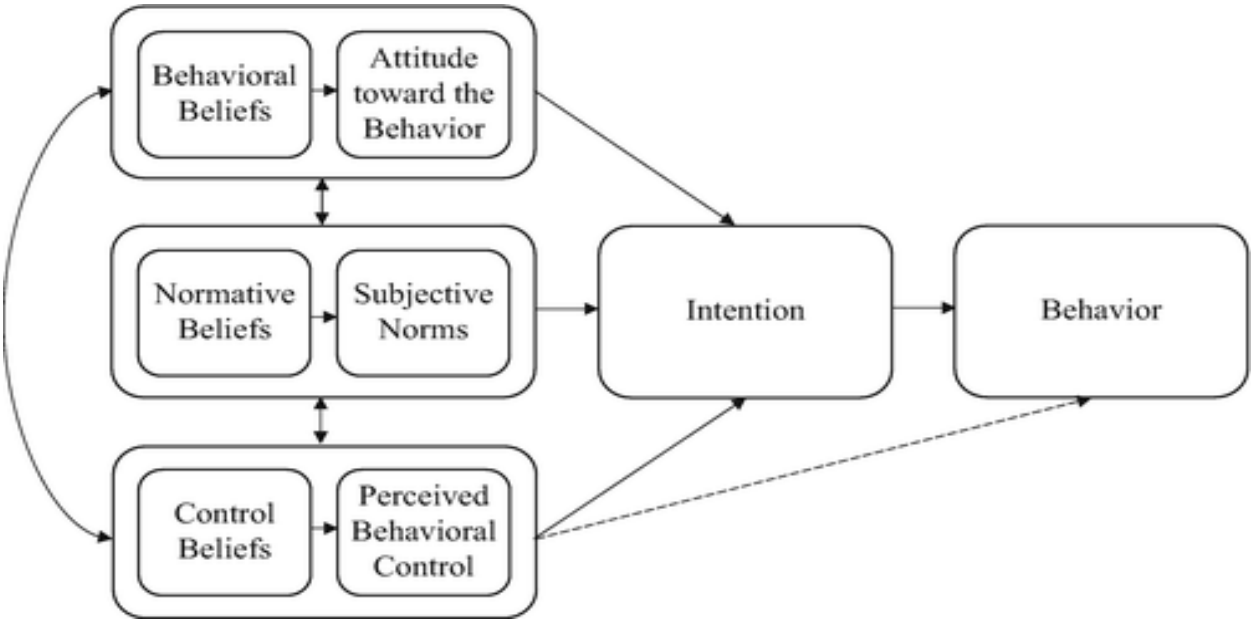


Figure 1.4. The Theory of Planned Behavior (Source: *Ajen 1985, 1991*)

Cognitive structures are schema or mental models that account for perceived knowledge in humans. An expectancy-value model can help determine which forms of knowledge and beliefs give rise to which attitudes (Bodur et al., 2000; Fishbein and Ajzen, 1975) Beliefs are formed based on people's knowledge and reasoned thinking about the outcome. How a person moves

through the reasoned thinking process influences their intentions to change behavior. Understanding underlying attitudes and beliefs can help inform educational strategies that advocate for environmental responsibility (Matlow et al., 2012). Extension programs are based on adult education theory which seeks to support transformative learning and critical reflection (Franz, 2007). However, there are limits to educational interventions since there is a wide range of other factors that can also influence behaviors (e.g., infrastructure, opportunity; Hashimoto-Martell et al., 2012).

1.5 Overview of Thesis Goals and Research Questions

My goal is to investigate the social value of birds in Pennsylvania by conducting a statewide survey that examines people's willingness to pay for bird conservation and the psychometric factors that drive those choices (i.e., knowledge, attitudes). Findings can be used by advocacy groups and government agencies to correct the market failure associated with private forests and wildlife-related benefits by justifying the advancement of bird-friendly forestry on private lands through the use of incentives, technical assistance, and public education.

Research Questions:

1. How does knowledge about birds and attitudes towards related issues (private lands management) potentially motivate different attitudes towards bird conservation?

2. What is the economic value of policies that promote the use of bird-friendly forestry on private lands?

1.6 Survey Design and Implementation

Survey Design

A statewide web survey was used to collect data from Pennsylvania residents to answer the research questions listed above (see a copy of the survey in Appendix A). The survey was developed using a multi-step process that included a literature review and interviews with stakeholders. Interviews were held with farmers, loggers, and forest landowners during Forest Expo and Ag progress days in State College. Five private forest conservation agencies and related federal stakeholders were also interviewed through telephone conversations and emails. Survey goals and survey design were also informed by experts and professionals from

Pennsylvania State University, Audubon Pennsylvania, Pennsylvania Game Commission, and Western Pennsylvania Conservancy. The final survey tool contained 39 questions.

Five-point agree/disagree Likert scales were developed to measure knowledge, perceptions, and attitudes towards bird conservation (Question 1). The knowledge questions pertained to bird identification, their food, status, habitat condition, and conservation status. The perception questions pertained to trends in bird populations, habitat loss, extinction, and risk of decline at present and in the future. Responses to the knowledge and perceptions scales were used as an indicator of how well-formed preferences were for the good on offer (i.e., the impact of information on choice). I also added the "I don't know" option to measure lack of knowledge. The perception questions pertained to trends in bird populations, habitat loss, extinction, and risk of decline at present and in the future. I used previously developed statements by (Kreye et.al, 2019) in a five-point Likert scale format to find respondent's perceptions on present good conditions and future risk of declination of birds and their habitats. The survey was presented to respondents with ten statements in which the first five describe the present good condition and the remaining talks about future (after 10 years) risk of decline. Participants were asked about their agreement and disagreement with the statements presented. Two different types of scenarios (good and risk) were presented to avoid bias about focusing on the declining trend. Later, I inverted the responses to see how well perceptions about condition align with recent research on the current poor condition of birds.

Since there are no psychometric scalar tools about birds, I developed a new attitude scale with 27 statements to measure people's attitudes towards birds. The scale was developed based on Kellert's attitudes towards wildlife scale and measured attitudes across 9 dimensions including: naturalistic, moralistic, ecologistic, aesthetic, humanistic, scientistic, dominionistic, negativistic, and symbolic ($\alpha = 0.91$; (Kellert, 1985). Chapter two of this thesis provides a complete description of how I developed and tested this new scale. I used existing attitude scales to measure attitudes towards harvesting and government involvement for managing private forests (Schaaf et al. 2006). The scale for harvesting contained statements related to harvesting for production and conservation outcomes. The scale measuring attitudes towards government involvement in private lands decisions contained statements related to using regulatory versus

educational interventions to encourage responsible forest management on private lands. The application of these scales is discussed further in Chapter two.

A choice experiment was used to measure individual WTP for bird conservation programs in PA (Question 2). Mean WTP values are then aggregated, based on the number of households in the state, to approximate statewide demand for bird conservation programs on private lands. The scenarios presented in the choice experiment included alternatives that described the types of bird that would be conserved (i.e., common or rare), the type of services the birds would provide (i.e., ecological or cultural services) the type of forest structure that would be conserved (i.e., young or mature), the type of assistance provided to forest owners (i.e., incentives, help with forest management plan) and the cost to the respondent per year (i.e., a general tax). I used a dichotomous choice question format where the respondent is asked to accept or reject each scenario, which is similar to the choice format used in a bond referendum to raise funds for local conservation activities. Chapter three of this thesis contains more information about how the choice experiment was designed, data analysis procedures (i.e., logistic regression), and the procedures used to estimate statewide demand for different policy alternatives. Multiple-choice questions were used to measure the demographic characteristics of respondents. This data would later be compared with US Census data to determine if a representative sample of Pennsylvania residents was collected.

Survey Implementation

The draft survey was pretested with professionals from forestry, resource economics, sociology, agriculture, engineering, law, management, business, Physics, Geoscience, and 11 public volunteers. The survey went through Institutional Review Board (IRB) approval before dissemination. The web survey was distributed using the web-based design platform (i.e., Qualtrics) in December of 2019. Online surveys are often considered more efficient, less time-consuming, and less expensive in data collection for large (regional and nationwide) studies (Dillman et al., 2008). To collected responses, I requested from Qualtrics a panel sample representing the demographic distribution of the population in PA based on the gender, race, age, education, and income distributions reported in the 2010 US Census. Qualtrics services collected the survey responses for me using their list of validated respondents in PA. Since the survey was

an opt-in web survey, a completion rate is considered comparable to a response rate in mail surveys (Callegaro and DiSogra, 2008).

Survey Response

A total of 821 complete survey responses were obtained for Qualtrics services. The responses had a completion rate of over 99%. Quality control procedures were used to remove the responses of those who completed the survey in less than 10 minutes (131 surveys) since it was estimated that the survey should take an average of 17 minutes to complete. Respondent zip codes were used to determine that responses were collected from every region of PA (Figure 1.5). The research results in Chapter 2 were based on 656 responses whereas the results in Chapter 3 were based on 690 usable responses.

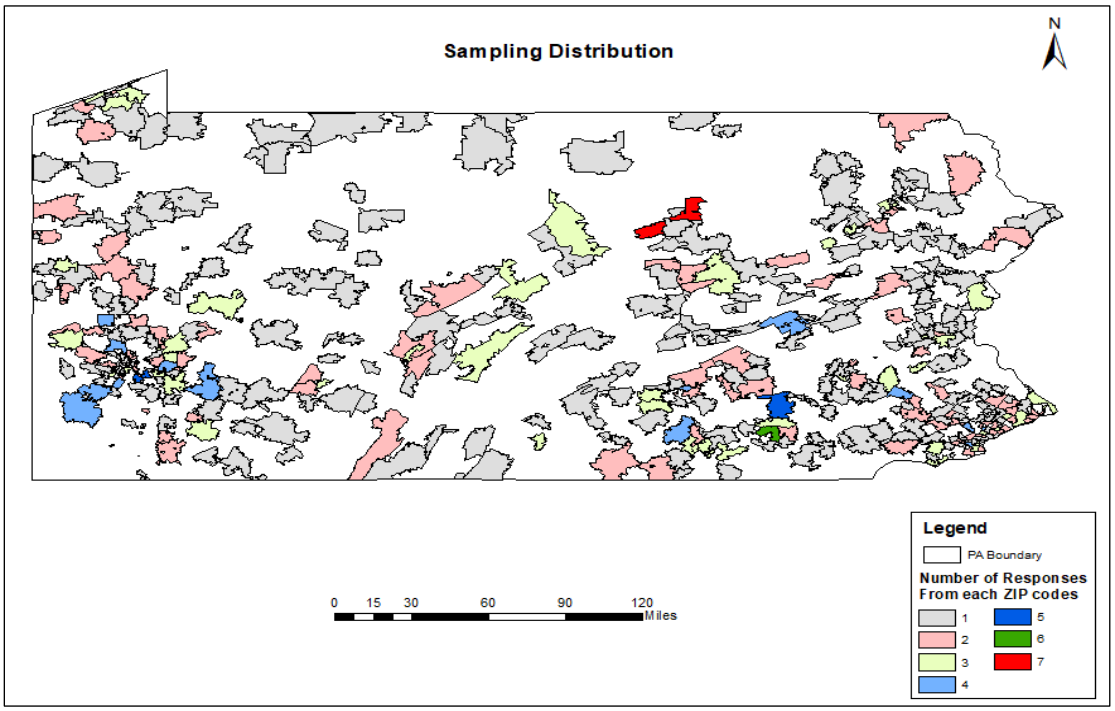


Figure 1.5. Respondents' distribution throughout Pennsylvania.

Approximately half (52.75%) of respondents were female, and 46.67% were male, and the remaining 0.82% did not prefer to answer as male or female (Table 1.1, see next page). Most respondents (69.42%) were classified as being 25 to 64 years in age. Most of the respondents were white/ Caucasian (86.09%) followed by African American (9.13%). Most of the respondents were high school graduates (31.30%) followed by respondents completing an undergraduate degree (21.01%). Most of the demographic distributions of survey respondents

were within 10% of the distributions reported in the 2010 US Census for Pennsylvania. Since standard raking procedures were incompatible with the analysis in Chapter 2, a conventional approach of dropping observations from categories that were oversampled was done before analysis to reduce sample bias (n=656). A raking procedure was used in the regression analysis in Chapter 3 to help create a more representative sample (n=690).

Table 1.1 Table showing respondent's characteristics in PA

Descriptive variables	**Sample**	**Sample**	**Pennsylvania Census 2010**
	Count	**%**	**%**
Gender			
Male	322	46.67	48.73
Female	364	52.75	51.17
Prefer not to answer	4	0.58	-
Age			
Age (median in years)	25-44		40.1 years
18 to 24	82	11.88	9.63
25 to 44	257	37.25	24.63
45 to 64	222	32.17	27.9
65 and over	129	18.70	16.68
Race			
White/Caucasian	594	86.09	77.7
African American	63	9.13	11.00
Asian/Pacific Islander(mixed)	10	1.45	4.8
Hispanic/Latino	17	2.46	6.1
Other	6	0.86	0.30
Education			
Some high school	25	3.62	8.80
High school graduate	216	31.30	30.80
Some college/no degree	127	18.41	11.00
Associates/ technical degree	100	14.49	12.30
Bachelor's degree	145	21.01	26.40

Graduate degree (MS/Ph.D.)	69	10.00	10.60
All other degrees	8	1.16	0.10
Income			
Less than $25,000	151	21.88	22.03
$25,000-$49,999	218	31.59	23.43
$50,000-$74,999	133	19.30	18.36
$75,000-$99,999	91	13.19	12.70
$100,000-$149,999	60	8.69	13.54
$150,000-$199,999	20	2.89	5.03
> $200,000	17	2.46	4.91

Source: U.S. Census Bureau, 2010

1.7 References:

Adamowicz, W., Louviere, J., & Williams, M. (1994). Combining revealed and stated preference methods for valuing environmental amenities. *Journal of environmental economics and management*, 26(3), 271-292.

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In *Action control* (pp. 11-39). Springer, Berlin, Heidelberg.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. doi:10.1016/0749-5978(91)90020-T.

Albright, T. A., McWilliams, W. H., Widmann, R. H., Butler, B. J., Crocker, S. J., Kurtz, C. M., ... & Riemann, R. (2017). Pennsylvania forests 2014. *Resour. Bull. NRS-111. Newtown Square, PA: US Department of Agriculture, Forest Service, Northern Research Station. 140 p., 111*, 1-140.

Anomaly, J. (2015). Public goods and government action. *Politics, Philosophy & Economics*, 14(2), 109-128.

Bergstrom, J. C., & Loomis, J. B. (2017). Economic valuation of river restoration: An analysis of the valuation literature and its uses in decision-making. *Water Resources and Economics*, 17, 9-19.

Bodur, H. O., Brinberg, D., & Coupey, E. (2000). Belief, affect, and attitude: Alternative models of the determinants of attitude. *Journal of Consumer Psychology*, 9(1), 17-28.

Boyle K.J. (2003). Introduction to Revealed Preference Methods. In: Champ P.A., Boyle K.J., Brown T.C. (eds) *A Primer on Nonmarket Valuation. The Economics of Non-Market Goods and Resources*, vol 3. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-0826-6_8

Brooks, K., & Lusk, J. L. (2010). Stated and revealed preferences for organic and cloned milk: combining choice experiment and scanner data. *American Journal of Agricultural Economics*, 92(4), 1229-1241.

Buffum, B., Modisette, C., & McWilliams, S. R. (2014). Encouraging family forest owners to create early successional wildlife habitat in southern New England. *PloS One*, 9(2), e89972.

Butler, J. S., Shanahan, J., & Decker, D. J. (2003). Public attitudes toward wildlife are changing: a trend analysis of New York residents. *Wildlife Society Bulletin*, 1027-1036.

Callegaro, M., DiSogra, C., 2008. Computing response metrics for online panels. *Public Opinion Quarterly* 72 (5), 1008–1032.

Chee, Y. E. (2004). An ecological perspective on the valuation of ecosystem services. *Biological Conservation*, 120(4), 549–565. https://doi.org/10.1016/j.biocon.2004.03.028

Clucas, B., & Marzluff, J. M. (2012). Attitudes and actions toward birds in urban areas: human cultural differences influence bird behavior. *The Auk*, 129(1), 8-16.

De Groot, R., Brander, L., Van Der Ploeg, S., Costanza, R., Bernard, F., Braat, L., ... & Hussain, S. (2012). Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem services*, 1(1), 50-61.

Dillman, D.A.; Smyth, J.D.; Christian, L.M. (2008). Internet, Mail, and Mixed-Mode Surveys. In the Tailored Design Method; John Wiley Sons: Hoboken, NJ, USA, 2008.

Edwards, P. J., & Abivardi, C. (1998). The value of biodiversity: where ecology and economy blend. *Biological Conservation*, *83*(3), 239-246.

Farber, S. C., Costanza, R., & Wilson, M. A. (2002). Economic and ecological concepts for valuing ecosystem services. *Ecological Economics*, 41(3), 375-392.

Fishbein, M. and Ajzen, I., (1975). Belief, attitude, intention, and behavior: an introduction to theory and research. Reading, MA: Addison-Wesley.

Franz, N. (2007). Adult education theories: Informing Cooperative Extension's transformation. *Journal of extension*, 45(1), 1-8.

Gürlük, S., and Rehber, E. (2008). A travel cost study to estimate recreational value for a bird refuge at Lake Manyas, Turkey. *Journal of Environmental Management* 88:1350–60.

Hashimoto-Martell, E. A., McNeill, K. L., & Hoffman, E. M. (2012). Connecting urban youth with their environment: The impact of an urban ecology course on student content knowledge, environmental attitudes, and responsible behaviors. *Research in Science Education*, 42(5), 1007-1026.

Hiron, M., Pärt, T., Siriwardena, G. M., & Whittingham, M. J. (2018). Species contributions to single biodiversity values under-estimate whole community contribution to a wider range of values to society. *Scientific reports*, 8(1), 1-7. https://doi.org/10.1038/s41598-018-25339-2

Holmes, R.T., J.C. Schultz & P. Nothnagle. (1979). Bird predation on forest insects: an enclosure experiment. *Science* 206: 462–463.

Hougner, C., Colding, J., & Söderqvist, T. (2006). Economic valuation of a seed dispersal service in the Stockholm National Urban Park, Sweden. *Ecological Economics*, 59(3), 364-374.

Hoyos, D. (2010). The state of the art of environmental valuation with discrete choice experiments. *Ecological Economics*, 69(8), 1595-1603.

Jenkins, M., Scherr, S. J., & Inbar, M. (2004). Markets for biodiversity services: potential roles and challenges. Environment: *Science and Policy for Sustainable Development*, 46(6), 32-42.

Kellert, S. R. (1985). American attitudes toward and knowledge of animals: An update. In *Advances in animal welfare science 1984* (pp. 177-213). Springer, Dordrecht.

Kiel, J. M. (1999). Reshaping Maslow's hierarchy of needs to reflect today's educational and managerial philosophies. *Journal of Instructional Psychology*, 26(3), 167-167.

King, E., Cavender-Bares, J., Balvanera, P., Mwampamba, T. H., & Polasky, S. (2015). Trade-offs in ecosystem services and varying stakeholder preferences: evaluating conflicts, obstacles, and opportunities. *Ecology and Society*, 20(3).

Kishi, H., Ito, K., Sugiura, S., & Kinoshita, E. (2012). A study of Maslow's hierarchy of needs and decision-making. In *Intelligent Decision Technologies* (pp. 89-97). Springer, Berlin, Heidelberg.

Kreye, M. M., Rimsaite, R., & Adams, D. C. (2019). Public attitudes about private forest management and government involvement in the southeastern United States. *Forests*, 10(9), 776.

Lele, E. a. (2014). Ecosystem Services: Origins, Contributions, Pitfalls, and Alternatives. *Conservation and Society*, *11*(4), 343. https://doi.org/10.4103/0972-4923.125752.

Loomis, J. B. (2000). Environmental valuation techniques in water resource decision making. *Journal of water resources planning and management*, 126(6), 339-344.

Maier, H. R.; Ascough, J. C.; Wattenbach, M.; Renschler, C. S.; Labiosa, W. B.; and Ravalico, J. K., (2008) Uncertainty in Environmental Decision Making: Issues, Challenges, and Future Directions. *Publications from USDA-ARS / UNL Faculty*. 399.https://digitalcommons.unl.edu/usdaarsfacpub/399

Matlow, A. G., Wray, R., & Richardson, S. E. (2012). Attitudes and beliefs, not just knowledge, influence the effectiveness of environmental cleaning by environmental service workers. *American Journal of Infection Control*, 40(3), 260-262., https://doi.org/10.1016/j.ajic.2011.02.024.

May, H. L. (2002). Managing forests for fish and wildlife. *Natural Resources Conservation Service*, Wildlife Habitat Management Institute. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010130.Pdf

Meijer, S. S., Catacutan, D., Ajayi, O. C., Sileshi, G. W., & Nieuwenhuis, M. (2015). The role of knowledge, attitudes, and perceptions in the uptake of agricultural and agroforestry

innovations among smallholder farmers in sub-Saharan Africa. *International Journal of Agricultural Sustainability*, 13(1), 40-54.

Metcalf, A.L., J.C. Finley, A.E. Luloff, and A.B. Muth. 2012. Pennsylvania's Private Forests: 2010 Private Forest Landowners Survey Summary. *Report to the Pennsylvania DCNR Bureau of Forestry*. 42 pp.

Nowacki, G. J., & Abrams, M. D. (1994). Forest composition, structure, and disturbance history of the Alan Seeger Natural Area, Huntington County, Pennsylvania. *Bulletin of the Torrey Botanical Club*, 277-291.

Paulhus, D. L. (1991). Measurement and control of response bias. In J. P. Robinson, P. R. Shaver, & L. S. Wrightsman (Eds.), Measures of social psychological attitudes, Vol. 1. Measures of personality and social psychological attitudes (p. 17–59). Academic Press. https://doi.org/10.1016/B978-0-12-590241-0.50006-X

Rannie, K., & Craig, D. M. (1997). Adolescent females' attitudes, subjective norms, perceived behavioral control, and intentions to use latex condoms. *Public Health Nursing*, 14(1), 51-57.

Ratnadass, A., Fernandes, P., Avelino, J., & Habib, R. (2012). Plant species diversity for sustainable management of crop pests and diseases in agroecosystems: a review. *Agronomy Sustain Dev* 32: 273–303. https://doi.org/10.1007/s13593-011-0022-4

Schaaf, K. A., Ross-Davis, A. L., & Broussard, S. R. (2006). Exploring the dimensionality and social bases of the public's timber harvesting attitudes. *Landscape and Urban Planning*, 78(1-2), 135-146.

Stevens, T. H., Echeverria, J., Glass, R. J., Hager, T., & More, T. A. (1991). Measuring the existence value of wildlife: what do CVM estimates really show? *Land Economics*, 67(4), 390-400.

Tuanmu, M. N., Viña, A., Yang, W., Chen, X., Shortridge, A. M., & Liu, J. (2016). Effects of payments for ecosystem services on wildlife habitat recovery. *Conservation Biology: The*

Journal of the Society for Conservation Biology, 30(4), 827–835. https://doi.org/10.1111/cobi.12669

United States Census Bureau / American FactFinder. “P12: Sex by Age.” 2010 Census.*U.S. Census Bureau, 2010*.Web. 1 January 2013 <http://factfinder2.census.gov>.

United States Census Bureau. 2010 Census.*U.S. Census Bureau. 2010*. Web. 1 January 2013 <http://www.census.gov/2010census/data/>.

Whitehead, P. M. (2017). Goldstein’s self-actualization: A biosemiotic view. *The Humanistic Psychologist*, *45*(1), 71.

CHAPTER 2

Knowledge Acquisition and Attitudes towards Birds and Private Forest Lands

Abstract: The eastern United States is dominated by private forest lands which are important for supporting a significant proportion of global bird populations. To help advance bird conservation on private lands, I assessed how public perceptions of birds and related cognitive states, such as attitudes towards private lands issues, may shape broader attitudes towards bird conservation. Data was collected using psychometric scales and a statewide web survey (n=656). We found bird-related attitudes were indeed a combination of people's understanding of birds as well as ideas about the role of private forest lands. Efforts to foster a positive feedback loop in the way people think about bird conservation and private forest management may help support bird conservation outcomes more broadly.

2.1. Introduction

As a category, birds are one of the most numerous animals on planet earth with upwards of 20,000 known species (May, 1992). Unfortunately, many bird species and population numbers are in decline, along with amphibians, fish, and insects, primarily due to habitat loss and pollution (Rosenberg et al., 2019). Government policies designed to protect vulnerable wildlife populations are dependent on strong public support to help justify the cost of taking action. Advocates of conservation look to use environmental education and outreach to help cultivate a more empathetic and knowledgeable public (e.g., environmental centers, summer camps). However, there is still a considerable amount of complacency and ignorance among the public regarding specific conservation needs (Bekoff, 2013; Vincenot, et al., 2015;). Private lands are also critical to the maintenance of many species as well as the recovery of federally listed endangered species due to changes in land use and other threats (Stein et al., 2010, Stauffer et al., 2017). But the subject of wildlife habitat conservation on private lands is often relegated to the idea that it is simply a benefit of landownership. Protection of endangered species on private lands can also be a potential source of conflict regarding the free exercise of private property rights (Kreye et al., 2018). However, research on family forest owners, one of the dominant

categories of forest landowners, suggests many have a strong ethical motivation to do right by the land and for wildlife (Bengston et al., 2011). Because of the dominance of private forest lands in the eastern United States (US), public attitudes about wildlife protection may interact with opinions about the role of private forest lands (Stein et al., 2009). In this paper, we explore some of the cognitive connections (i.e., the ways thoughts and feelings are processed to inform behavior) between birds and private forest lands to help better direct public education and policy efforts (Kreye et al., 2018).

2.1.1. Knowledge and Attitudes towards Wildlife

Social science concepts related to 'knowledge' have expanded in recent decades (Rydin, 2007). Knowledge is now understood as something embedded in sets of social relations (Wynne, 2002). How information is gathered, however, can affect the content and the quality of the information. The acquisition of factual knowledge is often done through formal education systems that provide foundational understanding in a specific discipline (Hew and Cheung, 2014). In the case of adults, however, information acquisition is more often self-directed and may lead people to depend on the information that is not science-based or make inaccurate judgments about how much he/she knows about the subject (Han, 2019). Perceptions about the environment are another form of knowledge and are a function of structure and spatial parts, underlying senses, and visual expressions (Johansson and Laike, 2007). Features about the person, such as profession, rank, and mobility can also shape perceptions and can also explain why some people can have different perspectives about the same problem (Breen, 2018; Koski et al., 2015). To help understand and overcome biases in knowledge acquisition there is a continuing need for research that examines the motives behind perceptions of value for wildlife (Ahnström et al., 2008; Vogdrup-Schmidt et al., 2019;).

The relationship between knowledge, attitudes, and pro-environmental behavior is well established through mega-theories such as the Theory of Planned Behavior and related studies (Lucarelli et al., 2020; Allum et al., 2008, Paço and Lavrador 2017). Attitudes can be a good predictor of motives and are generally defined as the tendency to think, feel, or act positively or negatively toward objects in our environment (Eagly and Chaiken 1993; Petty 1995). Social psychologists have long viewed attitudes as having three components: the cognitive, the affective, and the behavioral. The cognitive component refers to and depends on knowledge

about the object, the affective component addresses the feelings about the object, and finally, the behavioral component relates to the way people act toward the object (Eagly and Chaiken 1993). The balance between affection/sympathy and economic self-interest is often what complicates human attitudes toward animals (Serpell, 1986, 2004). Human evolutionary coexistence with wildlife, as a source of food/competition/predation, is the likely origin of some attitudes toward animals (Herzog & Burghardt, 1988). Human values toward animals may also be contingent on the biological and communicative resemblance between animals and humans. For example, birds are diurnal and use auditory forms of communication which makes them more analogous to humans and perhaps more favored when compared to fish or reptiles (Hummel et al., 2015). People also tend to be empathetic towards small animals, like birds and squirrels, but this doesn't always hold for all small animals such as bats, snails, and other invertebrates (Bjerke and Østdahl, 2004). Kellert (1985) offers a more holistic explanation and describes attitudes and actions towards wildlife as a function of the perceived utility of the animal, its capacity to draw empathy from humans, and our moral obligation to other living things (Batt, 2009).

Research in environmental education has found that helping people connect to nature and learn about wildlife can help increase the perceived value of nature and conservation actions (Deem et al., 2001). Perceptions of value and the desire for more information often occur within a feedback loop, each feeding the other. For example, landowners with positive perceptions of wildlife were found to be more willing to learn about birds and bird-friendly forestry (Lutter et al., 2018). Familiarity and exposure to common wildlife can also increase its value. For example, feeding garden birds have been found to increase people's personal wellbeing by viewing themselves as a caretaker (Brock et al., 2017). Some organizations will strategically use wildlife with appealing attributes to help invoke positive emotions towards conservation more broadly (e.g., panda bears; Batt, 2009). The information given at parks and zoos about species, such as endangered wildlife, has also been found to increase the likelihood that these species are eventually conserved (Maschinski et al., 2012; Tribe and Booth, 2003). Our ability as humans to manipulate our concern for certain species suggests that wildlife values are often a social construction operating independently of the ecological importance or inherent value of a species. Because of this, it is important to advance educational interventions that support not only human interests and promote sustainable relationships between humans and wildlife.

2.1.2 Attitudes about Wildlife on Private Lands

Many of the laws and regulations associated with wildlife function by directly protecting the animal itself (e.g., bag limits). This approach is incomplete, however, for the recovery of threatened and endangered species because declines in many species are related to habitat loss which causes more indirect harm to the broader population (Eichenwald et al., 2020). Because habitat loss is more likely to occur on private lands, the North American model of wildlife management works to support attitudes that motivate sustainable voluntary behaviors towards wildlife, rather than increase laws or regulation (Organ et al., 2012). This approach is not unwarranted as there is evidence that greater autonomy can be useful for motivating environmentally responsible actions by allowing individuals to have ownership of their actions (e.g., good land steward; Kreye et al., 2016).

Concepts such as *sense of place* are often used to explain how communities perceive and respond to social and ecological change and may be important for explaining how some people respond to changes in wildlife populations. Personal psychological connections to the land are sometimes described by participants as a "Way of life" (Rajala et al., 2020) which often involves certain actions (e.g., timber harvesting) and the cultivation of preferred relationships (e.g., with government or wildlife). When it comes to engaging in sustainable behaviors with wildlife, many forest owners face the same challenges as the public, including competing priorities and limited resources and knowledge (Bengston et al., 2011). For example, timber harvesting can be an important habitat management tool, but the knowledge needed to direct certain harvesting activities is often limited and cost-prohibitive (Finley, 2021). Many forests owners also need technical and financial assistance to help manage habitat and offset potential negative impacts of having wildlife on their land (e.g., crop damage; NRCS, 1970). Public opinions about the use of government involvement often adjoin community values about landowner autonomy since the type of government intervention (e.g., regulation, incentives, assistance) can compromise or enhance these values (Schaaf et al. 2006). The interaction between attitudes towards government and wildlife is most apparent when there is controversy over species management (Sponarski et al., 2014).

In this paper, we investigate how different forms of knowledge and attitudes towards birds potentially interact with attitudes towards private land management and government involvement

in management decisions. We hypothesize that in addition to conventional forms of information acquisition, opinions about the role of private forest lands may also influence perspectives about bird conservation. The cognitive-based parameters measured in this study include knowledge and perceptions about the condition of bird populations and attitudes towards birds, timber harvesting, and government involvement in private lands decisions.

2.2 Methodology

2.2.1 Theoretical Approach

The theoretical framework used in this study was based on the Theory of Planned Behavior which posits those behavioral intentions are a function of attitudes, subjective norms, and perceived behavioral control (Ajzen 1991). Attitudes in particular serve as an important motivation for acting and are often a function of people's knowledge and experiences with the issue (Albarracín and Wyer 2000). We broaden the scope of attitudinal factors by also examining how attitudes towards related policy issues can interfere or support motivations to support bird conservation (i.e., interactions between attitudes; Figure 2.1, see next page).

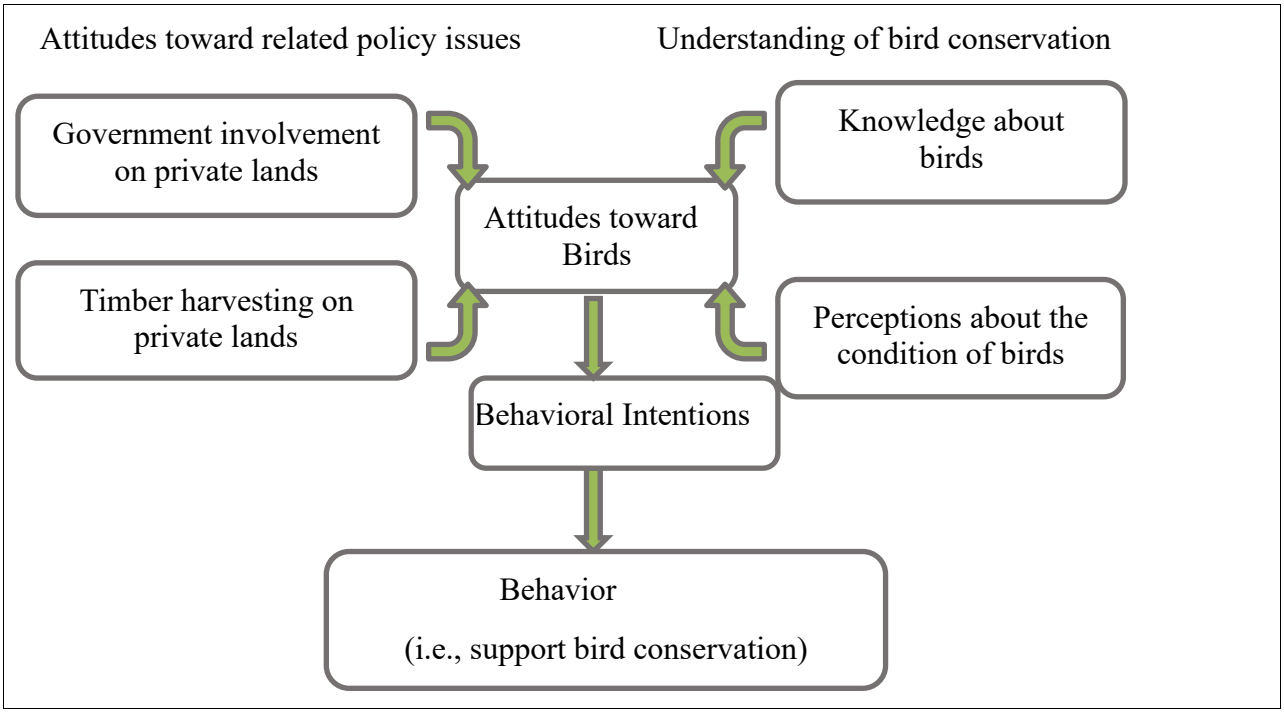


Figure 2.1. Conceptual model of the relationship between attitudes towards birds, knowledge and perceptions, and attitudes toward other issues related to bird conservation policy.

2.2.2 Study Site

This study was conducted in the state of Pennsylvania, which is located in the northeastern region of the United States. The Pennsylvania landscape is dominated by forests and a majority of forest lands are privately owned (70% private ownership; Albright et al., 2017). In this region, forests are an important landscape feature for many types of local and migratory birds, and forest management is an important strategy for enhancing the habitats needed to support healthy bird populations (Brittingham, 2021).

2.2.3 Survey Design

Data was collected using a statewide web survey targeting members of the public. The survey tool was developed using a multistep process including a literature review, interviews with stakeholders, validation procedures for the psychometric scales, and testing with prospective respondents. The final survey tool contained 40 questions and was estimated to take 17 minutes to complete. Multiple-choice questions were used to measure the demographic characteristics of respondents. Agree/disagree Likert scales (five-point) were used to measure knowledge, perceptions, and relevant attitudes. An example of the survey can be found in Appendix A.
To measure attitudes towards birds, a new psychometric scalar tool was developed using standard methods (Boateng et al., 2018). The purpose of developing the scale was to understand which attitudinal dimensions underpin broader attitudes towards birds, the direction of attitudes (positive or negative), and the intensity or strength of the attitude. The content of the scale was based on Kellert's attitudes towards wildlife scale which included attitudinal dimensions such as naturalistic, moralistic, ecologistic, aesthetic, humanistic, scientistic, dominionistic, negativistic, and symbolic (Kellert, 1985). Preliminary surveys were conducted to verify if the proposed dimensions were indeed relevant to birds (n = 96). Potential items (i.e., statements) in the scale were also drafted and tested using a literature review, expert consultations, and interviews with the public (n=39). A Cronbach's alpha test[2] was conducted with 80 observations to determine the

[2]The Cronbach's alpha assesses the internal consistency of the scale items, i.e., the degree to which the set of items in the scale co-vary, relative to their sum score. An alpha coefficient of 0.70 has often been regarded as an acceptable threshold for reliability; however, 0.80 and 0.95 is

reliability, or internal consistency of the scale (Taber, 2018). The final scale consisted of a five-point Likert scale response format, contained 27 statements across nine dimensions (3 items in each dimension), and had a Cronbach's alpha of 0.90 indicating the quality of the scale was very good (Wessa, 2017: Table 2.1).

Table 2.1. Statements (items) used to measure nine attitude dimensions towards birds (α =0.90).

Attitudinal dimension	**Statements**
Naturalistic Attitudes	I am very interested in observing birds in their natural habitat
	Birds often help enhance my recreational experiences (i.e., hiking, biking, camping)
	Observing birds in nature helps me feel connected with nature
Humanistic Attitudes	I feel a connection with birds because they seem to communicate the same way I do (e.g., vocal patterns/ language /conversation)
	I feel a connection with birds because of the way birds care and provide for their family (e.g., nesting, collecting food)
	I consider myself a caretaker of the birds that live around me.
Moralistic Attitudes	It is wrong to produce excessive pollution that harms birds and other wildlife
	Humans should work to reduce excess pollution to help improve the survival of birds and other wildlife
	Humans should conserve and manage habitat for birds along with other wildlife
Aesthetic Attitudes	I would describe the sights and sounds of birds as beautiful, pleasing, or satisfying.
	I would describe the sights and sounds of birds as fascinating or very interesting.
	I think birds are often colorful or eye-catching.

preferred for the psychometric quality of scales (Cronbach, 1951, Boateng et al., 2018; DeVellis, 2012; Raykov and Marcoulides, 2011;). Cronbach's alpha has been the most common and seems to have received general approval; however, reliability statistics such as Raykov's rho, ordinal alpha, and Revelle's beta, which are debated to have improvements over Cronbach's alpha, are beginning to gain acceptance (Boateng et al., 2018).

Ecologistic Attitudes	I appreciate the way that birds help make human lives better (i.e., pollination, seed dispersal, reducing pests, removing waste).
	I place a high value on bird species that are in danger of going extinct.
	It is important to me that we protect bird species so that future generations may enjoy them.
Scientistic Attitudes	We can learn a lot from understanding how bird species reproduce (i.e., courting, mating).
	We can learn a lot from understanding the survival strategies that birds use (i.e., hunting, and nesting strategies, defend territory, migration).
	We can learn a lot from understanding how birds fly (e.g., wing shape).
Symbolic Attitudes	Birds are important/useful to me as symbols of my religion or spirituality (e.g., peace, messenger).
	Birds are important/useful to me as symbols of groups or organizations I care about (e.g., company logo, sports team).
	Birds are important/useful to me as symbols of important cultural values (e.g., freedom, patriotism).
Negativistic Attitudes (disservices)	I get very upset when birds damage my property (e.g., crashing into windows, defecating on cars)
	I am very concerned about the public health risks associated with birds (e.g., fly into airplanes, carry disease)
	I think wild birds often destroy crops and harm domestic poultry.
Dominionistic Attitudes	I am not bothered when birds are caged.
	The purpose of birds is to please and entertain people.
	I am not bothered when birds are hunted for meat and recreation.

To measure public attitudes toward harvesting on private forest lands an existing validated attitude scale by Schaaf et al., 2006) was used ($\alpha = 0.75$). This five-point Likert scale contained seven statements (Table 2.2) representing either pro-harvesting (e.g., "harvesting is good for the economy") or anti-harvesting views (e.g., "forests should be left untouched by humans"). Another four statements related to harvesting for either forest management purposes (e.g., improve forest health and regeneration) or harvesting for production and economic purposes. A companion scale by Schaaf et al., 2006 was used to measure attitudes towards government involvement in private decisions about forest management ($\alpha = 0.85$). Four statements represented intervention through landowner assistance strategies and four statements represented top-down or regulatory approaches (Table 2.2).

Table 2.2 Statements used to measure the public attitudes towards timber harvesting and government involvement ($\alpha = 0.75$ and 0.85 respectively).

Topic	Attitudes	
Timber Harvesting	Management	Cutting trees can sometimes be good for a forest
		Some forest management by humans is necessary
		Cutting and removing trees should be following by planting trees
		Forests should be left untouched by humans
	Production	Harvesting is good for the economy
		Cutting and removing trees is sometimes necessary to provide economic profits to the forest owner.
		Forests should be used to provide products such as paper and lumber that humans can use.
Government Involvement	Landowner Assistance	The government should use financial incentives to help or encourage private owners to change management practices.
		The government should conduct workshops on best forest management practices for private forest owners.
		The government and private forest owners should work together toward forest conservation.
		The government should use positive images and cultural symbols to promote forest conservation.
	Regulation	The government should be able to regulate the use of forests located on private land to protect public benefits.
		The government should have the right to tell private forest owners how to best manage their forests.
		There should be regulations regarding how trees are managed on private forest land
		The government should fine privately forest owners who fail to use best management practices.

Scalar tools were also used to assess public knowledge and perceptions about birds and their condition (Kreye et.al, 2019). The items used in the knowledge scale provided both subjective and objective measures of knowledge (Table 2.3, see next page). For example, respondents were asked how strongly they agreed with statements describing judgments of their knowledge (2 statements), if they demonstrated reasoned action in the past by supporting local conservation

activities (1 statement) and how strongly they agreed with a list of bird facts (4 statements). An "I don't know" option was also presented along with the list of bird facts. The level of agreement with statements measuring subjective knowledge and reasoned action indicates the respondent's level of confidence in how much the respondent thinks they know. The level of agreement with statements measuring objective knowledge indicates the level of confidence that they answered the question correctly. Respondents who more often agreed with true bird facts were considered generally knowledgeable. Respondents who more often disagreed with bird facts were considered potentially misinformed. The "I don't know" response was used as an indicator of a lack of knowledge about birds. Perceptions were measured in a similar way using a agree/disagree five-point Likert scale (Table 2.3, see next page). These statements described positive and negative perceptions about the current and future condition of birds and the condition of different types of habitats. Those who more often agreed with positive statements about the current condition of birds and habitats were considered to have generally positive perceptions or low-risk perceptions. Those who more often agreed with statements that described birds and their habitats as being worse off in the future were considered to have greater risk perceptions.

Table 2.3. Statements (items) used to measure knowledge and perceptions in a five-point Likert scale (α=0.70 and 0.80 respectively)

Topic	Measure	Items
Knowledge	*Subjective*	I know most of the birds I encounter in my day-to-day surroundings
		I know most of the birds I encounter when visiting natural areas in Pennsylvania
		I actively support organizations that seek to conserve wildlife habitat (e.g., member, donor, voter)
	Factual	Plant and animal biodiversity is needed to ensure the sustainability of most ecosystems
		Some species of cranes, warblers, and grouse are on the federal endangered species list
		In more recent years whip-poor-wills have been less abundant
		The golden-winged warbler interbreeds with the blue-winged warbler to produce offspring
Perceptions	*Present*	Most common bird populations are in good condition
		Most rare bird populations are in good condition
		Field habitats are generally available and in good condition
		Young forest/shrubby habitats are generally available and in good condition
		Mature forest/old tree habitats are generally available and in good condition
	Future	In ten years, some common bird populations will be worse off than they are now
		In ten years, some rare bird populations will be in worse off than they are now
		In ten years, some field habitats will be lost or in worse condition
		In ten years some young/shrubby forests will be lost or in worse condition
		In ten years, some mature forests/old trees will be lost or in worse condition

2.2.4 Data Collection and Analysis

The Qualtrics web survey service was used to collect panel responses from 656 households in Pennsylvania based on gender, age, education, and income (95% CI and a 5% margin of error). The survey had a 99% completion rate indicating a low level of response bias. For opt-in web surveys, a completion rate is considered comparable to a response rate in mail surveys (Callegaro and DiSogra, 2008). When compared to the 2010 US Census, respondents were somewhat representative of the general population in Pennsylvania (see Table 1.1 Chapter 1). Approximately half (52.75%) of respondents were female. Most respondents (69.42%) were

classified as being 25 to 64 years in age and 46.66% a two-year college degree or greater. Respondents who were white/Caucasian were oversampled by almost 10%.

To determine the strength and direction of attitudes means and grand means were calculated for individual items and attitudinal dimensions (groups of items) within each scale. Means greater than 4 suggest that response options "agree" or "strongly agree" were frequently selected for that item or dimension. To understand associations between designated cognitive parameters (i.e., attitudes, knowledge) Spearman's correlation analysis was used with the grand means of the items. Spearman rank-order correlation coefficient is a nonparametric test that measures the strength and direction of association between two variables that are measured on an ordinal or continuous scale, such as Likert scale data (Lowry, 2005). With this test, we assume a monotonic or linear relationship between the two variables. A Spearman correlation coefficient of +1 indicates a perfect association of ranks, a coefficient of zero indicates no association between ranks and a coefficient of -1 indicates a perfect negative association of ranks. The closer coefficient is to zero, the weaker the association between the ranks. Demographic variables were coded using the categories presented in the survey question (e.g., male= 1, female =0).

Attitudinal data is also reported in the paper using a calculated score for each respondent. The score is the sum of a person's responses (ranging from 1 to 5) across all statements in the scale. Scores associated with the bird attitude scale could range from 27 (strongly negative) to 135 (strongly positive). Respondents with scores ranging from 27–63 were classified as strongly negative towards birds, scores between 64 and 99 were classified as having neutral attitudes, and scores between 100 and 135 were classified as strongly positive towards birds. Before this analysis, responses to items measuring negativistic attitudes (disservices) were inverted so that greater agreement indicates more positive attitudes towards birds. This same process was used for the other attitude and knowledge scales. In the timber harvest management scale, respondents with scores ranging from 4 to 9 were classified as strongly negative towards harvesting, scores between 10 to 15 were classified as having neutral attitudes, and scores between 16 to 20 were classified as strongly positive towards harvesting. Similarly, for the timber harvest production scale, respondents with scores ranging from 3 to 7 were classified as strongly negative towards harvesting, scores between 8-11 were classified as having neutral attitudes, and scores between 12-15 were classified as strongly positive towards harvesting. For the trust in government scale

respondents with scores ranging from 5-9 were classified as strongly negative towards government, scores between 10-15 were classified as having neutral attitudes, and scores between 16-20 were classified as strongly positive towards the government. For the subjective knowledge scales, respondents with scores ranging from 3-7 were classified as having low knowledge, scores between 8-11 represented a moderate level of knowledge, and 12-15 were classified as having a high level of knowledge. For the factual knowledge scale, respondents with scores ranging from 5-9 were classified as having low knowledge, scores between 10-15 were classified as having a moderate level of factual knowledge, and scores between 16-20 were classified as having high factual knowledge.

2.3 Results

Across all scalar tools, the largest grand means were associated with the perception that birds will decline in the future, attitudes towards landowner assistance programs, and attitudes towards birds (Table 2.4). Mean values for knowledge were generally lower and the variation in mean response was generally greater (SD>1; (Table 2.4).

Table 2.4. Descriptive statistics for 5-point Likert scale agree/disagree questions measuring attitudes and knowledge parameters.

Items	Grand Mean	St. dev.	Min	Max	No. of Statements	No. of Obs
Attitudes towards birds	3.72	0.51	1	5	27	656
Attitudes towards timber harvesting for management purposes	3.68	0.70	1	5	4	656
Attitudes towards timber harvesting for economic purposes	3.50	0.83	1	5	3	656
Attitudes towards landowner assistance programs	3.98	0.79	1	5	4	656
Attitudes towards government regulation	3.59	0.77	1	5	4	656
Subjective knowledge	3.13	1.02	1	5	3	656
Factual Knowledge	2.75	1.24	1	5	5	656
Perceived condition of birds	3.09	0.77	1	5	5	656
Perceived risk of a decline in birds	4.05	0.77	1	5	5	656

On the bird attitude scale, four of nine dimensions had grand means greater than four, including moralistic, aesthetic, eocologistic, and scientistic (Figure 2.2). Respondents most often agreed with statements that describe humans as having a moral responsibility to reduce pollution to protect bids, to protect birds so future generations can enjoy them, the idea that birds are colorful and eye-catching, and the idea that we can learn a lot from bird survival behaviors (Appendix B, Table 1). Positive experiences with birds in nature and concerns about the negative impact of birds (e.g., crop and property damage) had an important but lesser role in explaining attitudes towards birds with a grand mean of 3.83, SD 0.82 and 3.40, SD 0.77, respectively. Symbolic and dominionistic attitudes played a minor role overall with a grand mean of 3.32, SD 1.04 and 2.44, SD 0.91, respectively.

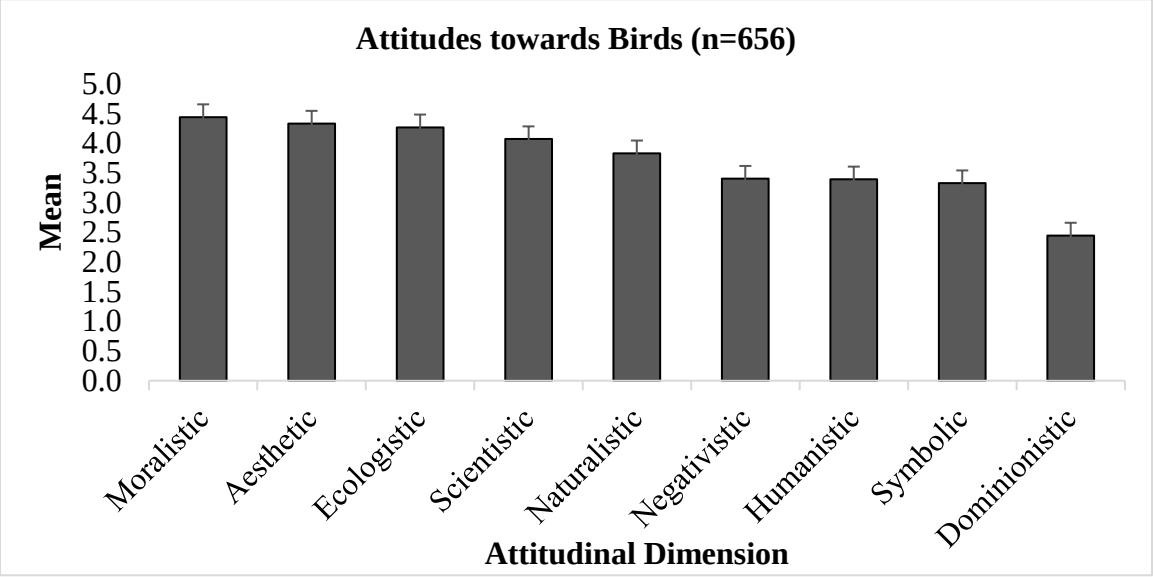


Figure 2.2 Grand means statements on a five-point Likert Scale describing different attitudinal dimensions towards birds in Pennsylvania (n=656).

Calculated respondent scores indicate most respondents have either neutral (40%) or positive (59%) attitudes towards birds. Very few were classified as having negative (1%) attitudes towards birds (Figure 2.3) on the next page.

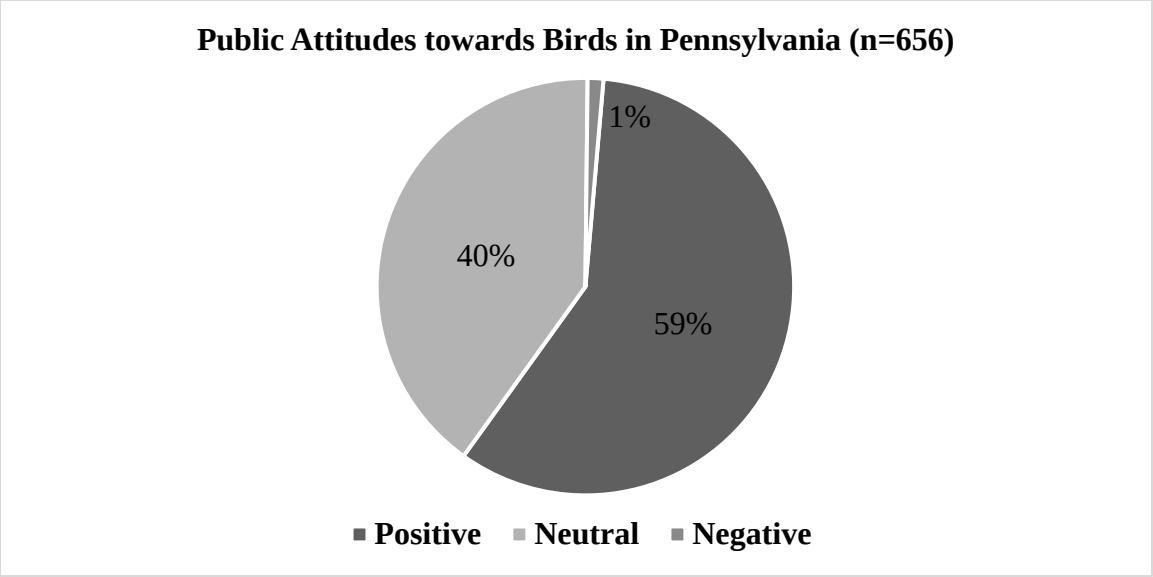


Figure 2.3. Percent of survey respondents classified as having positive, neutral, or negative attitudes towards bird conservation based on individual scores.

Attitudes toward harvesting on private lands were mixed with approximately half of respondents being neutral and half positive (Table 2.5). There was no significant difference in attitudes towards harvesting for management or production purposes (Table 2.5). Items with the highest percent agreement include the opinion that harvesting is good for the economy, but that trees should be replanted after harvesting (Table 2, Appendix B).

Table 2.5. The number and percent of survey respondents were classified as having positive or negative attitudes towards harvesting trees for timber production and management.

Attitudes	**Attitudes towards Harvesting**			
	Production		**Management**	
	Number	**% of the total sample**	**Number**	**% of the total sample**
Positive	266	40.54	295	44.97
Neutral	319	48.62	329	50.15
Negative	71	10.82	32	4.88
Total	**656**	**100**	**656**	**100**

Regarding government involvement in private land decisions, most respondents agreed that the government should have some role, but generally preferred landowner assistance strategies (Figure 2.4). Approximately 63% of respondents were classified as having positive attitudes towards landowner assistance programs, whereas attitudes towards regulations were more mixed. Most agreed and strongly agreed with statements that pose that forest owners and the government should work together towards forest conversion (Table 3, Appendix B). Most also disagreed or were neutral toward the statement that the government has a right to tell private forest owners what to do.

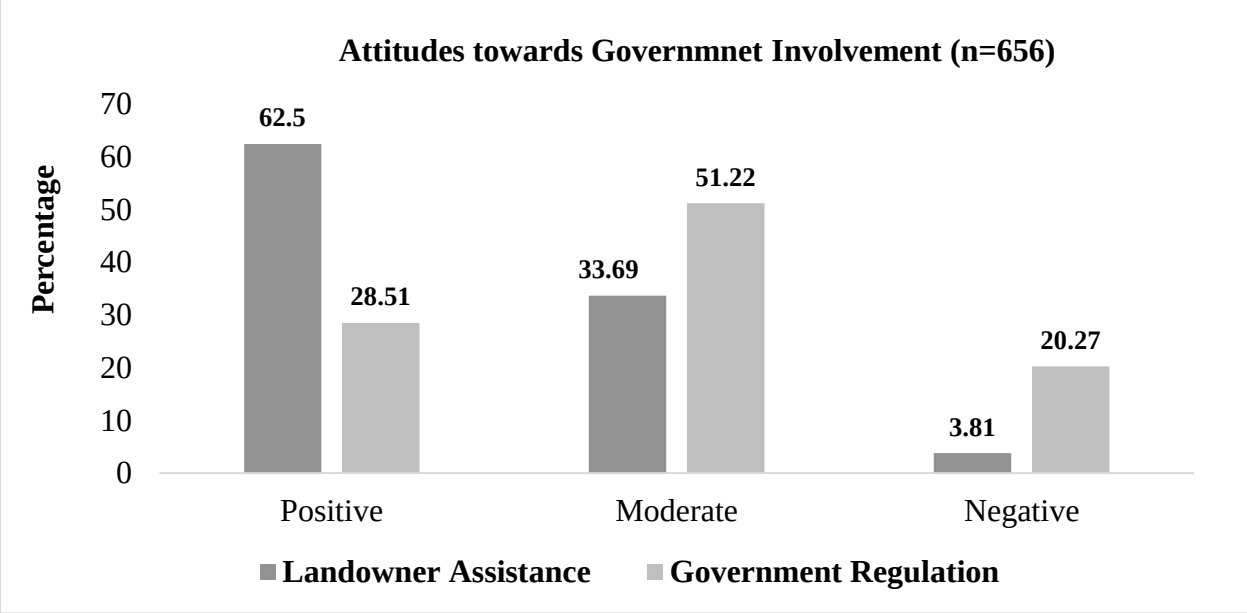


Figure 2.4. Percent of survey respondents and attitudes towards government involvement on private forest lands through landowner assistance programs and regulations.

Metrics assessing knowledge classified most respondents as having moderate levels of subjective knowledge (48.78%) and low levels of fact-based knowledge (61.28%; Table 2.6). Only 13% of respondents were classified as having a high level of factual knowledge about birds. Respondents selected “I don’t know” to factual statements 29% of the time on average. Up to three percent of respondents disagreed with some factual statements indicating few respondents have misinformation about birds (Table 4, Appendix B).

Table 2.6. Number and percent of survey respondents and level of subjective and factual knowledge based on respondent's confidence in identifying wild birds, support for conservation, and agreement with science facts about bird ecology.

	Subjective knowledge		**Factual knowledge**	
	Number	**% of the total sample**	**Number**	**% of the total sample**
High	187	28.51	84	12.80
Moderate	320	48.78	204	31.10
Low	183	27.90	402	61.28
Total	**656**	**100**	**656**	**100**

The risk that birds will be worse off in the future was the strongest perception among respondents. Over 76.0% were classified as believing that birds and their habitats will be worse off in 10 years (Figure 2.5). A little more than 50% expressed concern for birds at present, but these concerns were more moderate in tone. Most respondents agreed with statements that described common birds as being in good condition and both young and old forest habitats are generally available (Table 5, Appendix B). Most were concerned that rare birds would be worse off in the future followed by mature forests and young forest habitats.

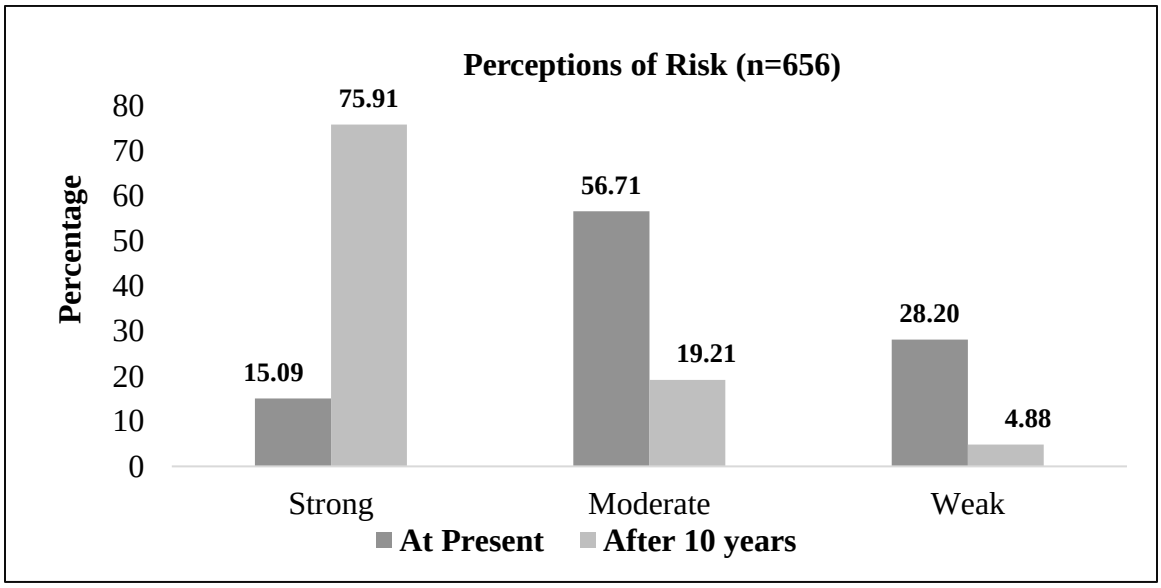


Figure 2.5. Percent of survey respondents classified by perceptions of current conditions and risk that birds and their habitats are worse in 10 years.

Spearman's correlation analysis revealed several important associations between attitudes towards birds and other cognitive parameters (Table 2.7). Many coefficients were signs indicating the presence of a correlation, but only a few had a coefficient greater than 0.4 indicating that the magnitude of the correlation was moderate or meaningful in size (Hassan, 2017, Weaver et al., 2017). Attitudes about landowner assistance programs had the greatest number of coefficients > 0.4 indicating that people with positive attitudes towards landowner assistance programs are also more likely to have diverse types of attitudes toward birds. Naturalistic and humanistic attitudes were moderately associated with subjective and factual forms of knowledge, whereas moralistic and ecologistic attitudes were moderately associated with risk perceptions about birds. The coefficients describing attitudes towards harvesting and demographic variables were also significant but weakly associated with attitudes towards birds in any dimension.

Table 2.7. Spearman's correlation rank test between attitudinal dimensions towards birds and designated cognitive parameters.

Attitudinal dimensions	Subjective Knowledge	Factual knowledge	Perception (Condition)	Perception (Risk)	Harvesting (Management)	Harvesting (Production)	Assistance Programs	Govt. Regulation	Gender	Age
Naturalistic	**0.4833***	0.3873*	-0.0062	0.2636*	0.0365*	0.0029	**0.4713***	0.2357*	0.0181	0.0266
Humanistic	**0.4734***	**0.4454***	0.0214	0.2135*	-0.0656*	-0.0413*	0.3612*	0.2180*	0.0112	0.093
Moralistic	0.1922*	0.1909*	-0.2615*	**0.4408***	0.1533*	-0.0719*	**0.5879***	0.2270*	-0.0812	0.054
Aesthetic	0.2571*	0.2356*	-0.1347*	0.3707*	0.1358*	0.0251	**0.5339***	0.1666*	-0.0395	0.1673
Ecologistic	0.3006*	0.2928*	-0.2042*	**0.4177***	0.1542*	-0.0367*	**0.5927***	0.2487*	0.0034	0.1101
Scientistic	0.2590*	0.2884*	-0.1133*	0.3858*	0.0499*	-0.0202	**0.5323***	0.2378*	-0.0168	0.1219
Symbolic	0.2995*	0.3385*	0.0690*	0.1788*	-0.0783*	0.1354*	0.2728*	0.2515*	0.0024	-0.0798
Negativistic	0.1168*	0.0926*	-0.2104*	0.1607*	-0.0066	-0.2325*	0.1289*	-0.0214	0.0082	0.0225
Dominionistic	-0.1058*	-0.0447*	0.3036*	-0.2875*	0.0883*	0.3221*	-0.2816*	-0.0932*	0.0939	-0.0339

*= 5%, 10%; bold text rho>0.40

2.4 Discussion

Most respondents in this study were classified as having low knowledge about birds, which suggests that many attitudes and preferences for bird conservation may not be well-formed. The knowledge and experiences people have in nature are important for shaping conservation-related attitudes (Cox and Gaston, 2015). Related studies have found familiarity with bird species can often be attributed to a person's past experiences with these species (Hummel et al., 2015) Respondents in Tanzania tended to know more about birds near the villages because they were more easily observed and thus are familiar to the respondents (Clamsen and Røskaft, 2013). When a person has enough similar experiences, they tend to reach some generalization about themselves, and he/she tends to label it as knowledge (Han, 2019). This analysis found those who considered themselves knowledgeable tended to have naturalistic and humanistic attitudes towards birds. This means that the way they valued birds was more often centered on enjoying birds in nature and having a feeling of connection with birds who have similar qualities as humans. Related studies have found many people derive wellbeing by adopting a warden-like role towards the wildlife in backyards (Brock et al., 2017). While both these types of attitudes are fundamentally good for motivating bird conservation behaviors, it may also bias people to support programs that focus only on local birds or birds with behaviors similar to humans (e.g., nesting). These attitudes may even work against efforts to support birds that are hidden from view (e.g., in a remote location) or birds that display behaviors that are revolting to humans (e.g., eating Carron). Wilson and Tisdell (2005) found public's support for the conservation of different bird species depends on people's understanding of that species' existence and status. As such, self-directed knowledge may be incomplete for motivating support for a more well-rounded perception of bird conservation.

Perceptions about the current conditions of birds were mixed, and most respondents classified as having moderately strong opinions that birds and habitats today are in good condition. This could be argued as being incongruent with the research related to the actual condition of birds, which shows many bird populations are in decline due to loss of habitat (Rosenberg et al., 2019). Related studies have found that people's perceptions about birds are often unrelated to the true condition of birds when it comes to species richness or biodiversity (Belaire et al., 2015). One reason could be related to local and regional differences in species and distribution of habitats.

For example, Tryjanowski et al., (2015) found well-known species, such as gulls, ducks, and corvids are mostly distributed in cities whereas farmland birds, such as finches and tree sparrows are distributed in rural areas. Misunderstandings about the conditions of birds can eventually limit a person's sense of responsibility and their willingness to pay for conservation (Jacobson et al., 2003; Smallshire et al., 2004; Herzon and Mikk, 2007). Similarly, this study found perceptions about current conditions to be weakly correlated attitudes towards birds, which suggests that without a better understanding of the problem there may not be enough motivation to act.

Despite having limited knowledge, most respondents did have established risk perceptions about the condition of birds and their habitats. This risk perception was positively correlated with both moralistic and ecologistic attitudes. Perceptions of risk are often a function of a complex mixture of information acquisition and understanding (Burger et al., (2008). However, the finding that many with risk perceptions feel a moral responsibility towards birds appears to be a rational response. Our own experiences with declines in environmental quality and associated health impacts could be a source of empathy and moral reasoning for protecting birds. Reynolds, (2006) that says if an individual understands how others might feel or react, he/she becomes more sensitive to potential negative effects of their choices and can better predict the likely outcomes of each option (see also Mayer et al., 2017). Vitell & Patwardhan (2008) advance the idea that individuals tend to use the perceived harm construct (e.g., the magnitude of consequences, probability of effect, temporal immediacy, and concentration of effect) to determine intentions in situations involving ethical issues.

Those with risk perceptions were also more likely to value birds simply because they exist as part of a holistic ecosystem or want to maintain birds for future generations to enjoy (Whelan et al., 2015). Importantly, these non-use values for birds are not subject to people having better experiences with birds, which could be an unwieldy requirement for supporting bird conservation more broadly. How risk perceptions were formed was not examined in this study, but some risk perceptions may come from information people select to learn about birds (Allum et al., 2008; Paço and Lavrador, 2017). The risk may also be related to broader perceptions about land-use change and a general interest in the wellbeing of animals overall (Chamberlain et al., 2016; Hummel et al., 2015). How the risk question was framed in this study may have also

affected responses. Economic studies show that presenting loss frames in ecological messages is often more effective in gaining support for conservation (De Golia et al., 2019). Likewise, loss aversion is often understood to be a powerful driver of conservation support (Gonzalez-Ramirez et al., 2018). More research is needed to better understand the factors that shape risk perceptions since the associated attitudes towards birds seem to serve an important role in motivating bird conservation behaviors.

Attitudes toward timber harvesting were not strongly associated with any of the attitudes towards birds. However, dominionistic attitudes were more often found among those who strongly support timber harvesting for production, but the association was relatively weak. The indifference found between harvesting for production or management purposes suggests public preferences for harvesting may not be well informed. A key indication of this was the large support for replanting after harvesting, but natural tree regeneration after harvest is the practice most used by foresters in Pennsylvania. Related studies also confirm that public opinions about harvesting are often not well informed. Many people tend to have intermittent experiences with forests (e.g., recreation) which may not give rise to a sophisticated understanding of forest management over long periods (McCool et al., 1986). People's preconceptions about silvicultural activities also do not always correspond with visual assessments of the forest condition (Tahvanainen et al., 2001). Overall, the public appears uninformed about the role of harvesting in habitat management.

Attitudes about government involvement in private lands decisions were generally positive and supportive of landowner assistance programs. Support for landowner assistance programs was more strongly correlated with five of the attitudinal dimensions towards birds. The attitudinal dimensions were the same as with the knowledge and risk perceptions variables, with one exception, humanistic attitudes. Aesthetic attitudes were also enhanced for those who supported landowner assistance. Pennsylvania has a long history of supporting strong private property rights. Many landowners in the US prefer Sermons (information, cooperation, advice, help, and management ideas) over Sticks (Restrictions and mandatory regulations) and Carrots (financial/informational subsidies) as indicated by a large body of research (Serbruyns and Luyssaert, 2006; Joshi and Arano, 2009; Kreye et al., 2019). The dominance of private lands in Pennsylvania also means that a large portion of the public are also landowners. It appears that the

knowledge and activities that lead people to support landowner assistance programs may also work to support a more well-rounded perspective of bird conservation. Interest in environmental quality often increases when people are given the right to protect, manage and utilize (e.g., revenue) the land (Rasolofoson et al., 2015). This suggests that cultural values that work to support private forest lands in Pennsylvania can also work to support positive attitudes towards bird conservation. It also suggests that society may look to private lands to help protect vulnerable bird populations.

In comparison, attitudes about government regulation, which were more mixed among respondents, were not associated with attitudes towards birds, even though regulations are often used to control pollution and there is a strong moral sentiment among respondents to protect birds from pollution (Castillo-Huitrón, 2020). This suggests that cultural values about how to best support bird populations would likely support a mix of voluntary and regulatory approaches. Demographic characteristics such as gender and age were also not correlated with attitudinal dimensions, suggesting that educational messages may not need to be strategically designed for specific categories of people to help foster a wider range of attitudes towards birds.

2.5 Conclusions

A statewide web survey with psychometric scales was used to help understand how people's perceptions and experiences with birds, and attitudes towards related policy issues can help shape attitudes about bird conservation in Pennsylvania. Study limitations include the underrepresentation of non-white members of the public. The four questions assessing factual knowledge were also likely limited as an indicator of a person's comprehensive knowledge about birds. I found many people have positive towards birds, but the finding that a large percent of the public is also neutral suggests that broader ambivalence towards bird conservation may be a barrier to taking action. The process by which knowledge about birds, and their need for conservation, is acquired seems to have an important influence on the attitudes people have towards birds and the type of conservation programs they may support. Having a general knowledge or interest in birds was associated with only a few attitudinal dimensions related to positive experiences with birds and may only support programs that foster positive interactions with nature. Risk perceptions were more often associated with non-use values and support for programs that minimize the harm done by humans. But again, there was less diversity in

attitudinal dimensions which may reduce the types of conservation programs people may be willing to support. Those with positive attitudes towards private lands and support for landowner's assistance programs were more likely to have a wider range of attitudinal dimensions towards birds. This suggests that advocates of private lands may be an important ally in helping educate people about the need for bird conservation. A more sophisticated emotional response towards birds is needed to support diverse types of bird conservation programs at local and regional levels. Fostering positive cognitive connections between birds and support for private forest owners may be an effective strategy for enhancing bird habitat on private lands. Future research should examine the economic value of managing birds on private lands to support the provision of these types of assistance programs.

2.6 References:

Ahnström, J. (2008). Höckert J. Bergeå HL Francis CA Skelton P. Hallgren L. Farmers and nature conservation: What is known about attitudes, context factors, and actions affecting conservation. *Renewable Agriculture and Food Systems*, *24*, 38-47.

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211.

Albarracín, D., & Wyer, R. S., Jr (2000). The cognitive impact of past behavior: influences on beliefs, attitudes, and future behavioral decisions. *Journal of personality and social psychology*, *79*(1), 5–22. https://doi.org/10.1037//0022-3514.79.1.5

Albright, T. A., McWilliams, W. H., Widmann, R. H., Butler, B. J., Crocker, S. J., Kurtz, C. M., ... & Smith, J. E. (2017). Pennsylvania forests 2014. *Resour. Bull. NRS-111. Newtown Square, PA: US Department of Agriculture, Forest Service, Northern Research Station. 140 p., 111*, 1-140.

Allum, N., Sturgis, P., Tabourazi, D., & Brunton-Smith, I. (2008). Science knowledge and attitudes across cultures: a meta-analysis. *Public understanding of science*, *17*(1), 35-54.

Batt S. (2009). Human attitudes towards animals in relation to species similarity to humans: a multivariate approach, Bioscience Horizons: *The International Journal of Student Research*, Volume 2, Issue 2, June 2009, Pages 180–190, https://doi.org/10.1093/biohorizons/hzp021.

Bekoff, M. (Ed.). (2013). Ignoring nature no more: The case for compassionate conservation. University of Chicago Press.

Belaire, J. A., Westphal, L. M., Whelan, C. J., & Minor, E. S. (2015). Urban residents' perceptions of birds in the neighborhood: Biodiversity, cultural ecosystem services, and disservices. *The Condor: Ornithological Applications*, *117*(2), 192-202.

Bengston, D. N., Asah, S. T., & Butler, B. J. (2011). The diverse values and motivations of family forest owners in the United States: an analysis of an open-ended question in the National Woodland Owner Survey. *Small-Scale Forestry*, *10*(3), 339-355.

Bjerke, T., & Østdahl, T. (2004). Animal-related attitudes and activities in an urban population. *Anthrozoös*, 17, 109-129.

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best practices for developing and validating scales for health, social, and behavioral research: a primer. *Frontiers in public health*, *6*, 149.

Breen, R. (2018). Social mobility in Europe (pp. 464-479). *Routledge.*

Brittingham, M. (2021, February 27). Management practices for enhancing wildlife habitat. Retrieved March 10, 2021, from https://extension.psu.edu/management-practices-for-enhancing-wildlife-habitat

Brock, M., Perino, G., & Sugden, R. (2017). The warden attitude: An investigation of the value of interaction with everyday wildlife. *Environmental and Resource Economics*, *67*(1), 127-155.

Burger, J., Greenberg, M., Gochfield, M., Shukla, S., Lowrie, K. and Keren, R. (2008), "Factors influencing acquisition of ecological and exposure information about hazards and risks from contaminated sites", *Environmental Monitoring and Assessment,* Vol. 137 Nos 1-3, pp. 413-425.

Callegaro, M., DiSogra, C., 2008. Computing response metrics for online panels. *Public Opinion Quarterly 72 (5),* 1008–1032.

Castillo-Huitrón, N. M., Naranjo, E. J., Santos-Fita, D., & Estrada-Lugo, E. (2020). The importance of human emotions for wildlife conservation. *Frontiers in Psychology, 11*.

Chamberlain, D. E., Pedrini, P., Brambilla, M., Rolando, A., & Girardello, M. (2016). Identifying key conservation threats to Alpine birds through expert knowledge. *PeerJ*, *4*, e1723.

Clamsen M. E., & Røskaft, E. (2013). Knowledge of birds of conservation interest among the people living close to protected areas in Serengeti, Northern Tanzania. *International Journal of Biodiversity Science, Ecosystem Services & Management*, *9*(2), 114-122.

Cox, D. T., & Gaston, K. J. (2015). Likeability of garden birds: Importance of species knowledge & richness in connecting people to nature. *PloS one*, *10*(11), e0141505.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *psychometrika*, *16*(3), 297-334. Doi:10.1007/BF02310555

De Golia, A. H., Hiroyasu, E. H., & Anderson, S. E. (2019). Economic losses or environmental gains? Framing effects on public support for environmental management. *PloS one*, *14*(7), e0220320.

Deem, S. L., Karesh, W. B., & Weisman, W. (2001). Putting theory into practice: wildlife health in conservation. *Conservation biology*, 15(5), 1224-1233.

DeVellis RF., (2012). Scale Development: Theory and Application. Los Angeles, CA: Sage; Publications (2012).

Eagly, A. H., & Chaiken, S. (1993). The psychology of attitudes. Harcourt brace Jovanovich college publishers.

Eichenwald, A. J., Evans, M. J., & Malcom, J. W. (2020). US imperiled species are most vulnerable to habitat loss on private lands. *Frontiers in Ecology and the Environment*, 18(8), 439-446.

Finley, J. (2021, February 07). Forest stewardship: Timber Harvesting: An Essential management tool. *PennState Extension*. Retrieved March 10, 2021, from https://extension.psu.edu/forest-stewardship-timber-harvesting-an-essential-management-tool

Gonzalez-Ramirez, J., Arora, P., & Podesta, G. (2018). Using insights from prospect theory to enhance sustainable decision making by agribusinesses in Argentina. *Sustainability*, *10*(8), 2693.

Han, T. I. (2019). Objective knowledge, subjective knowledge, and prior experience of organic cotton apparel. *Fashion and Textiles*, 6(1), 1-15.

Hassan, K. (2017). Re: Interpretation of correlation coefficients? Retrieved from: https://www.researchgate.net/post/Interpretation-of-correlation-coefficients/58f8d3eded99e127370dcf5c/citation/download.

Herzog Jr, H. A., & Burghardt, G. M. (1988). Attitudes toward animals: Origins and diversity. *Anthrozoös*, *1*(4), 214-222.

Herzon, I., & Mikk, M. (2007). Farmers' perceptions of biodiversity and their willingness to enhance it through agri-environment schemes: A comparative study from Estonia and Finland. *Journal for Nature Conservation*, 15(1), 10-25.

Hew K.F., Cheung W.S. (2014) Enhancing Students' Learning of Factual Knowledge. In: *Using Blended Learning*. Springer Briefs in Education. Springer, Singapore. https://doi.org/10.1007/978-981-287-089-6_6.

Hummel, E., Ozel, M., Jerez, W. M., Usak, M., Prokop, P., & Randler, C. (2015). Interest in birds and its relationship with attitudes and myths: A cross-cultural study in countries with different levels of economic development. *Educational Sciences: Theory & Practice*, *15*(1).

Jacobson, S.K., Sieving, K.E., Jones, G.A., Van Doorn, A. (2003). Assessment of farmer attitudes and behavioral intentions toward bird conservation on organic and conventional Florida farms. *Conservation Biology* 17 (2), 595–606.

Johansson, M., & Laike, T. (2007). Intention to respond to local wind turbines: the role of attitudes and visual perception. *Wind energy: an international journal for progress and applications in wind power conversion technology*, 10(5), 435-451.

Joshi, S., & Arano, K. G. (2009). Determinants of private forest management decisions: a study on West Virginia NIPF landowners. *Forest Policy and Economics*, *11*(2), 118-125.

Kellert, S. R. (1985). American attitudes toward and knowledge of animals: An update. In *Advances in animal welfare science 1984* (pp. 177-213). Springer, Dordrecht.

Koski, J. E., Xie, H., & Olson, I. R. (2015). Understanding social hierarchies: The neural and psychological foundations of status perception. *Social Neuroscience*, 10(5), 527-550.

Kreye, M. M., Adams, D. C., & Ober, H. K. (2018). Protecting imperiled wildlife species on private lands: Forest owner values and response to government interventions. *Ecological Economics*, 149, 254-264.

Kreye, M. M., Adams, D. C., Escobedo, F. J., & Soto, J. R. (2016). Does policy process influence public values for forest-water resource protection in Florida? *Ecological Economics*, 129, 122-131.

Kreye, M. M., Rimsaite, R., & Adams, D. C. (2019). Public attitudes about private forest management and government involvement in the southeastern United States. *Forests*, 10(9), 776.

Lowry, R. (2005). Spearman rank-order correlation coefficient. *Retrieved May*, *15*, 2005.

Lucarelli, C., Mazzoli, C., & Severini, S. (2020). Applying the Theory of Planned Behavior to Examine Pro-Environmental Behavior: The Moderating Effect of COVID-19 Beliefs. *Sustainability*, *12*(24), 10556.

Lutter, S. H., Dayer, A. A., Heggenstaller, E., & Larkin, J. L. (2018). Effects of biological monitoring and results outreach on private landowner conservation management. *PloS one*, 13(4), e0194740.

Maschinski J., Wright S.J., Lewis C. (2012) The Critical Role of the Public: Plant Conservation through Volunteer and Community Outreach Projects. In: Maschinski J., Haskins K.E., Raven P.H. (eds) Plant Reintroduction in a Changing Climate. *The Science and Practice of Ecological Restoration.* Island Press, Washington, DC.

May, R. (1992). How Many Species Inhabit the Earth? *Scientific American, 267*(4), 42-49. Retrieved March 9, 2021, from http://www.jstor.org/stable/24939252

Mayer, A., Shelley, T. O. C., Chiricos, T., & Gertz, M. (2017). Environmental risk exposure, risk perception, political ideology, and support for climate policy. *Sociological Focus*, *50*(4), 309-328.

McCool, S. F., Benson, R. E., & Ashor, J. L. (1986). How the public perceives the visual effects of timber harvesting: An evaluation of interest group preferences. *Environmental Management*, 10(3), 385-391.

National Research Council (NRC). 1970. *Land Use and Wildlife Resources*. Washington, DC: The National Academies Press. https://doi.org/10.17226/9576

Organ, J. F., Geist, V., Mahoney, S. P., Williams, S., Krausman, P. R., Batcheller, G. R., ... & Decker, D. J. (2012). The North American model of wildlife conservation. *The Wildlife Society Technical Review*, *12*(04).

Paço, A., & Lavrador, T. (2017). Environmental knowledge and attitudes and behaviors towards energy consumption. *Journal of environmental management*, *197*, 384-392.

Petty, R. 1995. Attitude change. In Advanced Social Psychology, 195–255, ed. A. Tesser. New York: McGraw-Hill.

Rajala, K., Sorice, M. G., & Thomas, V. A. (2020). The meaning (s) of place: Identifying the structure of sense of place across a social-ecological landscape. *People and Nature*, 2(3), 718-733.

Rasolofoson, R. A., Ferraro, P. J., Jenkins, C. N., & Jones, J. P. (2015). Effectiveness of community forest management at reducing deforestation in Madagascar. *Biological Conservation*, 184, 271-277.

Raykov T. & Marcoulides GA. *Introduction to Psychometric Theory*. New York, NY: Routledge, Taylor & Francis Group; (2011).

Reynolds, S. J. (2006). Moral awareness and ethical predispositions: Investigating the role of individual differences in the recognition of moral issues. *Journal of Applied Psychology*, 91, 233–243. Published by the American Psychological Association.

Rosenberg, K. V., Dokter, A. M., Blancher, P. J., Sauer, J. R., Smith, A. C., Smith, P. A., ... & Marra, P. P. (2019). Decline of the North American avifauna. *Science*, 366(6461), 120-124.

Rydin, Y. (2007). Re-examining the role of knowledge within planning theory. *Planning theory*, *6*(1), 52-68.

Schaaf, K. A., Ross-Davis, A. L., & Broussard, S. R. (2006). Exploring the dimensionality and social bases of the public's timber harvesting attitudes. *Landscape and Urban Planning*, 78(1-2), 135-146.

Serbruyns, I., & Luyssaert, S. (2006). Acceptance of sticks, carrots, and sermons as policy instruments for directing private forest management. *Forest Policy and Economics*, *9*(3), 285-296.

Serpell, J. A. (1986). In the company of animals. Oxford: Basil Blackwell. Serpell, J. A. (2004). Factors influencing human attitudes to animals and their welfare. *Animal Welfare*, 13, 145-151.

Serpell, J. A. (2004). Factors influencing human attitudes to animals and their welfare. *Animal Welfare*, 13, 145-151.

Smallshire, D., Robertson, P., & Thompson, P. (2004). Policy into practice: the development and delivery of agri-environment schemes and supporting advice in England. *Ibis*, 146, 250-258.

Spearman's rank-order correlation. (n.d.). Retrieved March 10, 2021, from https://statistics.laerd.com/statistical-guides/spearmans-rank-order-correlation-statistical-guide.php

Sponarski, C. C., Vaske, J. J., Bath, A. J., & Musiani, M. M. (2014). Salient values, social trust, and attitudes toward wolf management in south-western Alberta, Canada. *Environmental Conservation*, *41*(4), 303-310.

Stauffer, G. E., Miller, D. A., Wilson, A. M., Brittingham, M., & Brauning, D. W. (2017). Stewardship responsibility of Pennsylvania public and private lands for songbird conservation. *Biological Conservation*, 213, 185-193.

Stein, S. M., McRoberts, R. E., Mahal, L. G., Carr, M. A., Alig, R. J., Comas, S. J., ... & Cundiff, A. (2009). Private forests, public benefits: increased housing density and other pressures on private forest contributions. *General Technical Report-Pacific Northwest Research Station, USDA Forest Service*, (PNW-GTR-795).

Stein, S. M., McRoberts, R. E., Nelson, M. D., Mahal, L., Flather, C. H., Alig, R. J., & Comas, S. (2010). Private forest habitat for at-risk species: where is it and where might it be changing? *Journal of Forestry*, 108(2), 61-70.

Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, *48*(6), 1273-1296.

Tahvanainen, L., Tyrväinen, L., Ihalainen, M., Vuorela, N., & Kolehmainen, O. (2001). Forest management and public perceptions—visual versus verbal information. *Landscape and urban planning*, 53(1-4), 53-70.

Tribe, A., & Booth, R. (2003). Assessing the role of zoos in wildlife conservation. *Human Dimensions of Wildlife*, 8(1), 65-74.

Tryjanowski, P., Skórka, P., Sparks, T. H., Biaduń, W., Brauze, T., Hetmański, T., ... & Kawa, P. (2015). Urban and rural habitats differ in the number and type of bird feeders and bird species consuming supplementary food. *Environmental Science and Pollution Research*, *22*(19), 15097-15103.

United States Census Bureau / American FactFinder. "P12: Sex by Age." 2010 Census.U.S. Census Bureau, 2010.Web. 1 January 2013 <http://factfinder2.census.gov>.

United States Census Bureau. 2010 Census.U.S. Census Bureau. 2010. Web. 1 January 2013 <http://www.census.gov/2010census/data/>.

Vincenot, C. E., Collazo, A. M., Wallmo, K., & Koyama, L. (2015). Public awareness and perceptual factors in the conservation of elusive species: The case of the endangered Ryukyu flying fox. *Global Ecology and Conservation*, 3, 526-540.

Vitell, S. J., & Patwardhan, A. (2008). The role of moral intensity and moral philosophy in ethical decision making: a cross-cultural comparison of China and the European Union. *Business Ethics: A European Review, 17(2),* 196-209.

Vogdrup-Schmidt, M., Abatayo, A. L., Shogren, J. F., Strange, N., & Thorsen, B. J. (2019). Factors affecting support for transnational conservation targeting migratory species. *Ecological Economics*, 157, 156-164. https://doi.org/10.1016/j.ecolecon.2018.11.011

Weaver, K. F., Morales, V., Dunn, S. L., Godde, K., & Weaver, P. F. (2017). Pearson's and Spearman's Correlation. *An Introduction to Statistical Analysis in Research*. New Jersey: John Wiley & Sons, Inc, 435-71.

Wessa P. (2017), Cronbach alpha (v1.0.5) in Free Statistics Software (v1.2.1), *Office for Research Development and Education, URL*

Whelan, C. J., Şekercioğlu, Ç. H., & Wenny, D. G. (2015). Why birds matter: from economic ornithology to ecosystem services. *Journal of Ornithology*, 156(1), 227-238.

Wilson, C., & Tisdell, C. (2005). Knowledge of birds and willingness to support their conservation: an Australian case study. *Bird Conservation International*, *15*(3), 225-235.

Wynne, B. (2002). Risk and environment as legitimatory discourses of technology: reflexivity inside out? *Current sociology*, *50*(3), 459-477.

CHAPTER 3

Demand for Bird Conservation on Private Forest Lands in Pennsylvania

Abstract:

Global biodiversity is in decline due to factors such as land-use change, pollution, and climate change. Birds contribute to biodiversity in several ways, one way, in particular, is by cultivating public support for habitat conservation by being a socially desirable category of wildlife. To understand the social value of bird conservation on private forest lands, a statewide web survey was used containing psychometric scales and a choice experiment question (n=690). The data collected was used to identify important attitudinal positions and estimate statewide demand for bird conservation programs under different policy options. Mean household WTP was estimated to be $11.83 annually and statewide demand to be over $47 million annually. Nonuse values underpinned much of the utility associated with the proposed habitat conservation programs. Findings suggest investment in both public education and bird conservation on private lands is a legitimate strategy for mitigating biodiversity loss and enhancing social welfare.

3.1 Introduction

Birds provide an array of goods and services important for sustaining ecosystems and maintaining human health and wellbeing (Costanza et al. 1997; Martín-López et al. 2012; MEA 2005, Cedra et al., 2013). However, since the 1970's many bird populations in North America are in decline due to habitat degradation and loss (Rosenberg et al, 2019). Habitat loss often leads to increased ecological homogeneity at multiple spatial and temporal scales, otherwise known as biodiversity loss (Benton et al., 2003). The incentive to conserve nature tends to be based on people's perceptions about increased pressure on the environment and the desire to maintain important benefits (Cedra et al., 2013). Exactly how to integrate these values into policy decision-making is the subject of a growing body of research (Sagoff 2004; Christie et al. 2008). Since changes in land use and forest management are often driven by changes in economic pressure, economic values are often needed for justifying public investment in

conservation and green infrastructure (Balmford et al. 2002; McCarthy et al. 2012; Pearce,1994). Omitting economic values might result in systematic underestimation and under-investment in the natural environment (Kopp, 1992; MEA, 2005).

Assigning economic values to biodiversity, however, is challenging because many of the benefits to humans are not well understood, and only a few are captured by market-based economic activity (TEEB 2010). One approach is to focus valuation efforts on a specific species to justify support for biodiversity more broadly (Gowdy, 1997). This is reasonable as related studies have found that much of the value associated with a given species is made up of the value associated with the natural setting in which the species occurs (Decker and Watson, 2017). One concern about this approach, however, is that much of the valuation work has been concerned with megafauna (e.g., panda bear; White et al., 2001). Humans often relate better to wildlife, especially those who emulate human-like qualities, and this can lead to a stronger concern for wildlife and willingness to support related conservation activities (Gifford and Nilsson, 2014; Johnson and Hackett, 2016). This bias towards selected categories of wildlife, however, may not foster support for biodiversity conservation in areas that do not contain charismatic species (Martín-López et al., 2011). Birds, as a category, may offer a useful compromise as they are often seen as a positive feature on the landscape (Ha and Yang, 2019). Since some birds are migratory, different species can be widely distributed and utilize a range of habitats (Rushing et al., 2020). Because of these features, and because birds are an understudied subject in the valuation literature, an economic assessment of bird conservation can help increase the scope of biodiversity economic values.

Like most goods, public preferences for conservation are informed by a person's experiences and perceptions about the good on offer (Kreye, et al., 2016). Historically, birds have been valued for their consumptive uses (e.g., feathers, protein) and contributions to recreational experiences in nature. Attitudes towards wildlife are often based on how they are utilized to benefit humans (Kellert, 1985). More recent valuation research has found that nonuse values or existence values also underpins how people think and care about wildlife and this can affect which types of conservation policies and programs people will support (Ojea and Loureiro, 2007). For example, ethical motives for species protection are often associated with support for environmental issues in general (Kotchen and Reiling, 2000). If much of the value associated with wildlife is non-use,

or psychological, public education may then be a viable way of enhancing social welfare because it can enhance people's appreciation of nature even when they are not using it.

Since conservation activities can interfere with other land uses, attitudes towards how private lands are managed can also have an important influence on what ecosystem services are expected to arise from those lands (Kreye et al., 2016). In the United States over half of the forest lands are privately owned and are important for sustaining the timber economy in many regions of the eastern US (Kreye et al. 2019). In cases where private property rights are strong, landowners often prefer to use landowner assistance and market-based solutions to address conservation problems, compared to regulatory approaches (e.g., Coase theorem; Wicker, 2002). This means that the policy process itself can add value to conservation activities even though the process may be tangential to the biodiversity issue at hand (Kreye et al., 2016).

This paper examines how people's perceptions and knowledge about bird populations as well as attitudes toward birds, timber harvesting, and government assistance programs contribute to the value of bird conservation efforts. This line of inquiry is expected to provide a greater understanding of what factors may give rise to the nonuse values associated with conservation activities and the value of biodiversity more broadly. To understand the social value of bird conservation on private forest lands in Pennsylvania, we used a statewide web survey containing psychometric scales and choice experiment questions (n=690). We found public perceptions and attitudes underpinned much of the utility associated with the proposed programs indicating that much of the value associated with bird conservation was indeed non-use value. Findings suggest investment in public education and bird conservation on private lands is a legitimate strategy for mitigating biodiversity loss and enhancing social welfare.

3.2 Approach

Stated preference methods are the only known method for capturing both use and nonuse values; which includes choice experiment questions to capture non-market values (Hausmann et al. 2016; Bateman et al., 2002; Hoyos, 2010). In a choice experiment, a person is asked to express their willingness to pay (WTP) for a good containing a strategic combination of attributes including price. Since this study is focused on the value of conservation, respondents are asked to express their maximum WTP to maintain current levels of bird-related benefits (Cedra et al.,

2013). The use of stated preference methods in environmental policy is growing, because of its ability to estimate values for multiple services (Bateman et al., 2002; Kanninen, 2010). The part-worth values for key program features, estimated using choice experiment questions, are also useful for evaluating different policy alternatives (Blamey, et al., 2000).

The choice experiment approach is grounded in Lancaster's attribute theory of value and consumer choice (Lancaster, 1966), and random utility theory (McFadden, 1974). Lancaster holds that consumers derive satisfaction not from goods themselves but their attributes. Random utility theory postulates that choices can be modeled as a function of the attributes of the alternatives given (McFadden, 1974; Train 2009). It is assumed that an individual selects the alternative i that has the greatest overall utility and that each attribute contributes to a part of the compound utility of the alternative.

According to this framework, the indirect utility function for each respondent i(U) can be decomposed into two parts as a deterministic element V (linear index of the X attribute of j different alternatives in a choice set) and the stochastic element (e) which represents the unobservable influence in the individual choice as in the given equation (Hanley et al., 1998):

Uij=Vij (Xij)+eij ……. (1)

Respondents are asked to select from a series of alternatives which alternatives they are willing to pay for. The underlying theoretical assumption that individuals will select the alternative that they believe will provide them with the greatest utility (Train 2003). Regression modeling is used to correlate willingness to pay with attributes of the good as well as attributes of the respondent.

In this study the utility function for individual i is expressed as:

$$U_{ij} = U_{ij}\left(X_{ij}, P_i, C_i, Y_i - F_{ij}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where X_{ij} are the attributes of the bird conservation program j,

P_i describes the level of knowledge

C_i describes attitudes towards birds, timber harvesting, and government

Y_i is the disposable income of respondent i

F_{ij} is the cost to the respondent for bird conservation plan j through a mandatory payment vehicle.

3.2.1 Attributes used in the Choice Experiment

Bird conservation program attributes were selected based on a literature review, content analysis, and expert consultation (Table 3.1). Each scenario on offer was designed to represent a realistic bird conservation program and included a description of the types of birds that would be concerned (common or rare), the benefits provided by those birds (ecological or recreation) the type of forest management (young or mature forest) the policy process (Landowner assistance or incentives) and price.

Table 3.1. Description of the attributes included in the choice experiment.

Factors	Levels	Description
Type of birds that will benefit	Common species	Species that are often seen in the surroundings and can thrive in a wide variety of habitats and can make use of a variety of different resources.
	Rare species	Species are seen less frequently because they require a narrow range of habitat, or the populations are at risk.
Benefits to humans	Ecological	Services provided by birds that make human life better, such as seed disbursal, pest control, pollination, and waste removal through scavenging
	Aesthetic and recreation	Benefits that arise from positive interactions with birds in natural settings (e.g., bird watching, hiking, hunting)
Forest habitat	Young forest/shrubby habitat	The forest canopy is open and diverse shrubs and plant species cover the forest floor. The average tree age is 15 years.
	Mature forest/old tree habitat	The forest floor may be heavily shaded, with few shrubs, and is covered with leaves and pine needles. The average tree age is 75 years.
Landowner Assistance	Landowner incentives	Landowners improving habitat for birds can request financial assistance (50% cost share) to help with the management
	Management plan	Landowners are provided training on how to develop management plans for improving bird habitats on their lands

Cost to taxpayer - dollars per year	$10, $20, $30, $40	Funds would be raised through a new general tax applied to all PA residents (Note: Most government funds for wildlife management comes from excise taxes on firearms and hunting license fees in PA. This is not the tax proposed)

Types of Birds

How birds are valued is sometimes a function of the types of experiences people have with birds (Angelo, 2013). Birds seen in day-to-day surroundings may be classified as "common birds" and may be considered valuable because they are familiar to people and enhance the landscape (Brock et al., 2017). Birds that occur around humans may also be classified as generalist species because they can thrive in a wide variety of habitats and make use of a variety of different resources. Birds that are seen less frequently may be valued differently from common birds depending on why they are rare. Some birds may be rare because they require a narrow range of habitat far away from human encroachment. Other birds may be rare because the populations are at risk due to changes in environmental conditions (e.g., pollution).

Benefits to Humans

Birds are important to humans for many different reasons. The recreational benefits provided by birds (e.g., bird watching, hunting) are a tangible example of the use-values associated with birds in conserved landscapes. The regulating and supporting ecosystem services (i.e., ecological services) provided by birds represent the indirect benefits of protecting birds (e.g., seed disbursal, pollination, pest control; Johnson and Hackett, 2016).

Forest habitats

Forest succession is a natural process whereby habitats change over time as trees mature (McKelvey, 2015). Many forests in Pennsylvania are even-aged and approximately 80 – 120 years old indicating the abundant provision of habitats associated with middle-aged forests (Albright et al., 2017). To understand how different landscape features may affect consumer surplus, program attributes described forest management plans that promoted either young or mature forests structures.

Landowner Assistance

Landowner assistance programs offered by organizations within the public and private sector (e.g., Audubon Pennsylvania) sometimes seek to encourage bird-friendly forestry on private lands. The strategy used in these programs often involves technical assistance and helping owners develop forest management plans. In some cases, habitat management can also be cost-prohibitive for some owners and owners may need financial assistance (Allen, 2012).

Price

The price levels (dollars) were strategically selected using prices ranges offered in similar stated preference studies and median household income levels in PA (Census, 2010). For example, a study by Haefele et al., (2018) suggests that U.S. households would pay $30 annually to protect wildlife habitat in the United States. Moreover, estimated household's WTP to participate in easement programs range from $10.97 to $21.79 per year per household (Cho et al., 2005). The prices on offer in this survey include $10, $20, $20, and 40 dollars per household per year. The proposed payment vehicle was a general tax so that expected costs would be distributed evenly across the population and help control for the free-rider effect.

3.2.2 Choice Experiment

The choice experiment was structured using an orthogonal array containing four factors with two levels and one factor with four levels, which was used for the price. This produced a total of eight scenarios or proposed programs. An orthogonal array is a table whose entries come from a fixed finite set of variables (i.e., factors and levels) in this case. This table can be used directly for the determination of design variables in the discrete design space, i.e., design variables that must have discrete values (Arora, 2016; Hedayat et al., 2012).

The programs were presented to respondents one at a time using a dichotomous choice option where the respondents can select to accept or reject the program at the designated price (Figure 3.1). This question format is similar to a referendum, which is often used to approve funds or bonds that support local land conservation, and therefore may appear like a more realistic choice to the respondent. More reliable estimates of WTP can be captured by incorporating respondent's uncertainty into the analysis (Moore et al., 2010). After selecting or rejecting a program, respondents were asked using a ten-point Likert scale how confident they were when making the WTP decision. It was assumed that those with more established preferences would express more confidence when accepting or rejecting a program (Vossler et al., 2003). Confidence in WTP responses may also reveal hypothetical levels of utility closely corresponding to actual levels of utility (Vossler et al., 2003).

Program A:

This program provides **landowner incentives** to support **young forest/shrubby habitats** for **common bird** species who provide important **ecological services**, such as pollination, insect control, seed dispersal, and waste removal.

Some of the birds that would benefit include the red bellied woodpecker, American goldfinch, indigo bunting, eastern bluebird, blue jay, American woodcock, and red eyed vireo.

Would you pay a general tax of **$10** a year for this program?

- ○ Yes
- ○ No

Figure 3.1. Example of a dichotomous choice question.

3.2.3 Psychometric Scales

Knowledge and perceptions were measured using five-point Likert scales (Kreye et.al, 2019). The items used in the knowledge scale provided subjective and objective measures of knowledge by asking respondents what they think they know (3 statements) and how strongly they agreed with a list of bird facts (5 statements, Table 3 Chapter 2). The level of agreement with statements

measuring objective knowledge indicates the level of confidence that they answered the question correctly.

Statements measuring public perceptions about the current and future condition of birds related to the condition of common and rare birds and different types of habitats (See Table 3 Chapter 2). Those who more often agreed with positive statements about the current condition of birds and habitats were considered to have generally positive perceptions. Those who more often agreed with statements that described birds and their habitats as being worse off in the future were considered to have greater risk perceptions.

To measure attitudes towards birds, a psychometric scalar tool was developed using standard methods (See Table 1, Chapter 2). The content of the scale was based on Kellert's attitudes towards wildlife scale which included attitudinal dimensions such as naturalistic, moralistic, ecologistic, aesthetic, humanistic, scientistic, doministic, negativistic, and symbolic (Kellert, 1985). Preliminary surveys were conducted to verify if the proposed dimensions were indeed relevant to birds (n = 96). The final scale consisted of a five-point Likert scale response format, contained 27 statements across nine dimensions, and had a Cronbach's alpha of 0.90 indicating the quality of the scale was very good (Wessa, 2017: See Table 1, Chapter 2).

To measure public attitudes toward harvesting on private forest lands an existing validated attitude scale was used (Schaaf and Broussard, 2006; See Table 2, Chapter 2). The five-point Likert scale contained seven statements representing either pro-harvesting (e.g., "harvesting is good for the economy") or anti-harvesting views (e.g., "forests should be left untouched by humans"). Another four statements related to harvesting for either forest management purposes (e.g., improve forest health and regeneration) or harvesting for production and economic purposes. Another scale by Schaaf et al., 2006was used to measure attitudes towards government involvement in private decisions about forest management ($\alpha = 0.85$). Four statements represented intervention through landowner assistance strategies and four statements represented top-down or regulatory approaches.

3.2.4 Study Site and Data Collection

The survey of the public was conducted in the state of Pennsylvania located in the northeastern region of the United States. The Pennsylvania landscape is dominated by forests and most forest

lands are privately owned (70% private ownership; Albright et al., 2017). In this region, forests are an important landscape feature for many types of local and migratory birds, and forest management is an important strategy for enhancing the habitats needed to support healthy bird populations (Brittingham, 2021). The distribution of human populations in Pennsylvania is similar to other states within the northeast region that have tend to have large, urbanized areas and forested rural counties.

The Qualtrics web survey service was used to collect panel responses from 690 households in Pennsylvania based on gender, age, education, and income (95% CI and a 5% margin of error). The survey had a 99% completion rate indicating a low level of response bias. For opt-in web surveys, a completion rate is considered comparable to a response rate in mail surveys (Callegaro and DiSogra, 2008). Approximately more than half (52.75%) of respondents were female, 69.423%, were between 25 to 64 years of age, 86.89% were white and 31.01% had a bachelor's degree or greater. A slight oversampling of respondents in age, race, and income categories was corrected using a raking procedure before analysis (see Table 1.1 Chapter 1).

3.2.5 Data Analysis

The methods used for the choice experiment, model selection, and calculating dollar values were based on Rolfe et al., (2000). Data were applied to a mixed logistic regression (i.e., random parameter) model using STATA 15.1. A mixed logit model is an extension of multinomial logit models that control for unobserved heterogeneity (e.g., socioeconomic characteristics) and is less subject to the independence of irrelevant alternatives (IIA) assumption. Additionally, the model also allows parameter values to vary across the population according to some pre-specified distribution which is an advantage over traditional models that treat parameters as constant across observations (Greene, 2003; Hensher et al., 2003).

Quality control procedures were used to exclude unusable responses. Criteria for excluding responses include observations from people residing in states outside of Pennsylvania (based on zip code) and respondents that completed the survey in less than 10 minutes. A raking procedure was used to generate a weight to reduce sample bias. Raking (otherwise known as iterative proportional fitting, sample-balancing, or raking ratio estimation) is a method for adjusting the sampling weights of the sample data based on known population characteristics. By adjusting

these weights, the survey sample is essentially forced to resemble the population, therefore making an inference to the entire population possible (Anderson and Fricker, 2015).

To retain the more legitimate willingness to pay responses, a new choice variable was created using individual responses to the confidence scale. Willingness to pay responses were reclassified as 0 or rejecting the good on offer if the associated response on the ten-point confidence scale was < 6. Effect coding was used to derive point estimates of utility for each attribute level (Hensher et al., 2003). The cost attribute was entered into the model as a categorical variable using the actual attribute levels. To determine the strength and direction of attitudes, grand means were calculated for individual respondents for each scale. Grand means greater than 4 suggest that respondents frequently selected "agree" or "strongly agree" to items in the scale. Individual scores, ranging from 1 to 5, were used as covariates in the model. Gender, Age, Income, and Education were coded as ranked or ordered categories and the variable for the race was dummy coded so that 1= white and 0= all other races (Table 3.2).

Table 3.2. Description of the variables used in the model.

Variable Name	**Description of Variables**	**Data Type**	**Coding**
nchoice	Dependent variable. Observations were recoded to 0 if the associated response on the ten-point confidence scale was < 6.	Binary	1= Accept the good on offer, 0 = Reject the good on offer
d_bird	Category of birds benefitted from the program.	Effect code	1= Common and -1 = Rare (reference group)
d_services	Benefits provided by birds to humans.	Effect code	1= Recreation and -1 = Ecological services (reference group)
d_habitat	Type of forest habitat to be created.	Effect code	1= Young Forest and -1 = Mature Forest (reference group)
d_owner	Type of landowner assistance offered to private forest owners.	Effect code	1= Incentive and -1 = Help with forest management plan (reference group)

Price	The annual price of a program through a general tax.	Categorical	$10, $20, $30, $40
subjective knowledge	Subjective knowledge score	Continuous	1= strongly disagree, 5= strongly agree (Larger value indicates stronger perceptions about being knowledgeable about birds)
factual knowledge	Factual knowledge score	Continuous	1= strongly disagree, 5= strongly agree (Larger value indicates greater factual knowledge about birds)
risk perception at present	Perceptions about the current condition of birds and habitats score (with some observations inverted)	Continuous	1= strongly disagree, 5= strongly agree (Larger value represents the perception that the resource is in poor condition today)
risk perception in future	Perception of future risk in the condition of birds and habitats score	Continuous	1= strongly disagree, 5= strongly agree (Larger value represents the perception that the resource will be worse off in 10 years)
Attitude_birds	Attitude towards birds score	Continuous	1= strongly disagree, 5= strongly agree (Larger mean value represents strong positive attitudes towards birds)
Attitude_harvesting	Attitudes towards harvesting score	Continuous	1= strongly disagree, 5= strongly agree (Larger value represents strong positive attitudes towards harvesting)
Attitude_governmr nt involvement	Attitudes towards Government involvement in private lands decisions score	Continuous	1= strongly disagree, 5= strongly agree (Larger value represents strong positive attitudes towards government involvement)
Gender	Gender of a respondent	Binary	1= male, 0= female
Age	Age of a respondent (years)	Ranked Categories	1= 18 to 24, 2= 25 to 44, 3= 45 to 64, 4= 65 and over
White	White respondents	Binary	1= White/Caucasian, 0= all other races (African American, Hispanic/Latino,

			Asian/Pacific Islander, Others)
Income9	Annual household income	Ranked Categories	1=Less than $25,000; 2=$$25,00 -49,999; 3=$50,000-$74,999; 4=$75,000-$99,999; 5=100,000-$149,999; 6=$150,000-$199,999; 7=Greater than $200,000
Edu1	Respondent's educational attainment	Ordered categories	1= Some high school, 2 = High school graduate, 3= Some college/no degree, 4=Associates/ technical degree/all other degrees, 5= Bachelor's degree, 6= Graduate degrees (MS/Ph. D)

3.2.6 Model Development

All program attributes were parameterized using normal distributions, except for 'cost,' which was fixed. To avoid a saturated model one attribute level was omitted (i.e., reference variable). The missing coefficient was estimated post hoc by subtracting the coefficient from 1. The following is model 1 out of three separate models,

$$Vij = \beta + \beta 1\ (d\_bird) + \beta 2(d\_serv) + \beta 3\ (d\_hab) + \beta 4\ (d\_owner) + \beta 5\_\ (P\_Price) + \beta 6\_(gender) + \beta 7\_(age) + \beta 8\_(white) + \beta 9\_(Income9) + \beta 10\_(Edu1) \ldots\ldots\ldots\ldots\ (1)$$

where Vij is the expected utility of program j for individual i, β refers to the constant term and β1- 5 coefficients are independent variables describing the attributes of the program on offer, β6-10 are the coefficients of the independent demographic characteristics. Following Rolfe et al., (2000) all models included socio-economic variables. Variables containing psychometric data were considered theoretically interrelated, so knowledge and perceptions variables were analyzed separately from attitude variables (see models 2 and 3). Final models were selected using AIC/BIC procedures as well as Mc Fadden's rho and the Swaite Louivere tests. Coefficients for the reference variable were calculated by subtracting the other coefficient (s) within that level from 1.

The marginal value of a change within a single attribute (moving from one level to the next) is described as a part worth value[3] (PWV) and following Rolfe et al., (2000) was estimated for each variable using the following equation,

$$PWV = -1 * (\beta k/\beta 5) \quad \ldots\ldots (2)$$

where βk= coefficient of an attribute, k= 1, ...,4 and β5= coefficient of price

Following (Hanemann, 1984, 1989) and Kreye et al., (2016) mean WTP, was estimated using the following equation,

$$\text{Mean WTP} = [(1/\beta 5) + \ln(1+\exp(\beta 0))] \quad \ldots\ldots (3)$$

where β5 is the coefficient estimate on price and β0 is the estimated constant when no other independent variables are included in the model. This represents the preferred price respondents are willing to pay for any given bird conservation program across all program features and socio-economic characteristics in the model.

The value of different policy alternatives was also estimated for select combinations of variables, following Rolfe et al., (2000). For example, the value of policy A can be represented as,

$$\text{Total Annual household WTP for Policy A} = -1/\beta 5 * (\Delta \beta 1 + \Delta \beta 2 + \Delta \beta 3 + \Delta \beta 4) \quad \ldots\ldots (4)$$

Where β5 is the coefficient for price and β1 to β4 represents the variables included in the policy (Rolfe et al., 2000). To understand the value of the policy to the state, a conservative estimate was calculated by multiplying household mean WTP with 50% of the number of households in the state. To understand the potential value of these programs per forest acre, statewide demand was divided by 50% of the number of private forest acres in the state.

[3] Part Worth Values (PWV) are numerical scores that measure how much each feature influences the customer's decision to make that choice (Noguchi and Ishii, 2000).

3.3 Results

3.3.1 Psychometric Scales

On average, respondents agreed that they were concerned that birds will be worse off in the future and that they supported landowner assistance programs (Table 3.3). Attitudes towards birds and government regulations were also positive but somewhat less strong on average (Mean 3.72 and 3.59 respectively). A deeper examination of attitudes towards birds revealed that most people believe that humans have the responsibility to prevent harming birds by reducing pollution or protecting important habitats. Attitudes supporting timber harvesting were moderately strong on average (Mean 3.50). On average, respondents expressed low to moderate levels of knowledge about birds and were neutral in their perceptions regarding the present condition of birds (i.e., it was unclear to many respondents if there was currently a problem).

Table 3.3. Grand means of respondent's scores to Likert scale questions measuring attitudes and knowledge parameters.

Items	Mean	St. dev.	Min	Max	No. of Statements	No. of Observations
Attitudes towards birds	3.72	0.50	1	5	27	690
Attitudes towards timber harvesting for management purposes	3.68	0.70	1	5	4	690
Attitudes towards timber harvesting for economic purposes	3.50	0.83	1	5	3	690
Attitudes towards landowner assistance programs	3.98	0.78	1	5	4	690
Attitudes towards government regulation	3.59	0.77	1	5	4	690
Subjective knowledge	3.13	1.02	1	5	3	690
Factual Knowledge	2.75	1.24	1	5	5	690
Perceived condition of birds	3.09	0.77	1	5	5	690
Perceived risk of a decline in birds	4.05	0.77	1	5	5	690

3.3.2 Econometric Results

Mean household WTP for bird conservation across all variables was estimated to be $11.83 (95% CI $10.65 - $13.01) in model 3 (Table 3.4). Attributes of the programs offered in the choice experiment had varying impacts on marginal WTP, in that the part-worth estimates ranged from- $1.74 to $13. Types of bird species benefitting (common and rare) were significant with a positive coefficient indicating that respondents more often valued the conservation of common bird species compared to rare species. The type of use-values associated with birds (i.e., recreational and ecological services) did not have a significant influence on WTP suggesting respondents were indifferent towards these services as described in the survey or they thought both would be provided. Habitat type was significant with a negative coefficient suggesting respondents more often preferred mature forest habitats over young forests. Respondents also preferred that; landowners be offered incentives over help with a management plan. Price was significant with a negative coefficient meaning that participants were more likely to accept a program with a lower price.

Variables measuring knowledge and perceptions had a similar impact on WTP compared to program attributes. Part-worth estimates ranged from -$1.64 to $11. Both subjective and factual types of knowledge were significant and positively correlated with WTP. Perceptions about the present poor condition of birds were not significant in the model. However, the perception that the condition of birds will decline in the future was significant and associated with a positive WTP.

Variables measuring attitudes had the largest influence on WTP estimates. Part-worth estimates ranged from - $5 to $22 suggesting that nonuse values and opinions about the policy process underpin much of welfare associated with bird conservation. Attitudes towards birds were significant and positive and had the greatest overall influence on WTP for bird conservation. Attitudes towards harvesting were significant with a negative coefficient, indicating that WTP decreased as support for timber harvesting on private lands increased. Attitudes towards government involvement in private lands decisions were also significant and positive indicating that support for government involvement in conservation can increase WTP for bird conservation.

Respondent characteristics were found to have a modest impact on WTP behaviors. Annual household income and education level had part worth values ranging between $1.71 and $2.67. Respondents classified as white were generally willing to pay up to $16 less on average.

Table 3.4. Dichotomous choice model using mixed logistic regression to estimate mean household willingness to pay (WTP) for bird conservation in Pennsylvania

	Model 1			Model 2			Model 3		
Parameters	**Coef.**	**Std. Err.**	**PWV**	**Coef.**	**Std. Err.**	**PWV**	**Coef.**	**Std. Err.**	**PWV**
d_bird_common	0.0883**	0.0421	$1.04	0.0882**	0.0421	$1.04	0.0882**	0.0421	$1.04
d_bird_rare	-0.9116		-$10.76	-0.9117		-$10.75	-0.9117		-$10.75
d_serv_recreational	0.0220	0.0420	$0.26	0.0221	0.0420	$0.26	0.0222	0.0420	$0.26
d_serv_ecologcial	-0.9779		-$11.55	-0.9778		-$11.53	-0.9777		-$11.53
d_hab_young forest	-0.1472***	0.0422	-$1.74	-0.1472***	0.0422	-$1.73	-0.1473***	0.0422	-$1.74
d_hab_mature forest	1.1472		$13.54	1.1472		$13.53	1.1473		$13.53
d_owner_incentive	0.1440***	0.0421	$1.70	0.1440***	0.0422	$1.69	0.1440***	0.0422	$1.70
d_owner_plan	-0.8559		-$10.11	-0.8559		-$10.09	-0.8559		-$10.09
Price	-0.0847***	0.0043	-$1.00	-0.0847	0.0043	-$1.00	-0.0848***	0.0043	-$1.00
Subjective_Knowledge	-	-	-	0.3917**	0.1501	$4.62	-	-	-
Factual_Knowledge	-	-	-	0.6213***	0.2280	$7.33	-	-	-
Current condition (poor)	-	-	-	-0.1389	0.1869	-$1.64	-	-	-
Future condition (poor)	-	-	-	1.0034***	0.1951	$11.83	-	-	-
Att_ Birds	-	-	-	-	-	-	1.9382***	0.2912	$22.86
Att_ Harvesting	-	-	-	-	-	-	-0.4430**	0.2044	-$5.22
Att_ Government	-	-	-	-	-	-	1.2612***	0.1956	$14.87
Gender	-0.1377	0.2921	-$1.63	-0.1159	0.2804	-$1.36	-0.2216	0.2608	-$2.61
Age	-0.1874	0.1593	-$2.21	-0.1501	0.1517	-$1.77	-0.2402	0.1439	-$2.83
White	-1.2605***	0.3726	$14.88	-1.3895***	0.3588	-$16.39	-1.0662***	0.3357	-$12.57
Income categories	0.2185**	0.0930	$2.58	0.2266**	0.0881	$2.67	0.2168***	0.0826	$2.56
Education categories	0.2084**	0.1004	$2.46	0.1452	0.0959	$1.71	0.1701*	0.0893	$2.01
_cons	2.0974***	0.5585	$24.76	-4.6923***	1.2372	-$55.35	-7.8754***	1.1829	-$92.87
Mean WTP			$11.84			$11.83			$11.83
Log-likelihood			-2485.90			-2450.11			-2404.81
(Mc Fadden's Rho sqrd)			0.0976			0.1106			0.1170
AIC			4995.80			4932.23			4839.62
BIC			5075.19			5038.09			4938.86

PWV: Part-Worth value, Standard errors in second column, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

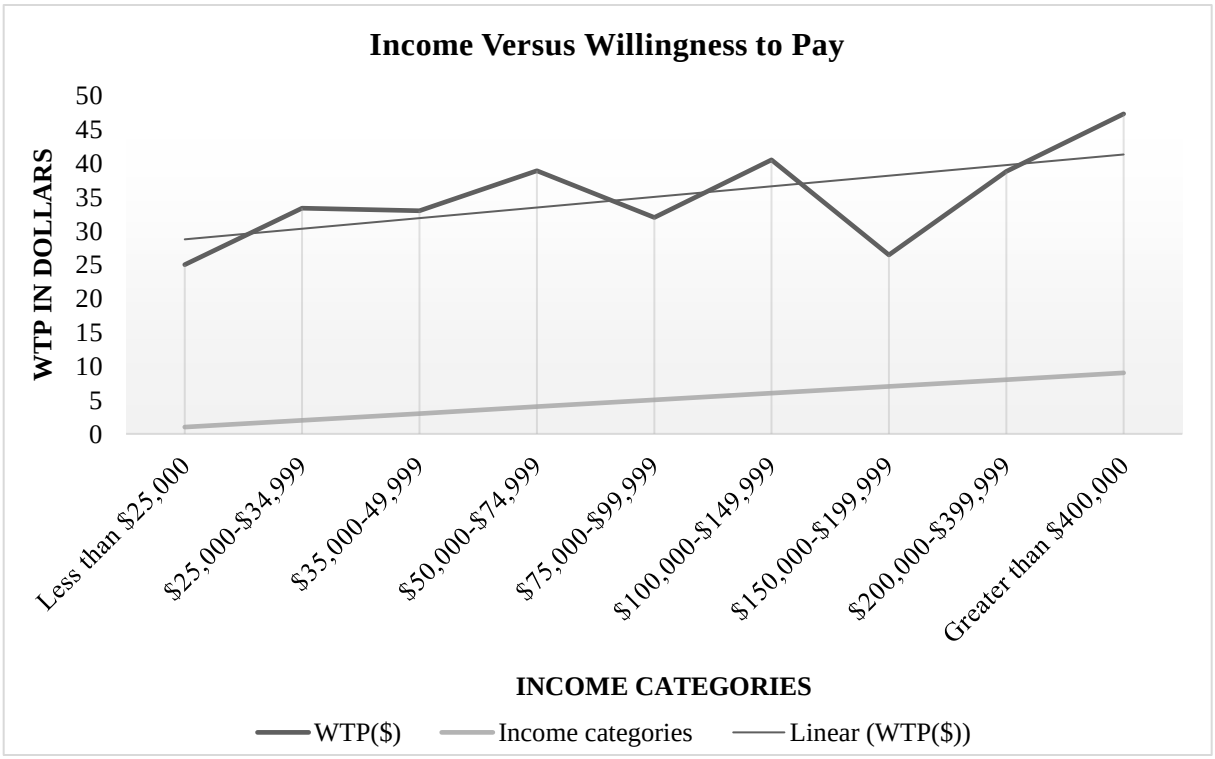


Figure 3.2. Relationship between WTP and Income categories

To understand the relationship between income and WTP all proposed categories of income levels were plotted with the mean WTP of respondents in each income level (Figure 3.2). The relationship between income and WTP for bird conservation was weakly linear, especially for people with income categories $75,000-$100,000 and $150,000-$200,000. However, the trendline for all categories revealed a slight positive slope which suggests that WTP increases as income increases and that bird conservation may be treated as a normal good.

3.3.3 Estimates of Statewide Demand

To understand how economic values can vary in an applied context, several policy alternatives were generated to estimate statewide demand and per-acre values (Table 3.5). The first proposed policy option (Policy A) describes a program that works to protect rare birds by helping landowners develop bird-friendly forest management plans. This option also describes the influence of positive attitudes towards timber harvesting on choices about bird conservation. The program was estimated to have a total annual household mean WTP of $15.62 per year, statewide demand of over $47 million per year, and a mean value of $8.14 per acre. This suggests for most people, the total value of bird conservation may be reduced if it is thought to potentially interfere with timber production objectives.

Table 3. 5. Proposed policy alternatives

Program attributes	Policy A	Policy B	Policy C	Policy D
Help owners with a management plan	o		o	o
Financial incentives for forest owners		o		
Support for rare birds	o	o	o	o
Positive attitudes towards birds		o		o
Positive attitudes toward harvesting	o			
Positive attitudes about government involvement			o	
Total household WTP	$15.62	$35.31	$35.72	$43.70
Statewide demand (50% households)	$47,277,849	$106,855,984	$108,104,031	$132,265,462
Value/acre (50% private forest acres)	$8.14	$18.39	$18.61	$22.77

Policy B also focused on protecting rare birds but offers forest owners a cost-share incentive and has a companion program that delivers public education and outreach to maintain widespread positive attitudes towards birds. This combination of factors was estimated to have a total annual household mean WTP of $35.31, statewide demand of over $106 million per year, and a mean value of $18.39 per acre.

The program in Policy C helps owners develop a management plan to support rare bird populations and works in partnership with government assistance programs and regulations to support bird conservation on private lands. This combination of factors was estimated to have a total annual household mean WTP of $35.72, statewide demand of just over $108 million per year, and a mean value of $18.61 per acre.

Policy D contained programs that helped forest owners develop a management plan to protect rare birds and a public education and outreach program to help maintain widespread positive attitudes towards birds. This combination of factors was estimated to have a total annual household mean WTP of $43.70, statewide demand of over $132 million per year, and a mean value of $22.77 per acre.

3.4 Discussion

Accurate measures of public preferences are necessary for a proper understanding of the value and informing wildlife policy-making level, particularly within state wildlife agencies (Smith and Molde, 2014). Researchers claim that hypothetical responses for environmental goods tend to overstate WTP (Vossler et al., 2003). However, respondents with high levels of certainty in responses (greater than 6 on a ten-point scale) are not statistically different from actual participation rates when treated with the "multiple-bounded discrete choice" (MBDC) approach

(Vossler et al., 2003). The confidence scale procedures used in this study suggest that respondents were behaving as honestly as they could when asked what they would pay for bird conservation.

People's perceptions about the condition of birds were found to have an important influence on WTP and likely involved a complex mixture of information acquisition and comprehension (Burger et al., 2008). Those who perceived birds would be worse off in the future had a higher WTP compared to those who did not believe birds were in poor condition now. Loss aversion is often understood to be a powerful driver of conservation support (Gonzalez-Ramirez et al., 2018). Tkac, (1998) found respondents were willing to pay more for the conservation of the Harlequin duck when the information on the endangered status of a Harlequin duck was disclosed. Similarly, DeGolia et al., (2019) found when designing ecological messaging, loss frames were more effective in gaining support than gain frames. Mao et al., (2019) also describe loss aversion as an important driver of public preferences for wetland management policies. Perceptions are not the only cause of risk aversion as behaviors can also be affected by factors such as individualism, culture, and emotions (Campos-Vazquez and Cuilty, 2014; Wang et al., 2017).

The positive relationship between knowledge about birds and stated willingness to pay, found in this study, has also been found in similar stated preference studies for environmental goods (Needham et al., 2018). Preference construction is generally affected by the information that participants hold on their prior knowledge about the goods and services (Needham et al., 2018). Knowledge about environmental issues may create a sense of increased responsibility towards the conservation of birds (Bradley et al., 2010). Recently acquired knowledge tends to produce a lower WTP compared to long-held knowledge which could result in a more sophisticated understanding of bird conservation needs and associated tradeoffs under different alternatives (Sardar et al., 2018). The correlation often found between education and income also suggests that willingness to pay more for conservation may be a function of a person's understanding, but also able to pay more (Sardar et al., 2018).

It is reasonable that common birds be seen as valuable by people. Recollections about experiences with birds can be used to estimate the expected utility of maintaining the presence of common birds in their day-to-day experiences (e.g., birds seen every day in their porch,

surrounding, backyard, birdfeeders). For example, a study examining homeowner preferences for feeding songbirds found people derive wellbeing by adopting a warden-like role towards 'their' wildlife (Brock et al., 2017). A related study by Sodhi et al (2010) found that the local people living near parks placed a greater value on the ecosystem services provided by the park compared to people who lived further away and perhaps visiting the park less frequently. Also, Meijaard et al., (2013) claim that forest use and cultural values are highest among people who live close to the remaining forest. In comparison, the perceived value of rare birds is often a function of their celebrity because they are endangered or large (Schuetz & Johnston, 2019). Regardless of their status among humans, rare birds have the potential to play an important role in ecosystem functioning, either by offering novel contributions to functional diversity or via functional redundancy depending on how rare species are defined (Mouillot et al., 2013; Jain et al., 2014). Efforts to increase public understanding of the importance of rare birds are needed to help increase their value and ensure their conservation.

Public preferences for mature forests, as found in this study, may be based on the perception that mature forests are more perfect, pristine, multi-purposed, and are more important for sustaining diverse wildlife habitats. While old-growth forests exhibit spatiotemporal stability and environmental continuity on the larger scales, there can be significant environmental heterogeneity at the micro-scale (Frank et al., 2009). For example, various canopy layers and berry-producing plants are beneficial for many bird species, and some trees will develop hollow cavities that can be used as nesting places. Older forests are also harder to replace since there is time invested in creating these stands. This perspective may prompt loss aversion behaviors towards the idea of converting older stands to other uses (Kanneman et al., 1991). Because of past disturbances in the Northeast, old forests are more often cared for compared to young forests (Frever et al., 2009). People might want to protect the appearance of these rare, matured forests so they can be appreciated by future generations (Webber, 2019).

Despite public preferences for mature forests, many species of wildlife also depend on early successional forests or shrub-dominated habitats, many of which are declining in portions of the eastern United States (Rosenberg et al., 2019; Meijaard et al., 2013). Much of this decline is attributed to the maturation of young forests that once dominated the East, along with fragmentation and suppression of natural forests (Rosenberg et al., 2019). Clustered patches of

early successional habitats are often necessary to maintain viable wildlife populations (Litvaitis, 2001). Education and extension programming is needed to help people gain a better understanding of the importance of forest management and mosaic landscapes for wildlife habitat.

The finding that many support offerings of financial assistance to forest owners suggest the public wants to take some fiscal responsibility for enhancing bird population health on private lands. This is in agreement with the idea that wildlife is considered a public good held in trust by the state, and not the complete responsibility of forest owners. Investment is certainly needed as the maintenance of habitats can be costly and some forest owners may require financial assistance to take action (e.g., controlling invasive plants; Buffum et al., 2014). Related studies have also found that voluntary strategies such as technical assistance and incentives tend to be preferred over regulatory strategies (Greene et al., 2007; Kreye et al., 2016, Kreye et al., 2018, Kreye et al., 2019).

Price is significant with a negative coefficient meaning that participants were more likely to select programs with lower prices. This indicates that respondents are being strategic in allocating income to maximize their utility. Price has also been found to influence willingness to pay for environmental programs in related studies (Lewis and Zalan, 2014). The law of demand in economics states that as the price of the good increases, the quantity demanded of the same goods falls and vice versa Nicholson and Synder (2012). This behavior agrees with economic assumptions about consumers' behaviors and suggests that stated preference methods are an appropriate strategy for measuring tradeoffs in social welfare (Nicholson and Synder, 2012).

Attitudes towards birds had the strongest influence on WTP in the model suggesting that these variables represent broader cultural values about how birds and private lands are to be managed. Zheng et al., (2018) assert that there is often a positive relationship between environmental knowledge, attitude, and behavior. Attitudes towards wildlife consist of multiple dimensions often representing both positive and negative interactions with wildlife. In this study, most respondents agreed with statements describing a moral responsibility towards birds that are harmed by pollution or loss of habitat (Organ et al., 2012). A study in the United States found many citizens tend to have positive attitudes towards a wide category of wildlife, even wildlife that causes damage (Reiter et al., 1999). Some people can even have strong emotional

attachments and empathy for individual animals, which suggests some see animals as having human characteristics (Kellert, 1993). Value orientations such as these often contribute to the formation of attitudes and WTP behaviors for environmental goods (Ojea and Loureiro, 2007).

Positive attitudes towards timber harvesting were widespread and tended to reduce the value of bird conservation. This suggests that for many, bird-related benefits are seen as potentially conflicting with timber production objectives. Limited timber supplies may not be a driving factor, as North Americans grow more forests than they harvest (Partners, 2016). Related studies have found that people are often indifferent if timber harvesting occurs for forest health purposes outcomes or timber production, suggesting that much of the public is unfamiliar with silvicultural practices and the role of harvesting in forest management (Kreye et al., 2019; Schaaf and Broussard, 2006; Schaaf et al., 2006). Many management practices that help improve wildlife habitat are often cost-prohibitive, and owners could benefit from some financial support.

Attitudes toward government involvement in private lands decisions were generally mixed, but positive attitudes in this area did increase the value of bird conservation. Most respondents expressed support for strategies that encouraged collaboration between government and private forest owners (e.g., technical assistance). This finding is consistent with Kreye et al., (2019) who found technical assistance is strongly supported in the southeastern US as well. Related research has found respect for wildlife professionals' judgment in specific management situations can serve as an indirect value associated with wildlife, which may explain the value of policies that include government programs (Organ et al., 2012). Conversely, if the public has low trust in government, they may be reluctant to support government regulation on private lands (David and King, 1997). Government regulations that provide environmental protection are often associated with weakening private property rights (Acemoglu et al., 2008). This suggests that policy design should consider ownership rights and interests as these can underpin certain moral judgments and economic considerations.

The positive relationship found between WTP, knowledge, and education are well supported in related research (Sardar et al, 2018; Moon et al., 2002). This suggests that programs that help increase public understanding of bird conservation issues can also provide real social benefits because they can increase the perceived value of taking action. Annual household income and WTP were positively correlated, however, an average $2.50 increase in WTP across income

categories suggests that income had less influence on choice compared to other variables (Bhandari and Heshmati., 2010). A separate set of model configurations (not reported here) revealed significant variation in mean WTP across income categories. Related studies have found that the relationship between income and WTP for environmental goods may not always linear, especially for very wealthy people (Shao et al., 2018). This type of phenomenon could explain why, for some people, income had less influence on marginal utility. The variable parametrized to represent all races, excluding the white race, was positively correlated with WTP and indicated that non-white respondents were willing to pay up to $16 more on average. It is unclear if there was a real difference in utility between the white race and all other races or if this finding is a function of sample bias. Non-white residents are already a minority in Pennsylvania, and non-white respondents were also under-sampled. The raking procedure then elevated the influence of the few observations from non-white respondents. This suggests that this finding could represent the values of a self-selected group of non-white respondents. There is research, however, that suggests that there are cases where non-white groups are more pro-environmental. Taylor (2018) found compared to other racial and ethnic groups, black students more often preferred naturalistic landscapes compared to urbanized settings. White respondents in this study were expected to be wealthier compared to non-white respondents, which may have led to wider variation in WTP (Shao et al., 2018). Decades of leading environmental conservation in Pennsylvania could also have made white respondents more apathetic.

In the proposed policy alternatives, the total annual household means WTP ranged from $15.62 per year to $43.73 depending upon the attributes in the proposed policy. This is similar to a study examining the value of conserving waterfowl, which reports that U.S. households would pay an average of $28 per year, an average of $18 per year in Canada, and an average of $16 per year in Mexico, to protect Pintail habitats (Haefele et al., 2019). Similarly, a study conducted in New England found the average household willingness to pay for the preservation of the bald eagle to be $19.28 annually, and the wild turkey was $11.86 annually (Steven et al., 1991). IN this same study, respondents assigned only 7% of their payments to support recreational uses of this wildlife, indicating much of the value associated with these species was non-use or protection value. The study reported here is somewhat dissimilar to the studies cited above, because it examined the value of birds as a category, and not a specific species. This suggests that WTP

values could be subject to scoping effects because the proposed scale of wildlife to be protected was larger than a single species (Giraud et al.,1999).

3.5 Conclusions

The methods used in this study are expected to produce accurate and useful estimates of value for bird conservation on private lands. That said, expressed preferences may not represent all held values for bird conservation, and estimated total values are strongly dependent on which parameters are included in the analysis. Despite this, statewide demand values were often found to range from $50 to 100 million dollars annually, which is competitive with the known costs of protecting bird populations. For example, since its induction in 1964 the PA Land and Water Conservation Fund has provided $309 million to support land acquisition for recreational uses. In fiscal years 2018-2019, the Pennsylvania Senate allocated $153 million in general fund support to the PA Department of Environmental Protection and $121 million to the Department of Conservation of Natural Resources. A report by the Ecosystem Marketplace estimates that private capital into conservation is generally about a third of public sector investment (Hamrick, 2016). When comparing actual program costs (funds allocated) with the estimated annual value of bird conservation on private lands we find a significant “return on investment". This suggests that public and private conservation programs are both effective and efficient in advancing conservation outcomes and enhancing public wellbeing. Importantly, the utility generated from the proposed programs was strongly dependent on dominant attitudes and opinions about the processes used to provide bird habitat (e.g., landowner assistance). This is consistent with the idea that much of the value associated with conservation is nonuse value, or “knowledge” based (Kreye et al., 2016). Because the value of conservation is strongly dependent on a person’s understanding of the issues, education and public outreach are important for adding significant value to conservation efforts**.**

3.6 References:

Acemoglu, D., Kremer, M., & Mian, A. (2008). Incentives in markets, firms, and governments. *The Journal of Law, Economics, and Organization*, 24(2), 273-306.

Albright, T. A., McWilliams, W. H., Widmann, R. H., Butler, B. J., Crocker, S. J., Kurtz, C. M., ... & Smith, J. E. (2017). Pennsylvania forests 2014. *Resour. Bull. NRS-111. Newtown Square, PA: US Department of Agriculture, Forest Service, Northern Research Station*. 140 p., 111, 1-140.

Allen, A. W., & Vandever, M. W. (2012). Conservation Reserve Program (CRP) Contributions to Wildlife Habitat, Management Issues, Challenges and Policy Choices: An Annotated Bibliography. *US Department of the Interior, US Geological Survey*.

Anderson, L., & Fricker Jr, R. D. (2015). Raking: An important and often overlooked survey analysis tool. *Phalanx*, *48*(3), 36-42.

Angelo, H. (2013). Bird in hand: How experience makes nature. *Theory and Society*, *42*(4), 351-368.

Arora, J. S. (2016). Introduction to Optimum Design, 2012. Retrieved from https://books.google.com/books?hl=en&lr=&id=9FbwVe577xwC&oi=fnd&pg=PP1&dq=Arora,+J.+S.+(2016).+Introduction+to+Optimum+Design,+2012.&ots=DT_k3z1TY5&sig=8FuzRZr-6CTfzn-m40KS9RZ25Ks#v=onepage&q&f=false.

Balmford, A., Bruner, A., Cooper, P., Costanza, R., Farber, S., Green, R. E., et al. (2002). Economic reasons for conserving wild nature. *Science*, 297, 950–953.

Bateman, I., Carson, R., Day, B., Hanemann, W. M., Hanley, N., Hett, T., et al. (2002). Economic valuation with stated preference techniques: *A manual*. Cheltenham: Edward Elgar.

Benton, T. G., Vickery, J. A., & Wilson, J. D. (2003). Farmland biodiversity: is habitat heterogeneity the key? *Trends in ecology & evolution*, *18*(4), 182-188.

Bhandari, A. K., & Heshmati, A. (2010). Willingness to pay for biodiversity conservation. *Journal of Travel & Tourism Marketing*, *27*(6), 612-623.

Blamey, R. K., Bennett, J. W., Louviere, J., Morrison, M. S., & Rolfe, J. (2000). A test of policy labels in environmental choice modelling studies. *Ecological Economics*, 32, 269–286.

Bradley, J. C., Waliczek, T. M., & Zajicek, J. M. (2010). Relationship between environmental knowledge and environmental attitude of high school students. *The Journal of Environmental Education*, 30(3), 17-21., doi: 10.1080/00958969909601873

Brittingham, M. (2021, February 27). Management practices for enhancing wildlife habitat. Retrieved March 10, 2021, from https://extension.psu.edu/management-practices-for-enhancing-wildlife-habitat

Brock, M., Perino, G., & Sugden, R. (2017). The warden attitude: An investigation of the value of interaction with everyday wildlife. *Environmental and Resource Economics*, *67*(1), 127-155.

Buffum, B., Modisette, C., & McWilliams, S. R. (2014). Encouraging family forest owners to create early successional wildlife habitat in southern New England. *PloS One*, 9(2), e89972.

Burger, J., Greenberg, M., Gochfield, M., Shukla, S., Lowrie, K. and Keren, R. (2008), Factors influencing acquisition of ecological and exposure information about hazards and risks from contaminated sites, *Environmental Monitoring and Assessment*, Vol. 137 Nos 1-3.

Callegaro, M., & DiSogra, C. (2008). Computing response metrics for online panels. *Public opinion quarterly*, 72(5), 1008-1032.

Campos-Vazquez, R. M., & Cuilty, E. (2014). The role of emotions on risk aversion: a prospect theory experiment. *Journal of Behavioral and Experimental Economics*, *50*, 1-9.

Cerda, C., Ponce, A., & Zappi, M. (2013). Using choice experiments to understand public demand for the conservation of nature: A case study in a protected area of Chile. *Journal for Nature Conservation*, *21*(3), 143-153.

Cho, S. H., Newman, D. H., & Bowker, J. M. (2005). Measuring rural homeowners' willingness to pay for land conservation easements. *Forest Policy and Economics*, 7(5), 757-770.

Christie, M., Fazey, D., Cooper, R., Hyde, T., Deri, A., Hughes, L., et al. (2008). An evaluation of economic and non-economic techniques for assessing the importance of biodiversity to people in developing countries. *Report to the Department for Environment*. London, UK: Food and Rural Affairs.

Costanza, R., D'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., et al. (1997). The value of the world's ecosystem services and natural capital. *Nature*, 387, 253–260.

David, J. S. N. P. Z., & King, C. (1997). Why people don't trust government. *Harvard University Press.*

De Golia, A. H., Hiroyasu, E. H., & Anderson, S. E. (2019). Economic losses or environmental gains? Framing effects on public support for environmental management. *PloS one*, *14*(7), e0220320.

Decker, K. A., & Watson, P. (2017). Estimating willingness to pay for a threatened species within a threatened ecosystem. *Journal of Environmental Planning and Management*, *60*(8), 1347-1365.

Frank, D., Finckh, M., & Wirth, C. (2009). Impacts of land use on habitat functions of old-growth forests and their biodiversity. *Old-Growth Forests*, 429-450.

Fraver, S., White, A. S., & Seymour, R. S. (2009). Natural disturbance in an old-growth landscape of northern Maine, USA. *Journal of ecology*, 97(2), 289-298.

Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International journal of psychology*, *49*(3), 141-157.

Giraud, K. L., Loomis, J. B., & Johnson, R. L. (1999). Internal and external scope in willingness-to-pay estimates for threatened and endangered wildlife. *Journal of Environmental Management,* 56(3), 221-229.

Gonzalez-Ramirez, J., Arora, P., & Podesta, G. (2018). Using insights from prospect theory to enhance sustainable decision making by agribusinesses in Argentina. *Sustainability*, *10*(8), 2693.

Gowdy, J. M. (1997). The value of biodiversity: markets, society, and ecosystems. *Land economics,* 25-41.

Greene, J. L., Kilgore, M. A., Jacobson, M. G., Daniels, S. E., & Straka, T. J. (2007). Existing and potential incentives for practicing sustainable forestry on non-industrial private forest lands. In: *Siry, J., ed. Proceedings of the 2006 Southern Forest Economics Workshop.* 174-187. (pp. 174-187).

Greene, W.H. (2003). Econometric Analysis. fifth ed. Prentice Hall, Upper Saddle River, NJ.

Ha, S., & Yang, Z. (2019). Evaluation for landscape aesthetic value of the Natural World Heritage Site. *Environmental monitoring and assessment*, 191(8), 1-20.

Haefele, M. A., Loomis, J. B., Merideth, R., Lien, A., Semmens, D. J., Dubovsky, J., ... & Medellin, R. A. (2018). Willingness to pay for conservation of transborder migratory species: a case study of the Mexican free-tailed bat in the United States and Mexico. *Environmental management,* 62(2), 229-240.

Hamrick, K. (2016). State of private investment in conservation 2016: A landscape assessment of an emerging market. *Forest Trends*.

Hanemann, W. M. (1984). Welfare evaluations in contingent valuation experiments with discrete responses. *American journal of agricultural economics*, *66*(3), 332-341.

Hanemann, W. M. (1989). Welfare evaluations in contingent valuation experiments with discrete response data: reply. *American journal of agricultural economics*, *71*(4), 1057-1061.

Hanley, N., Wright, R. E., & Adamowicz, V. (1998). Using choice experiments to value the environment. *Environmental and resource economics*, 11(3-4), 413-428.

Hausmann, A., Slotow, R., Fraser, I., & Di Minin, E. (2016). Ecotourism marketing alternative to charismatic megafauna can also support biodiversity conservation. *Animal Conservation*, 20(1), 91-100.

Hedayat, A. S., Sloane, N. J. A., & Stufken, J. (2012). *Orthogonal arrays: theory and applications*. Springer Science & Business Media.

Hensher, D. A., & Greene, W. H. (2003). The mixed logit model: the state of practice. *Transportation*, 30(2), 133-176.

Hoyos, D. (2010). The state ofthe art of environmental valuation with discrete choice experiments. *Ecological Economics*, 69, 1595–1603.

Jain, M., Flynn, D. F., Prager, C. M., Hart, G. M., DeVan, C. M., Ahrestani, F. S., ... & Naeem, S. (2014). The importance of rare species: A trait-based assessment of rare species contributions to functional diversity and possible ecosystem function in tall-grass prairies. *Ecology and evolution*, 4(1), 104-112.

Johnson, M. D., & Hackett, S. C. (2016). Why birds matter economically: values, markets, and policies. In *Why Birds Matter* (pp. 27-48). University of Chicago Press.

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias. *Journal of Economic perspectives, 5(1), 193-206.*

Kanninen, B. (2010). Valuing environmental amenities using stated choice studies. A commonsense approach to theory and practice. Dordrecht, The Netherlands: Springer.

Kellert, S. R. (1985). American attitudes toward and knowledge of animals: An update. In *Advances in animal welfare science 1984* (pp. 177-213). Springer, Dordrecht.

Kellert, S. R. (1993). Attitudes, knowledge, and behavior toward wildlife among the industrial superpowers: United States, Japan, and Germany. *Journal of social issues*, *49*(1), 53-69.

Kopp, R. (1992). Why existence value should be included in cost benefit analysis. In D. L. Weimer (Ed.), Cost-benefit analysis and public policy. *Oxford, UK*: Blackwell Publishing.

Kotchen, M. J., & Reiling, S. D. (2000). Environmental attitudes, motivations, and contingent valuation of nonuse values: a case study involving endangered species. *Ecological Economics*, *32*(1), 93-107.

Kreye, M. M., Adams, D. C., Escobedo, F. J., & Soto, J. R. (2016). Does policy process influence public values for forest-water resource protection in Florida? *Ecological Economics*, 129, 122-131.

Kreye, M. M., Adams, D. C., & Ober, H. K. (2018). Protecting imperiled wildlife species on private lands: Forest owner values and response to government interventions. *Ecological Economics*, 149, 254-264.

Kreye, M. M., Rimsaite, R., & Adams, D. C. (2019). Public attitudes about private forest management and government involvement in the southeastern United States. *Forests*, 10(9), 776.

Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of political economy*, 74(2), 132-157.

Lewis, G., & Zalan, T. (2014). Strategic implications of the relationship between price and willingness to pay: Evidence from a wine-tasting experiment. *Journal of Wine Economics*, *9*(2), 115-134.

Litvaitis, J. A. (2001). Importance of early successional habitats to mammals in eastern forests. *Wildlife Society Bulletin*, *29*(2), 466-473.

Mao, B., Ao, C., Wang, J., & Xu, L. (2019). The importance of loss aversion in public preferences for wetland management policies: evidence from a choice experiment with reference-dependent discrete choice model. *Wetlands*, 1-10.

Martín-López, B., González, J., & Montes, C. (2011). The pitfall-trap of species conservation priority setting. *Biodiversity and Conservation*, 20, 663–682.

Martín-López, B., Iniesta-Arandia, I., García-Llorente, M., Palomo, I., Casado-Arzuaga, I., García Del Amo, D., et al. (2012). Uncovering ecosystem service bundles through social preferences. *PLoS One*, 7(6), e38970. http://dx.doi.org/ 10.1371/journal.pone.0038970.

McCarthy, D. P., Donald, P. F., Scharlemann, J. P., Buchanan, G. M., Balmford, A., Green, J. M., ... & Leonard, D. L. (2012). Financial costs of meeting global biodiversity conservation targets: current spending and unmet needs. *Science*, 338(6109), 946-949.

McFadden, D. (1974). The measurement of urban travel demand. *Journal of public economics*, 3(4), 303-328.

McKelvey, K. S. (2015). 11 The Effects of Disturbance and Succession on Wildlife Habitat and Animal Communities. *Wildlife Habitat Conservation: Concepts, Challenges, and Solutions*.

Meijaard, E., Abram, N. K., Wells, J. A., Pellier, A. S., Ancrenaz, M., Gaveau, D. L., ... & Mengersen, K. (2013). People's perceptions about the importance of forests on Borneo. PloS one, 8(9), e73008.

Millennium Ecosystem Assessment (MEA). (2005). Ecosystems and human wellbeing: *Synthesis*. Washington, DC: Island Press.

Moon, W., Florkowski, W. J., Brückner, B., & Schonhof, I. (2002). Willingness to pay for environmental practices: implications for eco-labeling. *Land Economics*, *78*(1), 88-102.

Mouillot, D., Bellwood, D. R., Baraloto, C., Chave, J., Galzin, R., Harmelin-Vivien, M., ... & Thuiller, W. (2013). Rare species support vulnerable functions in high-diversity ecosystems. *PLoS*, 11(5), e1001569.

Needham, K., Czajkowski, M., Hanley, N., & LaRiviere, J. (2018). What is the causal impact of information and knowledge in stated preference studies? *Resource and Energy Economics*, *54*, 69-89.

Nicholson, W., & Snyder, C. M. (2012). Microeconomic theory: Basic principles and extensions. *Nelson Education.*

Noguchi, H., & Ishii, H. (2000). Methods for determining the statistical part worth value of factors in conjoint analysis. *Mathematical and computer modelling*, 31(10-12), 261-271.

Ojea, E., & Loureiro, M. L. (2007). Altruistic, egoistic and biospheric values in willingness to pay (WTP) for wildlife. *Ecological Economics*, *63*(4), 807-814.

Organ, J. F., Geist, V., Mahoney, S. P., Williams, S., Krausman, P. R., Batcheller, G. R., ... & Decker, D. J. (2012). The North American model of wildlife conservation. *The Wildlife Society Technical Review*, 12(04).

Partners, D. (2016). In North America, we grow many more trees than we harvest. The Fact in North America, We Grow Many More Trees Than We Harvest. https://twosidesna.org/paper-production-supports-sustainable-forest-management/

Pearce, D. W., & Moran, D. (1994). The economic value of biodiversity. London: Earthscan.

Reiter, D. K., Brunson, M. W., & Schmidt, R. H. (1999). Public attitudes toward wildlife damage management and policy. *Wildlife society bulletin*, 746-758.

Rolfe, J., Bennett, J., & Louviere, J. (2000). Choice modelling and its potential application to tropical rainforest preservation. *Ecological Economics*, *35*(2), 289-302.

Rosenberg, K. V., Dokter, A. M., Blancher, P. J., Sauer, J. R., Smith, A. C., Smith, P. A., ... & Marra, P. P. (2019). Decline of the North American avifauna. *Science*, *366*(6461), 120-124.

Rushing, C. S., Royle, J. A., Ziolkowski, D. J., & Pardieck, K. L. (2020). Migratory behavior and winter geography drive differential range shifts of eastern birds in response to recent climate change. *Proceedings of the National Academy of Sciences*, 117(23), 12897-12903.

Sagoff, M. (2004). Price, principle, and the environment. Cambridge, UK: Cambridge University Press.

Sardar, A., Yaseen, M. R., Abbas, A., Waqas, M., & Gill, B. A. (2018). Willingness to pay for vaccination against hepatitis b and its determinants: the case study of an industrial district of Pakistan. *Epidemiology, Biostatistics and Public Health*, *15*(4).

Schaaf, K. A., Ross-Davis, A. L., & Broussard, S. R. (2006). Exploring the dimensionality and social bases of the public's timber harvesting attitudes. *Landscape and Urban Planning*, 78(1-2), 135-146.

Schaaf, K.A.; and Broussard, S.R. (2006). Private Forest policy tools: A national survey exploring the American public's perceptions and support. *For. Policy Econ. 2006*, 9, 316–334.

Schuetz, J. G., & Johnston, A. (2019). Characterizing the cultural niches of North American birds. Proceedings of the National Academy of Sciences, 116(22), 10868-10873.

Shao, S., Tian, Z., & Fan, M. (2018). Do the rich have stronger willingness to pay for environmental protection? New evidence from a survey in China. *World Development*, *105*, 83-94.

Smith, M. E., & Molde, D. A. (2014). Wildlife Conservation & Management Funding in the US. Retrieved from https://mountainlion.org/featurearticleguestwhopaysforwildlife.php

Sodhi, N. S., Lee, T. M., Sekercioglu, C. H., Webb, E. L., Prawiradilaga, D. M., Lohman, D. J., ... & Ehrlich, P. R. (2010). Local people value environmental services provided by forested parks. *Biodiversity and Conservation*, *19*(4), 1175-1188.

Stevens, T. H., Echeverria, J., Glass, R. J., Hager, T., & More, T. A. (1991). Measuring the existence value of wildlife: what do CVM estimates really show*? Land Economics*, 67(4), 390-400.

Taylor, D. E. (2018). Racial and ethnic differences in connectedness to nature and landscape preferences among college students. *Environmental Justice*, *11*(3), 118-136.

TEEB. (2010). The economics of ecosystems and biodiversity. *Ecological and economics foundations*. London: Earthscan.

Tkac, J. (1998). Award-winning undergraduate paper: the effects of information on willingness-to-pay values of endangered species. *American Journal of Agricultural Economics*, *80*(5).

Train, K. E. (2003). Discrete choice methods with simulation. Online economics textbooks, SUNY-Oswego, Department of Economics, number emetr2. *Cambridge university press*.

Train, K. E. (2009). Discrete Choice Methods with Simulation (2nd ed.). Cambridge: *Cambridge University Press*. doi:10.1017/CBO9780511805271.

United States Census Bureau / American FactFinder. "P12: Sex by Age." 2010 Census.U.S. Census Bureau, 2010.Web. 1 January 2013 <http://factfinder2.census.gov>.

United States Census Bureau. 2010 Census.U.S. Census Bureau. 2010. Web. 1 January 2013 <http://www.census.gov/2010census/data/>.

Vossler, C. A., Ethier, R. G., Poe, G. L., & Welsh, M. P. (2003). Payment certainty in discrete choice contingent valuation responses: results from a field validity test. *Southern Economic Journal*, 886-902.

Wang, M., Rieger, M. O., & Hens, T. (2017). The impact of culture on loss aversion. *Journal of Behavioral Decision Making*, *30*(2), 270-281.

Webber, M. W. (2019, October 29). Forests for Future Generations. If it Matters to BC's Environment, We're on it. https://elc.uvic.ca/managing-forests-for-the-future/.

Wessa P. (2017), Cronbach alpha (v1.0.5) in Free Statistics Software (v1.2.1), *Office for Research Development and Education, URL*

White, P., Bennett,A. C., & Hayes, E.(2001). The use of willingness-to-pay approaches in mammal Conservation. *Mammal Review*, 31, 151–167.

Wicker, G. (2002). Motivation for private forest landowners. *Southern forest resource assessment*, 225-237. Retrieved from https://www.srs.fs.usda.gov/sustain/report/pdf/chapter_09e.pdf

Zheng, Q. J., Xu, A. X., Kong, D. Y., Deng, H. P., & Lin, Q. Q. (2018). Correlation between the environmental knowledge, environmental attitude, and behavioral intention of tourists for ecotourism in China. *Applied ecology and environmental research, 16*(1), 51-62.

CHAPTER 4

4.1 Summary and Conclusions

I found good evidence that many people in Pennsylvania are concerned about the welfare of birds in the future but have a poor understanding of the condition of birds and their need for more diverse habitats today. Instead, much of the value for bird conservation was explained by attitudes towards birds and government involvement in private lands decisions. The negative interaction between pro-harvesting attitudes and bird conservation may be due to a false narrative that bird conservation is incompatible with timber harvesting objectives. When choices about bird conservation are not well informed, preferences for related policies may not support sustainable outcomes. This points to the importance of continued public education about conservation issues, even when the conservation occurs on private lands.

Pennsylvania has limited regulatory strategies for private lands to protect risk species, instead, the focus is more on promoting voluntary action. Public demand for bird conservation appears substantive enough to justify financial support for programs that advance bird-friendly forestry on private lands. However, landowner's willingness to enter these programs needs to be studied at the grassroots level before implementation so that it can provide a reasonable starting point for building the future of proposed policies and programs. Forest owners may sometimes prefer innovative (non-conventional) ideas or the ideas to manage their land for public goods.

Continued research in behavioral science is needed to help address the public’s beliefs, opinions, and knowledge about conservation risks, risk perception, and other psychological factors affecting conservation. The potential for sample bias in this study also points to the need for more research to better understand the role of race and income on the social value of bird conservation.

Appendix A: Copy of Survey

https://pennstate.qualtrics.com/jfe/form/SV_3Q8GPQFnwr813St

Social Values for Bird and Habitat Conservation on Private Lands

The goal of this survey is to understand public support for bird conservation on private lands in PA.

You will be asked questions about:

- Your knowledge and interest in birds
- Your attitudes towards bird conservation and timber harvesting
- Your willingness to pay for bird conservation on private lands

The survey contains 40 questions and is estimated to take about 20 minutes or less to complete. It is important that everyone responds in order to represent the collective opinions of Pennsylvanians.

This study was designed by researchers at the Forest Benefits and Values lab at Penn State University. The data collected will be published in research outlets and will also inform policy and extension programming at Pennsylvania State University. Your participation is anonymous and completely voluntary, you can choose to stop at any time. There are no risks or benefits to participating in this survey. By taking the survey you are implying that you consent to be part of this study.

Thank you in advance for your assistance with this study.

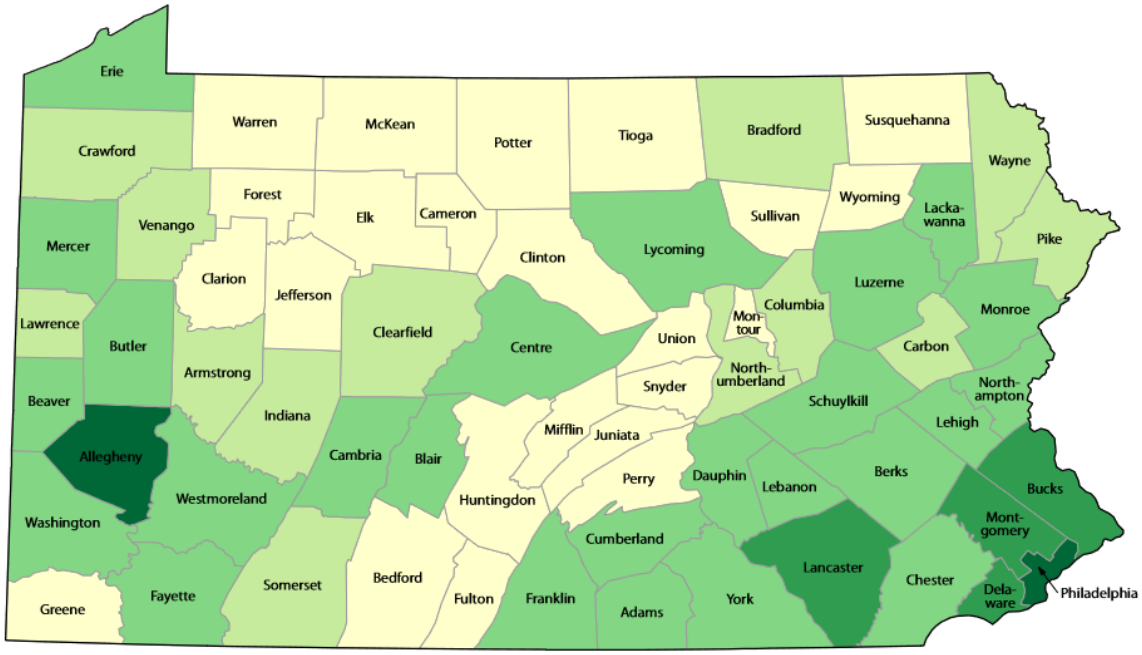
If you have questions or concerns, please contact Dr. Melissa M. Kreye, Assistant Professor, Pennsylvania State University. Phone: 814-867-1237, Email: mxk1244@psu.edu

If you have concerns about your rights please contact: The 330 Building, Suite 205, University Park, PA 16802 Phone: 814-865-1775 • Fax: 814-863-8699
Email: IRB-ORP@psu.edu.

Q1. Do you live in Pennsylvania?

- ○ Yes
- ○ No

Your location. Please click on the county where you primarily live.



Q2 What is your gender?

- ○ Male
- ○ Female
- ○ Prefer not to answer

Q3 How old are you?

- ○ under 18
- ○ 18-24
- ○ 25-44
- ○ 45-64
- ○ 65 and over

Q4 Which race/ethnicity do you identify with most?

- ○ White/Caucasian
- ○ African American
- ○ Asian/Pacific Islander
- ○ Hispanic/Latino
- ○ Other _____

Q5 How strongly do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewh at agree	Strongly agree
I know most of the birds I encounter in my day-to-day surroundings	○	○	○	○	○
I know most of the birds I encounter when visiting natural areas in Pennsylvania	○	○	○	○	○
I actively support organizations that seek to conserve wildlife habitat (e.g., member, donor, voter)	○	○	○	○	○

Q6. How strongly do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	I don't know
Plant and animal biodiversity is needed to ensure the sustainability of most ecosystems	○	○	○	○	○	○
Some species of cranes, warblers, and grouse are on the federal endangered species list	○	○	○	○	○	○
In more recent years whip-poor-wills have been less abundant	○	○	○	○	○	○
The golden-winged warbler interbreeds with the blue-winged warbler to produce offspring	○	○	○	○	○	○

Background/ scenario

Birds can be classified in many ways, but most fall into the category of being either **common** or **rare**.

Common birds can thrive in a wide variety of habitats and can make use of a variety of different resources. Common birds are not difficult to find in the natural areas that you own or visit. For example, the Blue jay can be found almost anywhere.

Rare birds need specific habitat which may or may not be on the lands you own or visit. For example, the golden-winged warbler needs shrubby young forests habitats. Birds may also be rare because of population declines due to changes in environmental quality (e.g., pollution). For example, the decline in bald eagle populations has been associated with DDT chemicals in the environment.

Many types of common and rare bird species depend on forested landscapes to survive and reproduce. The structure of the forest influences which types of habitats are available. Figure 1 is an example of how habitats change as forests age.

Source: Audubon Pennsylvania

How private lands are used (e.g., timber production, agriculture, development) determines how much habitat is available. Problems from excess pollution, invasive species, and climate change tend to affect the quality of available habitats.

Common bird species are better at dealing with changes in habitat compared to many rare bird species.

Q7 How strongly do you agree with the following statements about the condition of birds and their habitats in Pennsylvania?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Most common bird populations are in good condition	○	○	○	○	○
Most rare bird populations are in good condition	○	○	○	○	○
Field habitats are generally available and in good condition	○	○	○	○	○
Young forest/shrubby habitats are generally available and in good condition	○	○	○	○	○
Mature forest/old tree habitats are generally available and in good condition	○	○	○	○	○

Q8 How strongly do you agree with the following statements about a potential decline in the health or condition of bird populations and their habitats in Pennsylvania?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
In ten years, some common bird populations will be worse off than they are now	○	○	○	○	○
In ten years, some rare bird populations will be worse off than they are now	○	○	○	○	○
In ten years, some field habitats will be lost or in worse condition	○	○	○	○	○
In ten years some young/shrubby forests will be lost or in worse condition	○	○	○	○	○
In ten years, some mature forests/old trees will be lost or in worse condition	○	○	○	○	○

Background scenario

People often have different perspectives about the value of birds and natural areas.

The following sets of questions will investigate the way you think about bird conservation and natural areas.

Q9 How strongly do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I am very interested in observing birds in their natural habitat.	○	○	○	○	○
Birds often help enhance my recreational experiences (i.e., hiking, biking, camping).	○	○	○	○	○
Observing birds in nature helps me feel connected with nature.	○	○	○	○	○
I feel a connection with birds because they seem to communicate the same way I do (e.g., vocal patterns/ language /conversation).	○	○	○	○	○
I feel a connection with birds because of the way birds care and provide for their family (e.g., nesting, collecting food).	○	○	○	○	○
I consider myself a caretaker of the birds that live around me.	○	○	○	○	○

Q10 How strongly do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
It is wrong to produce excessive pollution that harms birds and other wildlife.	○	○	○	○	○
Humans should work to reduce excess pollution to help improve the survival of birds and other wildlife.	○	○	○	○	○
Humans should conserve and manage habitat for birds along with other wildlife.	○	○	○	○	○
I would describe the sights and sounds of birds as beautiful, pleasing, or satisfying.	○	○	○	○	○
I would describe the sights and sounds of birds as fascinating or very interesting.	○	○	○	○	○
I think birds are often colorful or eye-catching.	○	○	○	○	○

Q11 How strongly do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I appreciate the way that birds help make human lives better (i.e., pollination, seed dispersal, reducing pests, removing waste).	○	○	○	○	○
I place a high value on bird species that are in danger of going extinct.	○	○	○	○	○
It is important to me that we protect bird species so that future generations may enjoy them.	○	○	○	○	○
We can learn a lot from understanding how bird species reproduce (i.e., courting, mating).	○	○	○	○	○
We can learn a lot from understanding the survival strategies that birds use (i.e., hunting and nesting strategies, defend territory, migration).	○	○	○	○	○
We can learn a lot from understanding how birds fly (e.g., wing shape).	○	○	○	○	○

Q12 How strongly do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Birds are important/useful to me as symbols of my religion or spirituality (e.g., peace, messenger).	○	○	○	○	○
Birds are important/useful to me as symbols of groups or organizations I care about (e.g., company logo, sports team).	○	○	○	○	○
Birds are important/useful to me as symbols of important cultural values (e.g., freedom, patriotism)	○	○	○	○	○

Q13 How strongly do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I get very upset when birds damage my property (e.g., crashing into windows, defecating on cars)	○	○	○	○	○
I am very concerned about the public health risks associated with birds (e.g., fly into airplanes, carry disease)	○	○	○	○	○
I think wild birds often destroy crops and harm domestic poultry.	○	○	○	○	○
I am not bothered when birds are caged.	○	○	○	○	○
The purpose of birds is to please and entertain people.	○	○	○	○	○
I am not bothered when birds are hunted for meat and recreation.	○	○	○	○	○

Background

More than 70% of forests in Pennsylvania are privately owned by individuals, timber companies, and non-government groups, which means private forests are important to the future of many bird populations.

Cutting trees is a forest management practice often used to maintain or enhance habitats in young and old forests.

Next, you will be asked to give your opinion about cutting trees on private lands.

Q14 How strongly do you agree with the following statements about cutting trees as a forest management tool on private lands?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Cutting trees can sometimes be good for a forest	○	○	○	○	○
Some forest management by humans is necessary	○	○	○	○	○
Cutting and removing trees should be following by planting trees	○	○	○	○	○
Forests should be left untouched by humans	○	○	○	○	○

Q15 How strongly do you agree with the following statements about cutting trees for timber production on private forest lands?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Harvesting is good for the economy	○	○	○	○	○
Cutting and removing trees is sometimes necessary to provide economic profits to the forest owner.	○	○	○	○	○
Forests should be used to provide products such as paper and lumber that humans can use.	○	○	○	○	○

Background scenario

Some landowner programs in Pennsylvania provide training and incentives to landowners (e.g., cost-share) who help enhance wildlife habitat.

Next, you will be asked to give your opinion about government assistance for forest owners who help enhance important public benefits, such as wildlife conservation.

Q16 How strongly do you agree or disagree with the following statements about government agencies and programs that aid forest owners?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
The government should use financial incentives to help or encourage private owners to change management practices.	○	○	○	○	○
The government should conduct workshops on best forest management practices for private forest owners.	○	○	○	○	○
The government and private forest owners should work together toward forest conservation.	○	○	○	○	○
The government should use positive images and cultural symbols to promote forest conservation.	○	○	○	○	○

Factors and levels

You will now be presented with eight potential bird conservation programs that you will be asked to consider purchasing.

- Each program contains some of the following attributes but in different combinations.
- Landowner Assistance
- Habitat management plans
- Financial incentive programs
- Type of Bird Habitat
- Young forest/shrubby habitats
- Mature forest/old tree habitats
- Type of Bird Populations
- Common bird populations
- Rare bird populations
- Benefits to Society
- Recreational/aesthetic benefits
- Ecological services
- The annual cost to PA residents through a new general tax$10, $20, $30, $40

Description

This table offers a complete description of the program attributes you will be asked to consider.

Habitat management plans

Landowners are provided training on how to develop management plans for improving bird habitats on their lands.

Financial incentive programs

Landowners who improve habitat for birds can request financial assistance (a 50% cost-share) to help with management costs

Young forest/shrubby habitats

The forest canopy is open and diverse shrubs and plant species cover the forest floor. The average tree age is 15 years.

Mature forest/old tree habitats

The forest floor may be heavily shaded, with few shrubs, and is covered with leaves and pine needles. The average tree age is 75 years.

Common birds

These species are often seen in your day-to-day surroundings because they are able to thrive in a wide variety of habitats and can make use of a variety of different resources.

Rare birds

These species are seen less frequently because they require a narrow range of habitat or the populations are at risk because of changes in environmental conditions (e.g., pollution).

Recreational/aesthetic benefits

Benefits that arise from positive interactions with birds in natural settings (e.g., bird watching, hiking, hunting)

Ecological services

Services provided by birds that make human life better, such as seed disbursal, pest control, pollination, and waste removal through scavenging.

The annual cost to PA residents

Funds would be raised through a new general tax applied to all PA residents (Please note: in PA most government funds for wildlife management comes from excise taxes on firearms and hunting license fees. This is not the tax proposed in this survey)

Background Scenario This research will be used to inform wildlife policy. Please answer the following questions as honestly as you can.

The bird conservation programs are presented in random order.

Q17 **Program A:**
This program provides landowner **incentives** to support **young forest/shrubby** habitats for **common** bird species who provide important **ecological services**, such as pollination, insect control, seed dispersal, and waste removal.
Some of the birds that would benefit include the red-bellied woodpecker, American goldfinch, indigo bunting, eastern bluebird, blue jay, American woodcock, and red-eyed vireo.

Would you pay a general tax of $10 a year for this program?

- ○ Yes
- ○ No

Q18 Please rate how certain you are of your answer to Program A.

	Extremely Uncertain 1	2	3	4	5	6	7	8	9	Extremely certain 10
How certain are you?	○	○	○	○	○	○	○	○	○	○

Q19 **Program B:**

This program helps **landowners develop management plans** to enhance **mature forest/large tree habitats** for **common bird** species who provide **ecological services** such as, pollination, seed disbursal, insect control, and waste removal.

Some of the bird species that would benefit include the wild American turkey, white and red-breasted nuthatch, cerulean warbler, ovenbird, woodpeckers, barred owl, and Swainson's thrush.

Would you pay a general tax of $30 a year for this program?

- ○ Yes
- ○ No

Q20 Please rate how certain you are of your answer to Program B.

	Extremely Uncertain 1	2	3	4	5	6	7	8	9	Extremely certain 10
How certain are you?	○	○	○	○	○	○	○	○	○	○

Q21 **Program C:**

This program helps **landowners develop forest management plans** to enhance **young forest/shrubby** habitats for **common** bird species that provide **recreational/aesthetic** benefits such as, bird watching, hunting, and photography.

Some of the bird species that would benefit include the scarlet tanager, American goldfinch, eastern bluebird, blue jay, wild American turkey, indigo bunting, red-eyed vireo, and black and white warbler

Would you pay a general tax of $20 a year for this program?

- ○ Yes
- ○ No

Q22 Please rate how certain you are of your answer to Program C.

	Extremely Uncertain 1	2	3	4	5	6	7	8	9	Extremely certain 10
How certain are you?	○	○	○	○	○	○	○	○	○	○

Q23 **Program D:**
This program provides landowner **incentives** to support **mature forest/old tree** habitats for **common bird** species that provide **recreational/aesthetic** benefits such as bird watching, and photography.

Some of the bird species that would benefit include the American bald eagle, woodpecker, common raven, red-breasted nuthatch, and white-breasted nuthatch.

Would you pay a general tax of $40 a year for this program?

- ○ Yes
- ○ No

Q24 Please rate how certain you are of your answer to Program D.

	Extremely Uncertain 1	2	3	4	5	6	7	8	9	Extremely certain 10
How certain are you?	○	○	○	○	○	○	○	○	○	○

Q25 **Program E:**

This program helps **landowners develop forest management plans** to enhance **young forest/shrubby** habitats for **rare bird** species that provide **ecological services**, such as pest control, pollination, seed dispersal, and waste removal.

Some of the bird species that would benefit include the eastern towhee, pine siskin, golden-winged warbler, American woodcock, Canada warbler, chestnut-sided warbler, and black and white warbler.

Would you pay a general tax of $40 a year for this program?

- ○ Yes
- ○ No

Q26 Please rate how certain you are of your answer to Program E.

	Extremely Uncertain 1	2	3	4	5	6	7	8	9	Extremely certain 10
How certain are you?	○	○	○	○	○	○	○	○	○	○

Q27 **Program F:**

This program provides landowners **incentives** to support **mature forest/large tree** habitats for **rare bird** species who provide **ecological services**, such as pest control, pollination, and seed disbursal.

Some of the bird species that would benefit include the hooded warbler and cerulean warbler. Other common residents include barn owls, hairy woodpeckers, and raptors like a broad-winged hawk.

Would you pay a general tax of $20 a year for this program?

- ○ Yes
- ○ No

Q28 Please rate how certain you are of your answer to Program F.

	Extremely Uncertain 1	2	3	4	5	6	7	8	9	Extremely certain 10
How certain are you?	○	○	○	○	○	○	○	○	○	○

Q29 **Program G:**

This program provides landowner **incentives** to support **young forest** habitats for **rare bird** species that provide **recreational/aesthetic** benefits such as bird watching and photography.

Some of the bird species that would benefit include the golden-winged warbler, eastern towhee, hummingbirds, chestnut-sided warblers, and black and white warbler.

Would you pay a general tax of $30 a year for this program?

- ○ Yes
- ○ No

Q30 Please rate how certain you are of your answer to Program G.

	Extremely Uncertain 1	2	3	4	5	6	7	8	9	Extremely certain 10
How certain are you?	○	○	○	○	○	○	○	○	○	○

Q31 **Program H:**

This program helps **landowners develop forest management plans** to enhance **mature forest/large tree** habitats for **rare bird** species that provide **recreational/aesthetic** benefits such as bird watching and photography.

Some of the bird species that would benefit include the ovenbird**,** swain son's thrush, and black-throated blue warbler. Other common residents in mature forests include the barred owl, hairy woodpeckers, and raptors like the American bald eagle.

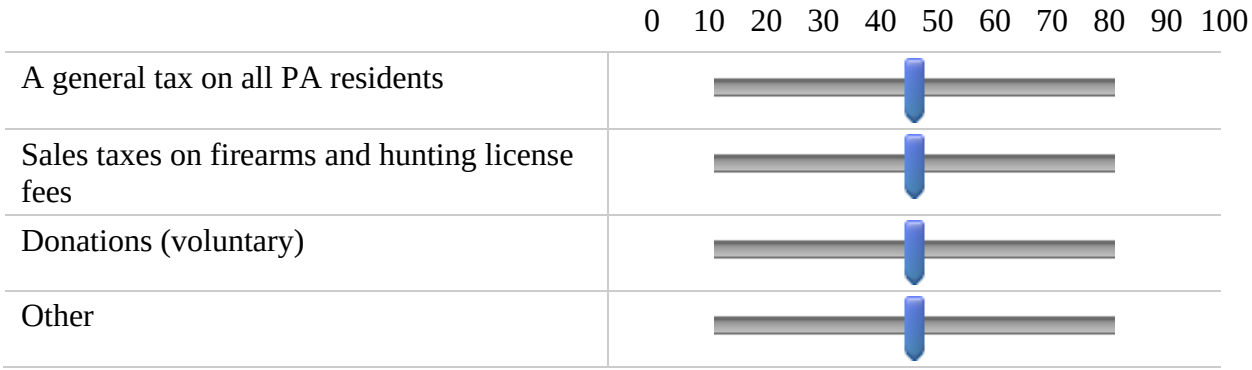
Would you pay a general tax of $10 a year for this program?

- ○ Yes
- ○ No

Q32 Please rate how certain you are of your answer to Program H.

	Extremely Uncertain 1	2	3	4	5	6	7	8	9	Extremely certain 10
How certain are you?	○	○	○	○	○	○	○	○	○	○

Q34 How much of total funding for bird conservation should <u>come</u> from the following sources? (sidebar to indicate the percent of total funding)



Q35 How much of the total funding for bird conservation should go to the following types of programs? (sidebar to indicate the percent of total funding)

	0 10 20 30 40 50 60 70 80 90 100
Programs that help humans have better access to bird-related benefits	
Programs that help protect bird populations into the future	

Background scenario

Regulations are another strategy for protecting important public benefits by imposing penalties on those who fail to meet certain environmental standards.

Private forests are often subject to certain federal and state regulations, such as the Endangered Species Act.

Q36 How strongly do you agree or disagree with the following statements about government regulations that impact private forest lands?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
The government should be able to regulate the use of forests located on private land to protect public benefits.	○	○	○	○	○
The government should have the right to tell private forest owners how to best manage their forests.	○	○	○	○	○
There should be regulations regarding how trees are managed on private forest land	○	○	○	○	○
The government should fine private forest owners who fail to use best management practices.	○	○	○	○	○

Q37 What is your zip code? (This will allow us to determine how forested your area is)

_____

Q38 Which of the following best describes your gross annual household income in 2018?

- ○ Less than $25,000
- ○ $25,000-$34,999
- ○ $35,000-49,999
- ○ $50,000-$74,999
- ○ $75,000-$99,999
- ○ $100,000-$149,999
- ○ $150,000-$199,999
- ○ $200,000-$399,999
- ○ Greater than $400,000

Q39 What is your highest level of education?

- ○ Some high school
- ○ High school graduate
- ○ Some college, no degree
- ○ Associates, technical degree
- ○ Bachelor's degree
- ○ Graduate degree (e.g., masters, PhD)
- ○ Other (Please specify) _____

This is the end of survey.
Thank you very much for your participation. Your opinion is very important to us. Please let us know any comments you have about the topics presented in this survey. You can also email your comments to sbs6203@psu.edu.

Appendix B: List of Tables (Likert Scale Responses)

Table 1. A percentage showing the total sum of individual responses in each category of the Likert scale (agree/disagree) and statements used to measure the respondent's attitudes on Naturalistic, Humanistic, Moralistic, Aesthetic, Ecologistic, Scientistic, Symbolic, Negativistic, and Dominionistic attitudes towards birds.

Statements	% Strongly disagree (1)	% Somewhat disagree (2)	% Neither agree nor disagree (3)	%Somewhat agree (4)	% Strongly agree (5)	Total obs.
Naturalistic						
I am very interested in observing birds in their natural habitat	5.65	9.42	20.14	41.01	23.77	**656**
Birds often help enhance my recreational experiences (i.e., hiking, biking, camping)	3.91	5.65	20.29	39.13	31.01	**656**
Observing birds in nature helps me feel connected with nature	3.33	4.78	17.54	43.04	31.30	**656**
Humanistic						
I feel a connection with birds because they seem to communicate the same way I do (e.g., vocal patterns/ language /conversation)	7.97	12.75	34.78	30.14	14.35	**656**
I feel a connection with birds because of the way birds care and provide for their family (e.g., nesting, collecting food)	5.36	8.84	27.97	38.26	19.57	**656**
I consider myself a caretaker of the birds that live around me.	10.14	14.06	28.12	29.71	17.97	**656**

Moralistic						
It is wrong to produce excessive pollution that harms birds and other wildlife	1.45	1.59	10.58	25.65	60.72	**656**
Humans should work to reduce excess pollution to help improve the survival of birds and other wildlife	1.30	2.17	9.13	26.52	60.87	**656**
Humans should conserve and manage habitat for birds along with other wildlife	0.72	1.30	8.41	31.74	57.83	**656**
Aesthetic						
I would describe the sights and sounds of birds as beautiful, pleasing, or satisfying.	1.16	2.61	10.58	32.46	53.19	**656**
I would describe the sights and sounds of birds as fascinating or very interesting.	1.88	3.04	12.75	33.48	48.84	**656**
I think birds are often colorful or eye-catching.	0.87	2.17	8.99	34.93	53.04	**656**
Ecologistic						
I appreciate the way that birds help make human lives better (i.e., pollination, seed dispersal, reducing pests, removing waste).	1.74	2.75	12.75	32.32	50.43	**656**
I place a high value on bird species that are in danger of going extinct.	2.03	2.61	16.96	35.07	43.33	**656**
It is important to me that we protect bird species so that future generations may enjoy them.	1.45	1.45	11.30	30.58	55.22	**656**
Scientistic						

We can learn a lot from understanding how bird species reproduce (i.e., courting, mating).	1.30	4.20	21.16	35.94	37.39	**656**
We can learn a lot from understanding the survival strategies that birds use (i.e., hunting, and nesting strategies, defend territory, migration).	1.88	3.62	17.39	36.23	40.87	**656**
We can learn a lot from understanding how birds fly (e.g., wing shape).	1.30	4.64	18.99	38.41	36.67	**656**
Symbolic						
Birds are important/useful to me as symbols of my religion or spirituality (e.g., peace, messenger).	13.19	13.77	33.48	23.33	16.23	**656**
Birds are important/useful to me as symbols of groups or organizations I care about (e.g., company logo, sports team).	11.59	13.04	32.32	29.13	13.91	**656**
Birds are important/useful to me as symbols of important cultural values (e.g., freedom, patriotism).	6.38	8.70	23.91	34.06	26.96	**656**
Negativistic						
I get very upset when birds damage my property (e.g., crashing into windows, defecating on cars)	7.25	18.70	25.07	27.97	21.01	**656**
I am very concerned about the public health risks associated with birds (e.g., fly into airplanes, carry disease)	9.57	27.10	30.58	20.14	12.61	**656**
I think wild birds often destroy crops and harm domestic poultry.	0.00	0.00	36.52	43.19	20.29	**656**

Dominionistic						
I am not bothered when birds are caged.	20.43	27.25	30.72	15.65	5.94	**656**
The purpose of birds is to please and entertain people.	37.39	26.67	21.16	9.28	5.51	**656**
I am not bothered when birds are hunted for meat and recreation.	26.96	21.59	25.94	19.28	6.23	**656**

Table 2. A percentage showing the total sum of individual responses in each category of the Likert scale (agree/disagree) and statements used to measure the respondent's attitudes towards harvesting trees on private lands based on different objectives of harvesting.

Statements	% Strongly disagree (1)	% Somewhat disagree (2)	% Neither agree nor disagree (3)	% Somewhat agree (4)	% Strongly agree (5)	Total obs.
Harvesting for Management						
Cutting trees can sometimes be good for a forest	8.12	10.87	18.99	44.93	17.10	**656**
Some forest management by humans is necessary	3.04	5.94	14.78	52.46	23.77	**656**
Cutting and removing trees should be following by planting trees	1.88	1.45	11.45	30.29	54.93	**656**
Forests should be left untouched by humans	12.75	21.30	29.28	28.26	8.41	**656**
Harvesting for Production						
Harvesting is good for the economy	2.32	5.22	27.10	45.36	20.00	**656**
Cutting and removing trees is sometimes necessary to provide economic profits to the forest owner.	6.52	9.71	29.42	42.75	11.59	**656**
Forests should be used to provide products such as paper and lumber that human can use.	9.13	11.74	28.70	37.10	13.33	**656**

Table 3. A percentage showing the total sum of individual responses in each category of the Likert scale (agree/disagree) and statements used to measure the respondent's attitudes on government involvement in managing private forested lands through assistance programs and regulation.

Statements	% Strongly disagree (1)	% Somewhat disagree (2)	% Neither agree nor disagree (3)	% Somewhat agree (4)	% Strongly agree (5)	Total Obs.
Government Assistant Programs						
The government should use financial incentives to help or encourage private owners to change management practices.	3.77	6.96	28.84	37.10	23.33	**656**
The government should conduct workshops on best forest management practices for private forest owners.	2.03	4.64	20.14	41.45	31.74	**656**
The government and private forest owners should work together toward forest conservation.	1.45	2.61	14.78	32.46	48.70	**656**
The government should use positive images and cultural symbols to promote forest conservation.	1.74	3.77	21.74	34.93	37.83	**656**
Government Regulation						
The government should be able to regulate the use of forests located on private land to protect public benefits.	10.87	15.80	28.84	30.29	14.20	**656**
The government should have the right to tell private forest owners how to best manage their forests.	15.51	20.43	28.55	24.64	10.87	**656**
There should be regulations regarding how trees are managed on private forest land	9.13	11.45	25.51	35.94	17.97	**656**
The government should fine private forest owners who fail to use best management practices.	13.91	12.75	27.54	29.57	16.23	**656**

Table 4. A percentage showing the total sum of individual responses in each category of the Likert scale (agree/disagree) and statements used to measure the types of knowledge in respondents.

Statements	% I do not know (0)	% Strongly disagree (1)	% Somewhat disagree (2)	% Neither agree nor disagree (3)	% Somewhat agree (4)	% Strongly agree (5)	Total Obs.
Subjective Knowledge							
I know most of the birds I encounter in my day-to-day surroundings	-	16.38	16.67	16.38	39.57	11.01	**656**
I know most of the birds I encounter when visiting natural areas in Pennsylvania	-	18.41	20.14	20.72	33.19	7.54	**656**
I actively support organizations that seek to conserve wildlife habitat (e.g., member, donor, voter)	-	10.58	14.49	23.48	30.29	21.16	**656**
Factual Knowledge							
Plant and animal biodiversity is needed to ensure the sustainability of most ecosystems	3.91	3.77	1.88	7.83	22.46	60.14	**656**
Some species of cranes, warblers, and grouse are on the federal endangered species list	25.07	2.32	2.32	14.06	27.39	28.84	**656**
In more recent years whip-poor-wills have been less abundant	35.80	2.03	2.32	21.59	20.43	17.83	**656**
The golden-winged warbler interbreeds with the blue-winged warbler to produce offspring	50.87	1.59	1.74	26.67	12.32	6.81	**656**

Table 5. A percentage showing the total sum of individual responses in each category of the Likert scale (agree/disagree) and statements used to measure the respondent's perception about the good condition of species population and their habitat versus risks of species declination and habitat loss.

Statements	% Strongly disagree (1)	% Somewhat disagree (2)	% Neither agree nor disagree (3)	% Somewhat agree (4)	% Strongly agree (5)	Total Obs.
Perceptions about condition						
Most common bird populations are in good condition	2.61	16.38	17.83	48.99	14.20	**656**
Most rare bird populations are in good condition	14.06	36.52	33.19	11.59	4.64	**656**
Field habitats are generally available and in good condition	4.35	23.77	33.33	31.30	7.25	**656**
Young forest/shrubby habitats are generally available and in good condition	5.22	21.01	35.36	29.13	9.28	**656**
Mature forest/old tree habitats are generally available and in good condition	8.12	25.36	28.70	27.54	10.29	**656**
Perceptions of risk						
In ten years, some common bird populations will be worse off than they are now	1.74	7.39	13.19	48.55	29.13	**656**
In ten years, some rare bird populations will be worse off than they are now	1.30	3.77	10.87	40.87	43.19	**656**
In ten years, some field habitats will be lost or in worse condition	1.59	6.09	13.04	44.35	34.93	**656**
In ten years some young/shrubby forests will be lost or in worse condition	2.03	6.52	15.07	45.94	30.43	**656**
In ten years, some mature forests/old trees will be lost or in worse condition	1.88	4.64	12.32	45.51	35.65	**656**