CLIMATE CHANGE AND TROUT FISHING IN GEORGIA: A VALUE ORIENTATION ASSESSMENT

by

RAMESH PAUDYAL

(Under the Direction of Neelam Poudyal)

ABSTRACT

A value orientation approach was used to segment a survey sample of Georgia trout anglers to better understand their perception of climate change (CC) risk and behavioral intentions of changing recreation pursuits with decrease in trout populations. Cluster analysis yielded four segments of respondents: pluralist (49%), protectionist (18%), dominionistic (18%), and distanced (17%). Protectionists followed by pluralists seemed to be relatively more aware of the risk of CC than the others and were also likely to reduce trips to affected fishing sites. Distanced were neither strong believers nor deniers of risk of CC, whereas dominionistics were deniers of CC and seemed to have the least concern over its impact on trout fishing. Further, a multivariate analysis revealed protection orientation, knowledge of current impact of CC on trout, belief about climate change, perceived quality of trout fishing, specialization, importance of catching many trout, and source of climate information as significant predictors of trout anglers' concern about risk of CC. Similarly, protection orientation, concern, specialization, importance of catching many trout, trout substitutes, and importance of nature and scenery were significant predictors of behavioral intentions of adjusting fishing trips to affected sites.

INDEX WORDS: adaptation, climate change, risk perception, trout angler, value orientation

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RAMESH PAUDYAL

B.S., Tribhuvan University, Nepal, 2004

M.S., Tribhuvan University, Nepal, 2006

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2013

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RAMESH PAUDYAL

Major Professor:	Neelam C. Poudyal
Committee:	J. M. Bowker
	Gary T. Green

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
December 2013

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my advisor, Dr. Neelam Poudyal, for his guidance and constructive comments throughout my graduate study and research work. My special thanks also go to members of my committee, Dr. J. M. Bowker and Dr. Gary Green, for their helpful comments to thesis and continuous support throughout my graduate work. I would like to thank Dr. Stanley Zarnoch for his support to design the survey.

I am thankful to Adrienne Dorison and James Mingie for their support during design and implementation of the survey and data entry. I am also grateful to my wife, family, and friends for their support and encouragement throughout this graduate study and thesis writing process.

Finally, I would like to thank all of the trout anglers who participated in this survey. Their responses were extremely valuable for the success of this project.

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CHAPTER 1

INTRODUCTION

Background

Recreational fishing is one of the most popular outdoor activities in the United States. It provides significant social and economic benefits to society and the nation (Hickley & Tompkins, 1998). For example, the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation indicated that 33.1 million people generated 456 million fishing trips, and spent $41.8 billion throughout the country in 2011, which generated a $115 billion impact on the nation's economy creating employment for more than 828,000 people (ASA, 2013; USDI, 2011). Recreational fishing, however, is exposed to numerous threats. Agricultural runoff, invasive species, pollution, and reduction of shoreline vegetation are a few examples of such threats (Arlinghaus, Mehner, & Cowx, 2002). Urbanization and structural shifts in population have also made many of the water areas less suitable or entirely unsuitable for fishing (Poudyal, Bowker, Green, & Hodges, 2011). As a result, fishermen often travel further to find a suitable fishing site or wait a longer time to catch fish. These issues may ultimately induce a decline in public participation in recreational fishing. For example, fishing demand in the southeast region of the United States is projected to decline through 2030 by a range between 4% and 24% because of the decline in fishable water resources and the structural shifts in population (Poudyal et al., 2011).

In addition to the threats discussed above, climate change is also expected to impact significantly on recreational fishing. Increases in stream temperatures as a result of climate change may cause a decrease in dissolved oxygen levels and loss of riparian vegetation, making streams less suitable for trout. Decrease in quality of habitat may result to a decline in trout populations and catch rates, unless stocking

is increased. This may result to a decline in fishing participation and ultimately affect some places, where recreational fishing is a significant part of local economy (Hodges, Fogel, Dale, Lannom, & Tharp, 2010).

Trout fishing in Georgia and potential impact of climate change

Georgia has more than 4,000 miles of trout-suitable streams. Located in the northern part of the state, these streams provide fishing opportunities for more than 100,000 resident and non-resident trout anglers (GA DNR, 2012a). Georgia streams provide habitat for three species of trout: Brook, Brown, and Rainbow.

Brook trout, *Salvelinus fontinalis*, are the only trout native to Georgia. Brook trout prefer fresh water bodies having a range of temperature between 32 and 72°F, and cannot tolerate a temperature exceeding 77°F (GA DNR, 2013b). Because of its higher sensitivity to the quality and temperature of water in comparison to other trout species, brook trout behave as an indicator species of the quality of fresh water habitat (Trout Unlimited, 2012b). About 142 miles of streams that occur close to North Georgia's mountains support native brook trout, making them the least widely distributed of the three trout species in Georgia (GA DNR, 2013b). Rainbow trout, *Oncorhyncus mykiss*, are native to the Pacific Coast in Asia and North America. Rainbow trout prefer a habitat with temperature below 70°F for better growth but can tolerate somewhat higher temperatures than either brown or brook trout (GA DNR, 2013). Because of its ability to adapt to a variety of cold water habitats, rainbow trout was introduced to Georgia and stocked throughout the mountains in the late 1800s. Now, rainbow trout occurs in most of the mountain streams in Georgia, and is the most abundant trout species in the state. Brown trout, *Salmo trutta*, a native of Europe and the British Isles, was introduced to north Georgia streams over 100 years ago. Brown trout prefers large and clear streams with a range of temperature between 54°F to 68°F but can tolerate water temperature up to 75°F (GA DNR, 2013b).

Trout are more sensitive to the quality of the habitat than most other species of fish. Water temperature and dissolved oxygen are two key factors that determine the suitability of trout habitat. In general, trout require cold water that is less than 72^{o}F and a dissolved oxygen level of at least 6 mg/L all

year, whereas bass survives with a dissolved oxygen level of about 4 mg/L; and catfish can exist even in less than 3 mg/L (GA DNR, 2013b).

Although most streams in north Georgia are cold enough to support trout in winter, only the mountain streams maintain suitable temperatures in summer to support them. North Georgia streams are relatively unproductive due to high proportion of calcium deficit soils, and therefore are poor habitat for normal growth of trout (GA DNR, 2012b). Trout species in the southern region of the Appalachian Mountains are vulnerable to the potential impacts of climate change (Ahn, de Steiguer, Palmquist, & Holmes, 2000; Clark, Rose, Levine, & Hargrove, 2001). Streams in northern Georgia, being located in the southernmost edge of the trout home range in eastern United States, may be relatively vulnerable to the potential early impacts of climate change.

Because of the limited natural supply, the wild trout population alone is not enough to meet the demand for trout fishing in GA. To meet the demand, Wildlife Resources Division of the Georgia Department of Natural Resources (GA DNR) and the U.S. Fish & Wildlife Service stock roughly a million of catchable-sized trout into North Georgia waters annually (Dallmier, 2010). Decline in trout population due to rising temperature could be partly offset by increasing the stocking amount and frequency. However, if stream temperatures reach beyond the tolerance limit of trout, such programs may have limited success in maintaining trout population. Thus, timely planning and implementation of long term adaptation and impact mitigation programs might be needed. Adaptation is "an adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts" (IPCC, 2001, p. 881). Thus, in a trout fishing context, any adjustment in recreation pursuits by trout anglers can be as an adaptation.

Information about trout anglers' knowledge and perception about the risk of climate change can be useful to understand how differently anglers may respond to change. More specifically, such information can be helpful in predicting potential changes in recreation behavior, which may ultimately be useful for climate change education, and adaptation programs. However, trout anglers are heterogeneous in terms of their personal values, fishing characteristics (e.g., preference, experience, and

attachment), demographics and socio-cultural backgrounds, and perhaps possess different perception about climate change. Inherent heterogeneity in user community could create additional challenge for management agencies in planning and implementation of trout management, climate change education, and adaptation.

One common approach for understanding needs and preference of heterogeneous public is to segment them into homogenous subgroups (Hubert & Gipson, 1996; Kyle, Norman, Jodice, Graefe, & Marsinko, 2007; Needham, 2010). By this token, trout anglers can also be segmented in to homogenous subgroups and identify their characteristics and preferences. Segments of anglers can then be evaluated and compared in terms of risk perception and potential adjustment in recreation pursuits in response to change in resources condition (i.e., trout population). While a number of different criteria have been commonly used in segmenting recreationists, little is known about relation between recreationists' value orientations and climate change risk perception. Thus, a value orientations based segmentation is of interest to this study.

Values are enduring belief about desirable modes of conduct or qualities of life (Rokeach, 1973), which a person learns early in his life (Manfredo, Teel, & Bright, 2003). Values vary among people of different geographic locations and socio-cultural context (Manfredo & Fulton, 1997; Vaske, Jacobs, & Sijtsma, 2011). Value orientations are patterns of direction and intensity of basic beliefs, and are stronger predictors of perception/attitudes, norms, and behaviors than demographic characteristics (Vaske & Donnelly, 1999; Whittaker, Vaske, & Manfredo, 2006). Environmental values and value orientations have been widely used to understand perceptions and behavioral intentions related to environmental risks, such as climate change, wildfire, and radiations (O'Connor, Bord, & Fisher, 1999; Slimak & Dietz, 2006; Stern & Dietz, 1994). Thus, segmenting trout anglers based on their value orientations can offer insights on whether and how variation in knowledge, concerns, and intentional behaviors exists among trout anglers regarding risk of climate change on trout fishing. In addition, anglers' knowledge and concerns about threats of climate change on trout fishing may also be influenced by other factors. For example, anglers with different level of education and income may perceive risk of climate change differently. Similarly,

avid and experienced anglers may perceive the threats of climate change differently than the occasional anglers and beginners. So, multivariate analysis of factors associated with trout anglers' risk perception and behavioral intentions of adjustment in response to the change in recreation resources can enhance our understanding of anglers' behavior.

Statement of the problem and justification

In recent years, climate change has become a serious public policy issue because of its wide range of impacts; ranging from ecosystem to human health. The outdoor recreation sector may not be an exception. For example, increases in temperature as a result of climate change may result in longer summer seasons and shorter winter seasons. Change in seasonal weather patterns may affect the availability of certain recreation opportunities and may also alter the overall quality and enjoyment of outdoor activities (Richardson & Loomis, 2005; Uyarra et al., 2005). Many research and development projects today are focused around developing mitigation and adaptation strategies to address climate change. Information about public perception and concern about risk of climate change are useful for planning and implementation of such strategies. Emerging literature on public knowledge and concern about climate change have found significant knowledge gaps and misunderstanding about the cause and consequences of climate change (Heeren, 2012; Leiserowitz, Smith, & Marlon, 2010). Studies have investigated climate change knowledge and risk perception among general public, but little is known about knowledge and concerns of specific user groups, such as trout anglers. More specifically, whether recreationists of different value orientations perceive the risk of climate change differently is still unanswered.

As individual anglers may hold different values about nature and sport fish, they may perceive the risk of climate change differently. Considering the unique socio-cultural context in the South, anglers' values and beliefs may become a barrier in appreciating the risks of climate change. By segmenting anglers based on their value orientations, management can be informed as to whether trout anglers of different value orientations perceive the risk of climate change differently. Information about whether and

to what extent different groups of anglers are aware of climate change and its potential impacts on their popular activity sites could be useful for outreach and extension programs to design appropriate programs. Different levels of awareness among anglers could mean that some anglers are better prepared than others to adapt to changing resources. Information about whether and how different groups of anglers are likely to adjust their recreation pursuits in response to the change in trout population are also important for management authorities (e.g., GA DNR and other agencies) in updating their trout stocking program and managing alternative recreation resources. Similarly, information about factors associated with trout anglers' perception about risk of climate change and their potential adjustment to change in resources may be useful in increasing their awareness and appreciation toward occurrence and impact of climate change and timely adoption of adjustment strategies against any impacts.

Objectives

The overall goal of this study is to examine Georgia trout anglers' perceptions about risk of climate change by segmenting them into different value orientation groups, and identify the factors associated with their risk perception and behavioral intentions of adjustment to the impacts of climate change.

The specific objectives are to:

1. Segment trout anglers in Georgia based on their value orientations.
2. Compare value orientation segments of trout anglers in terms of their awareness and concerns about risk of climate change, and intentional adjustment to the changes.
3. Examine factors associated with trout anglers' perceptions about risk of climate change and behavioral intentions of adjustment to the change in resources due to climate change.

CHAPTER 2

LITERATURE REVIEW

Climate change and nature-based recreation

Studies on the effects of climate change on nature-based recreation have recently emerged. Among many, some examples are: (Bowker et al., 2012; Coombes & Jones, 2010; Ficke, Myrick, & Hansen, 2007; Hodges et al., 2010; Morris & Walls, 2009; Shaw & Loomis, 2008). Studies reveal that climate change may pose both positive and negative impacts on recreation. Along with the anticipated change in climate, participations in certain sectors of recreation are expected to increase in the future, while participations in others are expected to decrease. For instance, increases in stream temperatures due to climate change are likely to increase warm water fishing opportunities but decrease cold water fishing opportunities. Bowker et al. (2012) projected participation in 17 recreation activities through 2060 under three different scenarios of climate change, as documented in IPCC(2007), and found participation in some activities (e.g., birding and hiking) to increase, and others (e.g., fishing) to decrease. Fishing activities are predicted to decrease, including warm and cold water fishing, saltwater fishing, and anadromous fishing.

A positive effect of rising temperature on recreation may lead to visitor growth on certain recreation activities. Examining a case from the UK coast, Coombes and Jones (2010) predicted highest potential increase (6.4% - 12.3%) in relaxing or sunbathing, the low impact activities, through 2060 under low and high scenarios of climate change as documented in the UK Climate Impact Program (Hulme et al., 2002). Hodges et al. (2010) used climate change projections from three General Circulation Models (dry, middle, and wet scenarios) to estimate the direct economic impact of projected climate change on recreation in Tennessee in 2030 and 2080 using Tourism Climatic Index. They also examined indirect effects based on current demand for recreation under the unique values associated with current conditions.

The anticipated direct effect of climate change on recreation varied according to activity, change in weather pattern, and location of activity within the state. Summer based recreation activities (e.g., lake recreation and camping) were likely to decline, whereas winter activities independent of snow, and other activities (e.g., rock climbing and whitewater boating) were likely to increase. Predicted indirect impacts included substantial economic impacts on forest-based recreation due to potential decline of species such as trout and high elevation spruce-fir forest.

Similarly, Richardson and Loomis (2004) examined potential change in recreation behavior among the Rocky Mountain National Park visitors under various scenarios of climate change impact. The authors predicted an increase in park visitation number by 9.9% to 13.6% (depending upon model used), under climate related scenario. Results indicated climate related variables (e.g., temperature and precipitation) and resource related variables (e.g., change in composition of vegetation and change in elk population) as significant predictors of change in visitation behavior.

Climate change and recreational fishing

Climate change may affect fish habitat by changing the water levels of lakes, rivers, and streams, increasing the water temperature levels, decreasing the dissolved oxygen levels, and increasing the toxicity of pollutants in fresh waters (Ficke et al., 2007). Changes in water levels could affect both quality and number of fishing trips to salt water as well. Whitehead et al. (2009) estimated the economic effects of sea level rise on recreational coastal fishing in North Carolina from 2006 to 2080. The predicted welfare loss of anglers due to reduced fishing access and quality was $1.8 billion over 75 years.

Different factors may affect the attractiveness of a fishing site and angler's satisfaction, including travel costs, fishing quality, water quality, facilities, encounters with other anglers, and regulations (Hunt, 2005). As climate change is predicted to reduce water quality, it may indirectly affect the attractiveness of fishing sites and anglers' satisfaction. Decline in anglers' satisfaction and participation in trout fishing could mean a significant welfare loss to anglers and reduction in economic benefit to fishing-dependent rural communities. Examining a scenario of loss of lake trout *(Salvelinus namaycush)* fishing

opportunities from waters around Thunder Bay in Northern Ontario, Hunt and Moore (2006) estimated a decrease in recreational fishing activity by about 5,400 days (2.1% decline in total days) from May 1 to September 30. This decrease in fishing participation was predicted to result in a loss of $175,000 per year in the economic value of fishing. Similarly, Ahn et al. (2000) estimated trout anglers in South Appalachian Mountains may experience a $53.18 loss in welfare per trip if trout habitat declined by 82% due to climate change.

A few studies have estimated both loss and benefit from climate change on recreational fishing. For example, Pendleton and Mendelsohn (1998) combined global climate models, ecological models of fish catch rates, and economic models to predict economic impact of climate change on sport fisheries of the northeastern United States. A doubling of atmospheric carbon dioxide is predicted to generate between $4.6 million net loss and a $20.5 million net benefit in recreational fishing depending on climate scenario. Authors indicated that the welfare loss of anglers associated with decrease in rainbow trout population, due to increases in mean July temperature, could be more than compensated by the increase in other trout populations (e.g., brook), due to increase in October temperature. As studies have found, the brook trout living at high latitudes will benefits from longer summers (Meisner, 1990).

Other studies predicted the potential impact of climate change on different species of trout and other species of fish under different scenarios of climate change. Meisner (1990) estimated an increase in July and August temperature by 7.4°F could result in a loss of 30 – 42% of available brook trout habitat in two Southern Ontario streams. Flebbe (1994) estimated a potential loss of 82 – 89% of brook trout from North Carolina and Virginia as a result of an increase in average air temperature by 6.8°F. Similarly, Keleher and Rahel (1996) predicted a loss of 17 – 72% of habitat of different trout species from Rocky Mountain region as a consequence of increase in July temperature by 1.8 – 9°F. Similarly, Clark et al. (2001) predicted brook and rainbow trout could lose 24% and 16% respectively of the available habitats in the Southern Appalachians. Clark et al.'s prediction was based on a model scenario that included an increase in daily temperature by 1.5 – 2.5°C, change in water flows, and mortality episodes associated with flow-related scouring of reeds. Similarly, O'Neal (2002) predicted 18 – 38% of presently-suitable

streams across the U.S. could become unsuitable for all trout and salmon by the year 2090. This prediction was based on different emissions scenarios as suggested by IPCC.

Perception of climate change as a risk

Since preventing climate change is believed to be a slow and long term process, natural resource agencies are considering a variety of adaptive strategies and mitigative actions to cope with the change and risk posed by climate change. Information about whether and how people perceive climate change as a risk may be useful in understanding their vulnerability (in terms of lack of information, poor- or mis-understanding of the risk involved etc.), and perhaps in predicting their behavioral intentions of adaptation (O'Connor et al., 1999). For example, if people perceive climate change as a risk to their well-being, they are more likely to support climate change initiatives (Cameron, 2005; Zahran, Brody, Grover, & Vedlitz, 2006). Some people who do not view climate change as a risk may hesitate to adopt adaptive and mitigative strategies (Browne & Hunt, 2007). In other words, the greater the perceived risk, the greater will be an individual's likelihood of adopting adaptive strategies.

Literature on public perceptions and concerns about climate change have recently emerged (Heeren, 2012; Leiserowitz, 2005, 2006; Leiserowitz et al., 2010; Maibach, Roser-Renouf, & Leiserowitz, 2009; McCright, 2010). Lazo, Kinnell, and Fisher (2000) showed experts believed climate change to have a lower impact on ecosystems than the general public believed. However, compared to general public, they perceived it as a less controllable and less understandable risk. Another study found that slightly more than 60% of the American public were somewhat sure about the occurrence of global warming, but most of them were not aware of the reason (Leiserowitz et al., 2010). The same study showed only eight percent of Americans had climate change knowledge equivalent to A or B grades; whereas the other 40 percent had knowledge of C or D grade, and the remaining 52 percent had knowledge equivalent to F grade. The grading scale used was 90% and above =A, 80-89% = B, 70-79% = C, 60-69 = D, and 59% and below = F. The general public perceives climate change as a moderate risk, but does not perceive it as being an immediate risk to individuals or their communities. Rather, they believe that climate change will

cause harm to future generations and geographically distant people and places or nature such as polar ice caps (Leiserowitz, 2005; Lorenzoni & Pidgeon, 2006).

Yale Project on Climate Change Communication analyzed the general American public's perception of climate change by segmenting them into six groups (Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Howe, 2013; Maibach et al., 2009). The segments identified were *Alarmed, Concerned, Cautious, Disengaged, Doubtful,* and *Dismissive*, which were different from each other in terms of climate change related beliefs, attitudes, risk perceptions, motivations, values, policy preferences, behaviors, and underlying barriers to actions. The Alarmed, being at one end among the six groups, were fully convinced about the reality and seriousness of climate change and were ready to take action to address it, whereas the Dismissive, being at other end, were very doubtful of climate change and actively served as opponents of a national effort to reduce greenhouse gas emission.

Understanding how people perceive the risk is important because previous studies on human dimensions have found risk perception to have strong influence on behavioral intentions (McFarlane, 2005; O'Connor et al., 1999). Heeren (2012) reported people from Minnesota had climate change knowledge of 51 on a scale of 0 to 100. About 72% of the respondents were at least somewhat sure about the occurrence of climate change. Further, those who did not believe in climate change were less supportive of all management actions aimed toward adaptation and mitigation of impacts (Heeren, 2012). Public understanding of socio-economic and environmental impact of climate change may not only influence their potential support for policies and regulations intended to minimize the impacts, but also affect their travel and tourism decisions (Huebner, 2012). In addition to support for climate change policies and regulations, public's understanding of socio-economic and environmental impact of climate change may not only influence their affect their travel decisions and choice of recreation activities (Huebner, 2012). Beliefs and concerns held by specific groups of people have recently been examined by researchers in other fields of natural resources. For example, Arbuckle, Morton, and Hobbs (2013) examined farmers' beliefs and concerns about climate change and its impact on agriculture. Results showed concerned farmers hold positive attitudes toward adaptive and mitigative management strategies.

Similarly, PINEMAP (2013) examined climate change perceptions of the foresters from southern United States. As the study found, 62% of the southern foresters believe that climate change is occurring but only 16% believe that climate change is caused by human. Study reported that some 65% of the southern foresters are 'somewhat' to 'very interested' in learning more about climate change.

Socio-demographic factors, worldviews, and risk perception

Many socio-demographic and psychological factors appear to relate with public understanding of climate change. Some studies found women to be more concerned about the risk of climate change than men (O'Connor et al., 1999; Semenza et al., 2008; Stedman, 2004). Other studies found women and racial minorities were more likely than white men to support national policies on global warming (Dietz, Dan, & Shwom, 2007; Leiserowitz, 2006; Shao, 2012; Zahran et al., 2006).

Studies looking at the effect of education and income on the knowledge and concerns of climate change have found mixed results. Some studies showed educated people were more concerned about the global warming and climate change issues than their less educated counterparts (Hamilton, 2008), whereas others have found the opposite to be true (Malka, Krosnick, & Langer, 2009; McCright & Dunlap, 2011). Similarly, some studies (Hamilton & Keim, 2009; McCright & Dunlap, 2011; Semenza et al., 2008) found individuals with higher income were less concerned about the impact of climate change. Although, individuals with higher income were found to be less concerned about impact of climate change, Dietz et al. (2007) found income to be a strong predictor of support for climate change and global warming policies. Meanwhile, some other studies have shown insignificant relation of education and income on climate change knowledge and concern (Brody, Zahran, Vedlitz, & Grover, 2008; Kellstedt, Zahran, & Vedlitz, 2008). Likewise, age has been found to have a negative relation with climate change knowledge and concern (Kellstedt et al., 2008; Malka et al., 2009; McCright & Dunlap, 2011), and a positive relation with support for global warming policies (Dietz et al., 2007). On the other hand, Hamilton and Keim (2009) did not find a significant effect of age on public perception and concern of risk associated with climate change.

Environmental values and other higher order cognitions, e.g., attitudes, and experiential factors, are also important in predicting public perception and concerns about climate change and global warming. For example, Dietz et al. (2007) found the social psychological variables, including attitudes, beliefs, and worldviews have effects on environmental concern and policy support. Leiserowitz (2006) found values and other experiential factors, such as affects and imagery largely influence American's perception of risk and support for policy. Similarly, Whitmarsh (2011) investigated skepticism and uncertainty about the climate change and found environmental values strongly determine public skepticism of climate change; and age, gender, location, and life style indirectly affect the same. Stedman (2004) examined factors affecting Canadian policy actors' perception of risk associated with global climate change by integrating three approaches, psychometric (cognitive), demographic, and political. Stedman found an indirect effect of socio-demographic characteristics on risk perception, but found its direct effect on beliefs about climate change that ultimately affect risk perception.

Public perception of climate change and global warming may also be influenced by the trend of local weather and climate. For example, Shao (2012) found the summer temperature trend over the past ten years to have a positive effect on public acceptance of anthropogenic global warming and their concern for the issue. Perhaps, individuals exposed to high summer temperatures translate increasingly hot summers into knowledge and concerns about global warming (Shao, 2012). Similarly, Lorenzoni and Pidgeon (2006) found people residing in areas with currently cool climates and areas with no weather extremes were less likely to perceive an increase in temperature as a result of climate change. On the other hand, Brulle, Carmichael, & Jenkins, (2012) found no significant relationship between weather extremes and public knowledge and concerns of climate change. Their study, however, found political mobilization by elites and advocacy groups and structural economic factors (unemployment rate, increase in GDP, and number of U.S. war deaths in Iraq and Afghanistan) can have great del of influence on public concern about climate change. Other studies also found strong influence of political views on public knowledge and concern about climate change and policy supports (Dietz et al., 2007; McCright & Dunlap, 2011; Shao, 2012). Whitmarsh (2011) showed people having right-of-center political views are

the most skeptical about the cause and consequences of climate change. Others argued climate change and global warming are politically polarizing issues. For example, Shao (2012) argued people having liberal and Democratic views are more likely to accept anthropogenic causes of global warming and show higher level of concern towards the issue than their conservative and Republican counterparts. Similarly, studies have found peers (e.g., friends and colleagues), media, and public agencies can have great deal of influence on individual's perception of climate change risk (Grothmann & Patt, 2005; Shao, 2012).

Value orientations and audience segmentation

Analysis of users' value orientations has been a popular approach in predicting individual's behaviors regarding natural resources management and use. Researchers have used this approach to illustrate that wildlife value orientations are useful in predicting the support for various policies and actions (Manfredo & Fulton, 1997; Vaske & Donnelly, 1999; Whittaker et al., 2006). Value orientations have also been used in recreation and tourism settings to understand recreationists' perceptions, attitudes, and behaviors towards protection and use of recreation resources. For example, Needham (2010) segmented marine recreationists based on their value orientations toward coral reefs, and compared value orientation segments by recreation activity and demographic characteristics. Needham found three segments of recreationist and showed that swimmers and sunbathers were most likely to hold strong protection orientation, anglers were most likely to have mixed protection-use orientation, and scuba divers were most likely to hold moderate protection orientation. Similarly, other researchers used a value orientation approach to examine anglers' attitude and behavior in the context of recreational fishing and other aquatic resources (Bruskotter & Fulton, 2007, 2008). Bruskotter and Fulton found three value orientations of anglers (utilitarianism, dominance, and protectionism) to examine the relationship between angler's value orientations and norms related to stewardship of aquatic resources and the use of technological aids to angling. They found positive significant relations of all three value orientation types with anglers' stewardship norms related to aquatic resources, but found negative significant relation of only protection orientation and utilitarian orientation with support for the use of technological aids.

Environmental value orientation has been found to be a significant predictor of public perception and response to the environmental risk, such as climate change and wild fire. (McFarlane, 2005; O'Connor et al., 1999). For example, McFarlane (2005) examined public perception of risk to forest biodiversity; and found value orientation to have a stronger power to predict perception of risk and perceived effectiveness of conservation strategies than the knowledge indicators and socio-cultural variables. Results showed people having a biocentric value orientation perceive risk of natural hazards to forest diversity with higher risk rating than their anthropocentric counterparts. Similarly, O'Connor et al. (1999) found risk perception, knowledge about climate change, and general environmental belief as independent predictors of behavioral intentions related to climate change. Authors found general public to be neither non-believers, who take no initiatives and oppose all governmental efforts, nor strong believers, who make personal efforts themselves and vote for every governmental initiative.

Gigliotti and Peyton (1993) studied values and behavior of trout anglers by segmenting them on the basis of whether or not they were members of fishing organizations (i.e., Trout Unlimited and Fly Fishing Federation) and compared their preferences toward management and regulations. Comparison revealed a higher percentage of members than nonmembers had favorable attitudes towards proposed regulations such as catch and release and fly fishing only. Nonmembers, on the other hand, showed greater preference toward stocking of trout than the members did.

A few studies have used cluster analysis as a tool for segmenting anglers based on different orientations. For example, Fisher (1997) applied cluster analysis to survey responses from Texas fishing license holders and segmented them into seven groups. The criteria of segmentation included six variables: fishing participation, fishing experience, club membership, tournament participation, activity-specific attitudes, and opinions on fishery management options. The study showed the anglers' group had diverse attitude pertaining to the size and number of fish sought, importance placed on keeping the catch etc. Similarly another study in New York also identified seven distinct types of anglers based on their fishing preferences, such as desire for catch, skill development, and fish consumption (Connelly, Knuth, & Brown, 2001). Likewise, Kyle et al. (2007), based on the consumption orientations of anglers,

identified four segments of anglers as: catching many fish, catching big fish, catching no fish was okay, and keepers (who prefer to keep the caught fish). Segmenting anglers based on their specialization is another way of identifying diverse subgroups of anglers. For example, Chipman and Helfrich (1988) identified six types of anglers characterizing low to high level of recreation specialization in two Rivers of Virginia. Different aspects of anglers' behavior such as, frequency of fishing, investment on fishing activities, and consumptive habits were used determine their specialization. As the study found, the highly specialized anglers had motives for trophy fish and catch and release of larger fish; and were also more favorable towards restrictive harvest regulations. Less specialized anglers had the objectives of family oriented recreation and were happy with catching smaller fish and more favorable toward liberal harvest regulations.

As discussed in the beginning of this section, several researchers have highlighted the potential impact of climate change on recreation resources and recreationists' behavior. Some studies specifically highlighted the potential impact of climate change on trout. Most of the previous studies on outdoor recreation and climate change investigated the economic impact, with little focus on outdoor recreationists' awareness and concerns about environmental issues (e.g. climate change). Yet, little is known about recreationists' perception and concerns about risk of climate change. Many past studies (discussed above) used different criteria (e.g. specialization, membership of organization, and catching preferences) to segment anglers. However, these segmentation criteria may not explain much of variance among trout anglers regarding their perception and concern about climate change and its impact on trout fishing. Thus, this study aims to identify the values and value orientation based heterogeneity among the trout anglers and attempts to examine how this heterogeneity is associated with their climate change risk perception. Perception, concern, and behavioral intention are cognitive factors. Values being in lower order of cognitive hierarchy directly affect attitudes and indirectly (through attitudes) affect behavioral intentions (Ajzen, 1991; Vaske & Donnelly, 1999). Unlike the demographic and other characteristics, values are relatively stable i.e. slow to change over time (Fulton, Manfredo, & Lipscomb, 1996; Vaske & Donnelly, 1999). Thus, subgroups of trout anglers based on their value orientation could be more stable

and reliable for prediction of climate change related perceptions and concerns. Studies have found individuals who value other species highly will be concerned about environmental conditions that threaten those valued objects (Stern, Dietz, Abel, Guagnano, & Kalof, 1999). Thus, value orientation could be more appropriate criteria to segment trout anglers to understand their perception and concern about risk of climate change.

Conceptual background

Burgman (2005) defines risk as "the chance, within a time frame, of an adverse event with specific consequences" (p. 1). Different theories explain the concept behind risk and risk perception with different approaches. According to the psychological approach, risk perception are shaped primarily by the characteristics of the risks themselves, and risk is commonly perceived in two ways: 'risk as feeling' and 'risk as analysis'(Slovic, 2000; Slovic & Peters, 2006). Arnoldi (2009) explains risk as a social problem (social approach) arguing people worry about different risks due to different socio-cultural background. Another approach defines risk perception from an anthropological perspective, and is known as cultural theory of risk perception. Proponents of this theory argue that risks are perceived based on cultural bias (Douglas & Wildavsky, 1983; Wildavsky & Dake, 1990). In other words, the values and world views of certain cultural context shape one's perception and judgment of risk (Rippl, 2002). Following, this theory, Dake (1991) developed three scales of orientation: egalitarianism, hierarchy, and individualism. Dake suggests egalitarians are the most concerned with the environment and individualists the least concerned. However, the conceptual approach of cultural theory has been widely criticized (Marris, Langford, Saunderson, & O'Riordan, 1997; Slimak & Dietz, 2006). Marris et al. (1997) found only few respondents can be placed in these hypothesized orientation types. Similarly, Sjöberg (2000) found very little explanatory power of the cultural theory of risk perception.

In this context, Stern et al. (1999) proposed Values-Beliefs -Norms (VBN) theory, which suggests individuals' susceptibility to mobilization as a response to a threat depends on their basic value priorities and their willingness to believe in the claimed threats. Stern and colleagues have incorporated the New

Environmental Paradigm (NEP) as a measure of beliefs in VBN model. Stern et al. suggested this model of social movement mobilization can be useful in understanding public opinion and attitude-behavior relationships in the context of environmental issues. Slimak and Dietz (2006) explained this concept as a general theory of environmental concern and suggested the appropriateness of its use on risk perceptions. New Ecological Paradigm Scale, originally developed by Dunlap and Van Liere (1978) and revised by Dunlap, Van Liere, Mertig, and Jones (2000) is a measure of endorsement of a 'pro-ecological' world views and has become the most widely used measure of environmental concern. Use of NEP has become a part of extensive social-psychological research to explain the root causes of environmental behavior (Anderson, 2012).

Values, beliefs, attitudes, and norms are collectively referred as cognition, the mental processes and dispositions which people use in thinking and understanding situations (Vaske & Manfredo, 2012). The development of the cognitive approach has helped social scientists to arrange human thoughts into a hierarchy of cognitions (values, value orientations, attitudes, and norms), which can influence human behavior (Vaske et al., 2011). Theory of planned behavior also suggests that attitudes, subjective norms, and perceived behavioral control are the predictors of behavioral intentions, which together with behavioral control account for considerable variance in actual behavior (Ajzen, 1991).

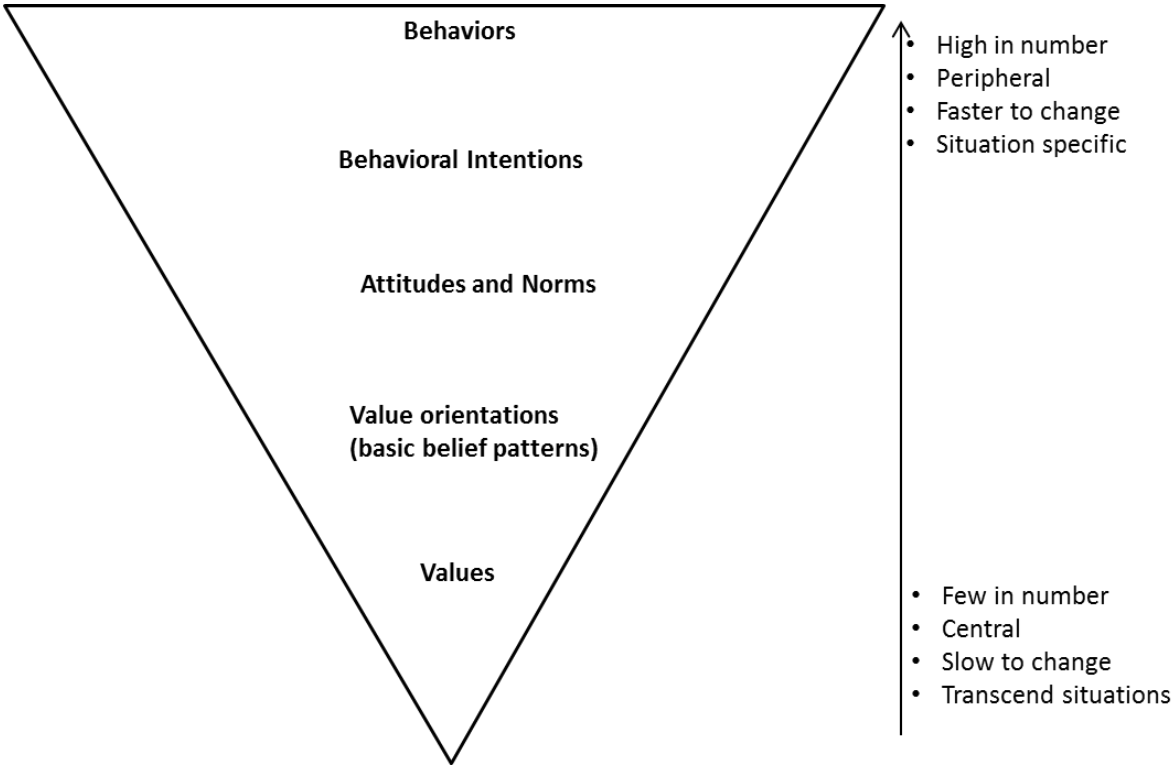
Values are commonly defined as desirable individual's end state, modes of conduct, or qualities of life that a person holds dear, such as freedom, equality, and honesty (Rokeach, 1973). For example, a person who holds "honesty" as an important values is likely to be honest when completing IRS tax forms, conducting business deals, or interacting with friends (Whittaker et al., 2006). According to the concept of cognitive hierarchy, values are in lower order of cognition, are few in number, central in belief, slow to change, and they transcend (go beyond) any situation. Whereas, attitudes and behaviors, being in higher order of cognition, are high in number, peripheral in belief, faster to change, and specific to a situation (Fulton et al., 1996; Vaske & Donnelly, 1999). Personal values are hard to change; however, value orientations and other higher order cognitions may be changed as a result of antecedent factors such as

social structure. Similarly, attitudes, norms, and behavior may also change as a result of knowledge or education (McFarlane & Boxall, 2000).

The study of values has become common in human dimensions of wildlife and recreation literature; however, values account for limited variability within a given culture, and thus are the poor measures for the prediction of attitudes, norms, and behaviors (Fulton et al., 1996; Manfredo et al., 2003; Vaske, 2008). Value orientations, on the other hand, are patterns of direction and intensity of basic beliefs, and are more powerful in accounting for variations in people's perception/attitudes, norms, and behavior (Vaske & Donnelly, 1999; Whittaker et al., 2006). For example, values measure the extent to which people identify with abstract concepts like altruism or honesty; value orientations, on the other hand, explore patterns of beliefs about broad classes of objects, such as wildlife or forests (Whittaker et al., 2006). Common value orientation continuums defined in studies of wildlife value orientations are biocentric-anthropocentric (Vaske & Donnelly, 1999; Vaske, Donnelly, Williams, & Jonker, 2001), protection-use (Bright, Manfredo, & Fulton, 2000; Fulton et al., 1996; Manfredo & Fulton, 1997), and utilitarianism-mutualism (Teel, Dayer, Manfredo, & Bright, 2005). However, Vaske and Donnelly (1999) suggested protection-use and biocentric-anthropocentric value orientation continuum have conceptual similarity.

An anthropocentric or use orientation assumes non-human parts of nature are not important in their own right or for their own sake, and human uses and benefits should be the primary focus of the natural resources management (Vaske, 2008; Vaske et al., 2001). For example, a person with use orientation may strongly believe sport fishing is important for food, human well-being, jobs, and income. In contrast, a bio-centric or protection orientation is a nature-centered approach which assumes nonhuman parts of nature also have inherent worth and thus human uses and benefits should not be the first priority for the natural resources management (Vaske, 2008; Vaske et al., 2001). For example, a person with protection orientation may strongly agree that management should focus on doing what is best for nature instead of what is best for people. The protection and use orientations are not mutually exclusive, and thus can be arrayed along a continuum with protection orientation at one end and the use orientation at the

other end. The mid-portion of the continuum represents a mixture of these two extremes and can resemble partial characteristics of both protection and use orientations (Needham, 2010; Vaske, 2008; Vaske & Donnelly, 1999). Between these two extremes, different levels of orientations are possible.



(Sources: Fulton et al., 1996, pg. 26 and Vaske & Donnelly, 1999, pg. 525)

Figure 2.1. Cognitive Hierarchy Model of Human Behavior

Recreationists and tourists are heterogeneous because they exhibit different range of skills, attitudes, and behavior (Needham, Vaske, Donnelly, & Manfredo, 2007). Considering this diversity, researchers have given importance to grouping individuals into meaningful homogenous subgroups to improve understanding of behavior and response to natural resources related issues (Bright et al., 2000;

Needham, 2010). For example, researchers have differentiated anglers as specialized versus less specialized (Chipman & Helfrich, 1988), catch oriented versus catching no fish was okay (Kyle et al., 2007), and urban versus rural (Hubert & Gipson, 1996).

Users have also been grouped by their value orientations toward natural resources in recreation and tourism settings. For example, Bruskotter and Fulton (2008) modified the basic belief statements used in wildlife and forest related value orientation measurement (Fulton et al., 1996; Vaske & Donnelly, 1999) to fit in angler's basic belief about natural resources, and used to identify value orientation segments. Similarly, (Needham, 2010) modified those statements to fit in recreation settings related to coral reefs, and identified three segments of users based on their value orientations. Thus, heterogeneous users (trout anglers in this case) arranged in the protection-use continuum can be grouped in to more homogenous subgroups (Needham, 2010). As discussed previously in this section, researchers have proved the effectiveness of using values and basic beliefs as predictors of concerns and behavioral responses related to environmental risk (such as climate change).

This study attempts to integrate concepts of risk perception and cognitive hierarchy to examine trout anglers' risk perception associated with climate change by segmenting them into different groups of value orientations. It also aims to examine what factors influence trout anglers' perceptions of risk associated with climate change and intentional response behaviors to changes in resources.

Based on the concept of cognitive hierarchy, and conclusions of the previous studies, the following hypotheses were developed:

Hypothesis (H_1): Georgia trout anglers form distinct segments based on their nature/sport-fish related value orientations.

Hypothesis (H_2): Value orientation segments among Georgia trout anglers are different in terms of their awareness and concerns about risk of climate change and behavioral intentions to adjust their recreation pursuits.

Hypothesis (H_3): Perception of risk and potential adjustment to the change are associated with cognitive variables, demographics, and fishing characteristics of the anglers.

CHAPTER 3

METHODS

This chapter starts with a description of the research design and then presents a description of variables used in the study. Finally, it includes a description of sample response and methods adopted for data analyses.

Research design and survey instrument

The population of interest for this study was trout anglers in Georgia (resident and non-residents), who could legally trout fish in 2011. Mail and email surveys were used to collect data during late springs and early summer of 2012. Contact information for license holders was obtained from the Georgia Department of Natural Resources' license database. Altogether, eighteen different types of licenses were issued to 313,693 anglers providing trout fishing privilege in Georgia in 2011. To ensure proportional representation of all license types, a computer-generated stratified random sample of 3,000 anglers was selected. The sample size was representative of almost all major license categories, and was also consistent with that suggested by Dillman (2000) for a 95% confidence level that the sample accurately represents the population. Sample size for each license category was first chosen based on the proportions of the population for each type and then adjusted for expected variable response rates among license categories (Table 3.1). For example, the number of samples on Nonresident Three Day Trout Fishing was increased from 54 on proportional allocation to 300 on adjusted allocation, and number of samples on Resident Trout Fishing was decreased from 1250 to 802.

Following a method modified from Dillman, Smyth, and Christian (2009), survey packets were mailed to all 3000 randomly selected anglers. The packet included a personalized cover letter, nine-page

questionnaire (Appendix 1), and a postage-paid business reply envelope. Following the initial mail-out, a post card reminder was sent to all respondents as an appreciation to those who already responded the survey, and as a reminder to those who had yet to respond (Appendix 2). Two weeks after the follow-up reminder, a final round mail survey packet was sent to each non-responding angler in the sample. Considering the low response rate from the mail survey, a web survey was developed in SurveyMonkey.com and a request was sent by email to those in the selected sample who had email address in the license database. Taking advantage of a low-cost follow up option, non-respondents in email survey were followed up until the seventh round.

The survey included three sections of questions; section A: current and past trout fishing in Georgia, section B: perspectives about sport fishing, nature and climate change, and section C: the demographics (Appendix 1). Section A requested anglers to provide information regarding their catch and stream type preference, fishing trips and associated expenditures, preferences for selecting a fishing site, perception in quality of trout fishing then compared to past, and preferred alternatives if a place they often trout fish was not available on a typical fishing day.

The section B included questions about nature and sport fish related basic beliefs, climate change knowledge and concerns, potential responses to impact of climate change, preferred alternatives outdoor activities, sources of climate information, and factors affecting trout populations in GA. Perception and attitude questions were in five-point Likert scale, (strongly disagree←→strongly agree or not important←→very important), whereas other questions were with categorical or continuous measurement units. In the demographics portion (section C), anglers reported their age, sex, origin, race and ethnicity, household size, education level, employment, membership on any trout fishing, environmental, or social organizations, and annual income.

Table 3.1. Sampling Distribution by License Types of Trout Fishing Privilege in Georgia in 2011.

License Description	# of Licenses	% of Total License Population	Proportional Allocation	Adjusted allocation	% of sample
Disability Honorary Combo Hunting	9574	3.05%	92	150	5.00
Disability Honorary Fishing	4408	1.41%	42	150	5.00
Honorary Veteran 1-Time Fishing	37	0.01%	0	0	0.00
Honorary Veteran 1-Time H/F	203	0.06%	2	0	0.00
Lifetime Adult H/F	8888	2.83%	85	129	4.30
Lifetime Non Resident Grandchild H/F	1	0.00%	0	0	0.00
Lifetime Senior Card	6709	2.14%	64	123	4.10
Lifetime Senior Discount H/F	6203	1.98%	59	114	3.80
Lifetime Veteran H/F	468	0.15%	4	0	0.00
Lifetime Youth H/F	157	0.05%	2	0	0.00
Nonresident 3-Day Trout Fishing	5597	1.78%	54	300	10.00
Nonresident Trout Fishing	5886	1.88%	56	200	6.67
Resident 3 Day Trout Fishing	958	0.31%	9	100	3.33
Resident Trout Fishing	130708	41.67%	1250	802	26.73
Resident Sportsman Combo	51669	16.47%	494	500	16.67
Resident Trout Fishing 2-Year	9789	3.12%	94	86	2.87
Senior (65+) Lifetime H/F	71710	22.86%	686	330	11.00
SR (65+) Lifetime H/F w/ Plastic Card	728	0.23%	7	16	0.53
Total Licenses	313693		3000	3000	0.96

Sample responses

Out of 3,000 contacted, 278 addresses were undeliverable and 238 anglers completed and returned the survey in the first round. Thus, the adjusted response rate in the first round mail survey was nine percent. A second round mail out was sent to 2,484 anglers (excluding those who responded, or had undeliverable address in from first round). A total of 106 addresses were undeliverable, and 295 returned the survey. The response rate for this round slightly improved (12%). For just mail surveys, undeliverable surveys were 384 and returned surveys were 533, accounting a cumulative mail-only response rate of 20%. Table 3.1 below shows the breakdown of responses on each round and version of surveys.

Table 3.2. Break Down of Responses by Survey Round and Version.

	Mail out 1	Mail out 2	Email	Total
Survey Sent	3000	2484	769	3000
Undeliverable	278	106	76	438
Returned	238	295	94	627
Response Rate (%)	8.74	12.41	13.56	23.84

Among 852 records in the original list of 3000 anglers having an email address in GA-DNR database, and who had not responded to the mail survey, a web-based email survey was sent (769 anglers). Out of the 769 email addresses, 76 were undeliverable. Among the undeliverable, some anglers had already opted-out from receiving any surveys administered through Survey Monkey, and thus were unreachable. Among 693 anglers who received email, 94 responded either through email or by completing the survey; thus response rate obtained was 14%. Some ten surveys were undeliverable both in the mail and email. The mailing addresses of 12 anglers were undeliverable, but their email addresses were deliverable. Thus, those anglers were removed from the list of undeliverable samples. Finally, out of the total sample of 3000 anglers, 438 were undeliverable and 627 anglers responded the survey either by mail or email. Accordingly, the adjusted final response rate was approximately 24% (Table 3.2). Comparison of age and gender, available in license database, shows that responders were slightly older

than non-responders (Table 3.3). However, gender proportions were not different between responders and non-responders.

Table 3.3. Comparison of Age and Gender Between Responders and Non-responders

Group	Average age	% Males	% Females
Responders	49.7	82.6	16.9
Non-responders	47.6	81.9	17.7

Data processing

Among 627 returned surveys, 75 did not provide data useful for this study. They returned the unfilled/incomplete survey or contacted the researchers indicating they do not use the trout stamp included in their license, or do not want to participate in the survey. Responses for the remaining 552 surveys were entered in Excel spreadsheet.

The target population for this study was GA trout anglers. However, the 552 responses available from the earlier survey included both trout anglers and non-trout anglers. Some of the license categories (e.g., Resident Sportsman Combo) provide privilege for multiple recreation activities including trout fishing. Those license holders who responded the survey may or may not fish for trout. Therefore, a classification system was implemented on respondents to determine if they were trout anglers. The system is as follows:

1. Respondent reported fished for trout in GA in 2011 (A4 in survey) (n=337).
2. Respondent did not fish in 2011, but selected the options 1st ("I usually go every year, but 2011 was an exception") or 2nd ("I quit trout fishing altogether") of question A5 in survey which stated "which best describes your reason for answering no in A4?" (n=121).
3. Respondent did not respond A4 but checked 1st or 2nd option in question A5 (n = 1).
4. Respondent skipped both A4 and A5 but provided 2011 trout fishing trips in A12 or expenses information in questions A14 or A16 or A17 (n=6).

Remaining respondents who did not meet the criteria mentioned above were classified as non-trout anglers (n=87). Thus, the final sample determined to represent trout anglers in Georgia consisted of 465 observations. Because the selection of a respondent as trout angler was based on multiple selection criteria, it is expected the selected respondents were only trout anglers and included all respondents who fish for trout.

Value orientations segmentation

Trout anglers' value orientations were assessed based on their responses to a set of value statements related to sport fish and nature as given in Table 3.3. These statements assessed anglers' responses regarding how they use, treat, and value nature and sport fisheries, and were conceptualized as indicators of either protection or use orientations. The first six statements were expected to measure trout anglers' use orientation, whereas the remaining four were expected to measure protection orientation. Some of these statements were primarily adapted from Vaske and Donnelly (1999), (Vaske et al., 2001), and (Bruskotter & Fulton, 2008); and some were added to represent the context of recreational fishing.

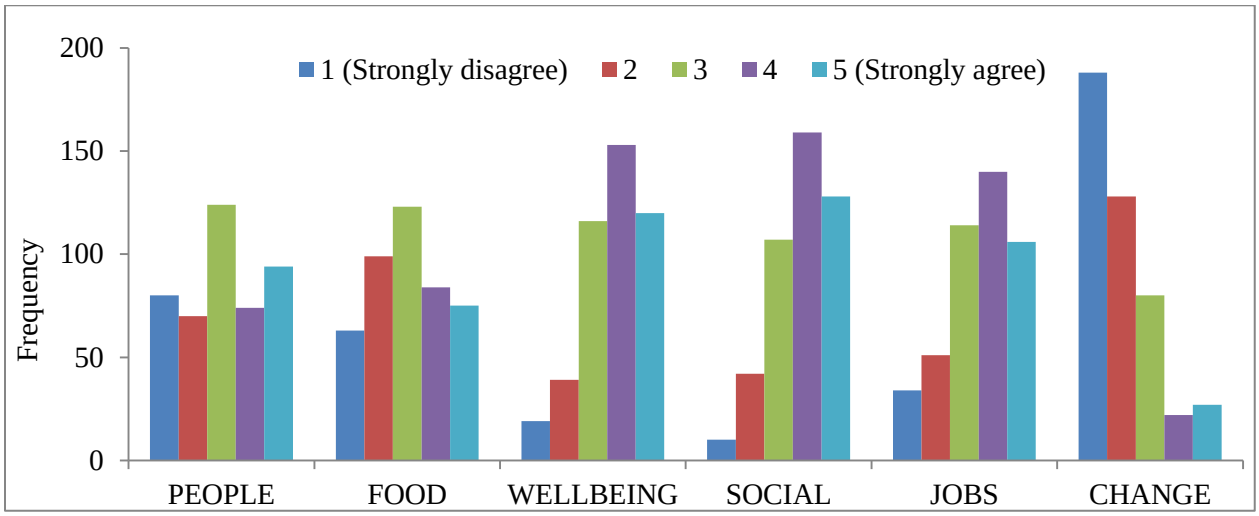
Among the six use orientation statements, the first and sixth statements were exactly the same as used by past studies in recreational fishing context (Bruskotter & Fulton, 2007, 2008). Given these statements best fit the anthropocentric value orientation in those studies, they were expected to fit the use orientation in this study as well. As discussed previously, protection-use and biocentric-anthropocentric value orientations are conceptually similar. It should be noted some of the statements used here appear worded slightly differently in other studies. However, the overall meaning or the essence of the statement remains the same. Rewording these orientation statements to fit the study context is fairly common (Needham, 2010). For example, the second statement, 'sport fishing is a valuable food source' was worded differently as 'fish are primarily valuable as food for people' by (Bruskotter & Fulton, 2007, 2008). Similarly, the fifth statement, 'sport fishing is important for jobs and income' was worded differently as 'fisheries are valuable only if they produce jobs and income for people' by the same authors.

Table 3.4. Reliability Analysis of Variables Intended to Use for Segmentation of Respondents.

Values Statements	n	Mean	SD	Skew.	Kurt.	C. Alpha	Item Total Corr.	C. Alpha if Item Deleted
Use Orientation						0.66		
1. Nature's primary value is to provide things that are useful to people.	442	3.07	1.38	-0.06	-1.16		.28	.66
2. Sport fishing is a valuable food source.	444	3.02	1.29	0.04	-1.04		.45	.59
3. Sport fishing is important for human well-being.	447	3.71	1.08	-0.62	-0.20		.48	.59
4. Sport fishing helps develop social ties.	446	3.79	1.03	-0.59	-0.30		.53	.57
5. Sport fishing is important for jobs and income.	445	3.52	1.19	-0.52	-0.55		.41	.61
6. Humans have a right to change the natural world to suit their needs.	445	2.04	1.16	1.05	0.36		.24	.67
Protection Orientation						0.59		
7. Sport fish are valuable part of nature	440	4.27	0.92	-1.41	1.96		-.03	.75
8. Protecting the environment is more important than providing sport fishing opportunities.	444	3.56	1.19	-0.43	-0.62		.50	.43
9. Fish have as much right as people to exist.	442	3.08	1.44	-0.07	-1.28		.50	.41
10. Management should focus on doing what is best for nature instead of what is best for people.	445	3.33	1.19	-0.20	-0.72		.58	.36

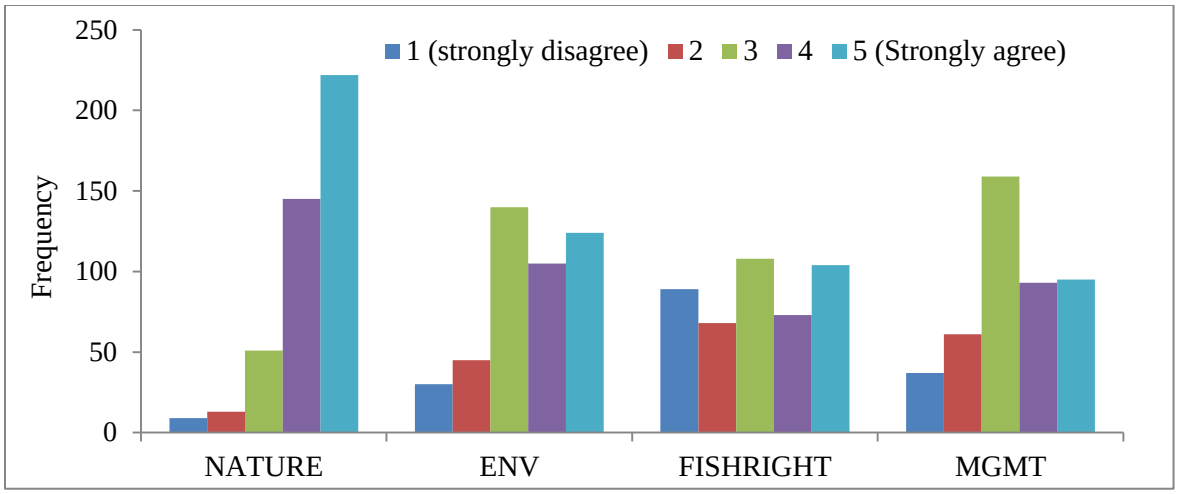
Note: Variables were measured in a Likert scale of 1 (strongly disagree) to 5 (strongly agree).
C. Alpha: Cronbach's alpha

The third and the fourth statements were not a part of any past studies and were a new addition to this study. In terms of wellbeing or social ties, a trout angler may value the use of trout differently than he values the same in terms of food or income. Inclusions of these statements were expected to represent social values and human welfare values anglers attribute to the trout fishing. Among the four statements included in the protection orientation, the eighth, ninth, and tenth statements were previously used by similar studies to measure bio-centric orientation (Bruskotter & Fulton, 2007, 2008). The seventh statement was an addition to this study. A trout angler, who values fish as a part of nature is more likely to be nature centered and therefore the statement was expected to measure the protection orientation.



PEOPLE: Nature's primary value is to provide things that are useful to people. FOOD: Sport fishing is a valuable food source. WELLBEING: Sport fishing is important for human well-being. SOCIAL: Sport fishing helps develop social ties. JOBS: Sport fishing is important for jobs and income. CHANGE: Humans have a right to change the natural world to suit their needs.

Figure 3.1. Response Frequencies for the Use Orientation Statements.



NATURE: Sport fish are a valuable part of nature. ENV: Protecting the environment is more important than providing sport fishing opportunities. FISHRIGHT: Fish have as much right as people to exist. MGMT: Management should focus on doing what is best for nature instead of what is best for people.

Figure 3.2. Response Frequencies for the Protection Orientation Statements.

Before proceeding to the cluster analysis to identify the value orientation segments, a Principal Component Analysis (PCA) on the variance-covariance matrix was performed using SPSS 21 statistical software (IBM, 2012). This analysis was used to test whether these basic belief statements represent the latent construct of protection and use orientations. A latent construct refers to an unobserved variable which can be measured through the observable variables (Byrne, 2001). A PCA is one of the most important and widely used statistical tools for dimension reduction. It transforms a larger set of correlated variables into a smaller set of uncorrelated factors without losing much of the information in original variables (Jolliffe, 2005). An assumption in PCA is a multivariate normality of the variables. So, to include the basic belief statements variables in to PCA, preference was given to statements with skewness index less than one and kurtosis index less than two (Noar, 2003). Items within a measure are useful only to the extent that they share a common core – the attribute which is to be measured (Gerbing & Anderson, 1988). The item total correlation refers to the correlation between a variable and the total scale score. A higher item total correlation indicates higher internal consistency, and the value close to zero indicates no

relationship between the given item and other items loading on the factor suggesting a poor internal consistency (Pett, Lackey, & Sullivan, 2003). Thus, following Leong and Austin (2006) and Vaske (2008), only variables having item total correlation of 0.4 were considered for the analysis. In addition, Cronbach's alpha was used to test the reliability of the variables (Cronbach & Shavelson, 2004). Tests of reliability examine the internal consistency among the variables and shows whether the multiple items measure the same construct (Vaske, 2008). An alpha coefficient ≥ 0.7 indicates the acceptable internal consistency among the variables to be reliable for measuring respective orientations (George & Mallery, 2003).

Among the statements intended to include in the analysis, the first, sixth, and seventh statements did not meet the recommended criteria of skewness or item total correlation or both. Tests of reliability (Cronbach's alphas) were also not within the acceptable limit (0.66 for use orientation and 0.59 for protection orientation) (Table 3.4). Thus, those variables were removed and the test of reliability was repeated with the rest of the value statements. The remaining seven variables (statements) met all the criteria discussed above with acceptable level of Cronbach's alpha (0.71 for use orientation and 0.75 for protection orientation) (Table 3.5).

A varimax (orthogonal) rotation option was selected while running a PCA because it maximizes the variance of loadings (correlation between variables and factors) on each factor, and eases the interpretation. The number of factors were chosen based on Kaiser Criteria, which suggests retaining components with eigenvalue greater than one (Kaiser, 1960). If all variables are independent, then the number of principal components is the same as the number of original variables and all components have unit variance. Thus any component with variance (eigenvalue) less than one contains less information than one of the original variables and so is not worth retaining (Jolliffe, 2002).

Table 3.5. Reliability Analysis of Final Variables Included in the Value Orientations Segmentation.

Values Statements	n	Mean	SD	Skew.	Kurt.	C. Alpha	Item Total Corr.	C. Alpha if Item Deleted
Use Orientation						0.71		
1. Sport fishing is a valuable food source.	444	3.02	1.29	0.04	-1.04		.41	.70
2. Sport fishing is important for human well-being.	447	3.71	1.08	-0.62	-0.20		.51	.64
3. Sport fishing helps develop social ties.	446	3.79	1.03	-0.59	-0.30		.61	.58
4. Sport fishing is important for jobs and income.	445	3.52	1.19	-0.52	-0.55		.50	.64
Protection Orientation						.75		
5. Protecting the environment is more important than providing sport fishing opportunities.	444	3.56	1.19	-0.43	-0.62		.54	.70
6. Fish have as much right as people to exist.	442	3.08	1.44	-0.07	-1.28		.55	.70
7. Management should focus on doing what is best for nature instead of what is best for people.	445	3.33	1.19	-0.20	-0.72		.65	.59

Note: Variables were measured in a Likert scale of 1 (strongly disagree) to 5 (strongly agree). C. alpha: Cronbach's alpha.

After identifying the latent construct of the belief statements, a confirmatory factor analysis (CFA) was performed using AMOS 21 version of SPSS software. The purpose was to test the construct validity of the statements used in PCA. Construct validity refers to the way indicator variables and concepts relate to one another within a system of theoretical relationships (Vaske, 2008). A CFA tests whether the belief statements fit well to measure the two latent dimensions of protection and use orientations (Needham, 2010; Vaske, 2008). An asymptotically distribution free (ADF) estimator was used for the CFA. The maximum likelihood (ML) estimate has been a common approach in the confirmatory factor analysis. However, ML estimates perform best when variables are continuous and follow multivariate normal distribution (Brown, 2006; Harrington, 2008). Variables with a kurtosis index $|x>10|$ and a skewness index $|x>3|$ indicate a serious violation of multivariate normality (Kline, 2005) and a skewness index less than one and kurtosis index less than two are preferable (Noar, 2003). All seven variables used in CFA following the PCA met both criteria (skewness and kurtosis) for a multivariate normal distribution. However, the measurement scale of the variables was in ordinal categorical nature, and the sample size was large (n >200) (Harrington, 2008). Thus, ADF estimation was used as suggested by Hancock and Mueller (2006) and (Harrington, 2008) for categorical data with large sample size.

The results of the CFA were evaluated using factor loadings of variables and model fit indices. To retain in each latent construct of the value orientation, the factor loading should be greater or equal to 0.40 (Vaske, 2008). As suggested by Hu and Bentler (1999) and Kline (2005), a Comparative Fit Index (CFI), Root mean square error of approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR), were considered as criteria index for selecting the best fitting model. $CFI \geq 0.95$, $RMSEA \leq 0.06$, and $SRMR \leq 0.08$ are suggested to be the acceptable threshold values for the best fitting models.

After the latent construct and construct validity of value statements were checked with PCA and CFA, a cluster analysis procedure was used on the same value statements to segment trout anglers in to different subgroups of value orientations. Cluster analysis is a tool that classifies a set of cases such as people, or things, or events into relatively homogenous groups or clusters that are distinct from each

other. Previous studies have also used cluster analysis tool for segmenting anglers based on different orientations such as consumption, catch preference, or fishing experience (Connelly et al., 2001; Fisher, 1997; Kyle et al., 2007).

There is no standard rule about the selection of a clustering procedure. Almost all of the clustering algorithms available in different mathematical software identify clusters with certain characteristics. However, it is necessary to identify the algorithm that best fits the data to generate valid clusters and meaningful results (Majumdar, Teeter, & Butler, 2008). A Ward's minimum variance (hierarchical) and K-means (non-hierarchical) are the most commonly used clustering algorithms in segmentation studies related to natural resources (Connelly et al., 2001; Fisher, 1997; Kyle et al., 2007). Hierarchical clustering is exploratory in nature, which assumes no prior information about the number of clusters. Ward's minimum variance method is based on a least-square criteria, which minimizes the within cluster sum of squares, and thus maximizes the within-cluster homogeneity. The K-means clustering algorithm proceeds by selecting K initial cluster centers and then iteratively refines them to generate homogenous subgroups. However, there are a few drawbacks associated with K-means algorithm. First, it assumes that the number of clusters (K) for a data set should be known beforehand (Peña, Lozano, & Larrañaga, 1999); which is not the case in many studies. Second, this algorithm is effective for large datasets with continuous variables, but its efficiency is poor when variables are categorical (Huang, 1998). Some statistical software have also recommended not to use K-means algorithm for categorical data (IBM, 2011). Although, this study involves a large data set (n> 200) (Harrington, 2008), the variables included in cluster analysis were categorical.

In spite of the drawbacks discussed above, K-means algorithm has been widely used in value orientation segmentation studies (Needham, 2010; Vaske et al., 2011). Therefore, two to five clusters were assessed and compared using both Ward's and K-means clustering algorithms. Cluster solutions from each method were compared based on mean score of each variable by clusters. A cluster solution that provided the most distinct and meaningful subgroups was chosen as the final solution. The meaningfulness of subgroups was checked by comparing with the characteristics of different value

orientation subgroups as suggested by existing literature in wildlife and natural resources related value orientations. Then, the demographic and fishing characteristics of trout anglers and their knowledge and concerns associated with climate change impact on trout fishing were compared among the subgroups of value orientations.

Factors associated with concern about risk of climate change and intention of adjustment

Comparisons among value orientation subgroups of respondents are useful to understand how perception of climate change as a risk and responses to it vary among trout anglers. However, perception of climate change and responses toward the impacts may not only be related with value orientations, but also with other factors such as knowledge, belief about climate change, fishing preferences, specialization, and demographics. Thus, multivariate modeling is important to investigate the relationship of a variety of other factors with anglers' concern over the risk of climate change and behavioral intention to adjust their recreation behavior in climate change scenarios.

Models and variables

To understand factors associated with trout anglers' perception of climate change risk and behavioral intentions of adjustment to change, a multivariate ordered logistic regression model was used. Perceived risk of climate change (concern) and intention to change fishing behavior in response to a decrease in tout population were included as dependent variables in two separate models. Both dependent variables were hypothesized to be a function of independent variables as below.

Concern = f (cognitive variables, fishing characteristics, demographics)……. (1)

Behavioral intention = f (cognitive variables, fishing characteristics, demographics)….. (2)

As discussed previously, risk perception literature suggests that cognitive variables (e.g., values/value orientations, knowledge, and beliefs about climate change) and demographic variables are related with an individual's concerns about risk of climate change. Similarly, values/value orientation and

attitudes are also considered predictors of behavioral intentions (Ajzen, 1991; Fulton et al., 1996; Vaske & Donnelly, 1999). Certain fishing characteristics were included as independent variables to examine the significance of fishing preference and specialization level in predicting concern and behavioral intentions.

Dependent variables

1. Concerns about risk of climate change

   Two statements of perception of risk to trout habitat, measured in a Likert scale of one (strongly disagree) – five (strongly agree), were included as dependent variables in separate models of concern. The first is 'Rising stream temperature due to climate change is negatively affecting trout habitat in GA now' and the other is 'Rising stream temperature due to climate change will negatively affect trout habitat in GA in the future'. Some trout anglers may consider climate change as a future risk, and may not perceive it as a risk now. Other trout anglers may relate some extreme weather events to climate change and consider its impact now. To examine whether the factors associated with perception of risk also vary with change in time being considered, both statements were regressed against explanatory variables separately. Figure 3.3 shows responses on each variable considered.

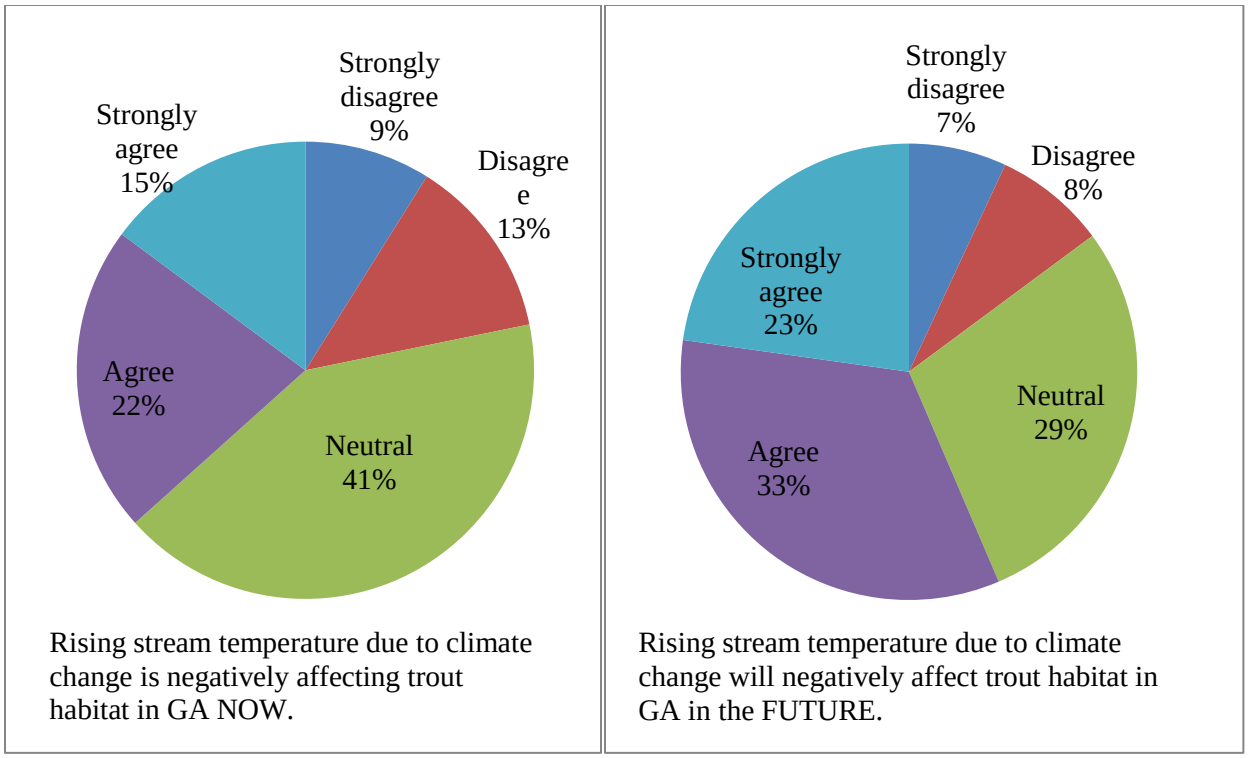


Figure 3.3. Respondents' Agreements with the Statements Included as Dependent Variables in Concern Models.

2. Behavioral intentions

Trout anglers' behavioral intentions for responding to impact of climate change were examined with following question:

"If the trout population and your catch rate at the places in GA you fish the most were reduced by certain amounts due to rising stream temperatures, how your trips to those places would change?"

Among the four reduction scenarios, 25% and 75% were considered as low reduction scenario and high reduction scenario respectively and were included as dependent variables in the behavioral intention models. Although ten percent reduction scenario was the lowest among the four given reduction scenarios, about 75% of the respondents indicated an intention of not changing their trips and only two percent indicated they would stop fishing there (Table 3.6). Because of this fewer variation among the respondents, ten percent reduction scenario may not be appropriate to examine factors associated with

behavioral intentions. The 25% reduction scenario was labeled as REDUCTION_25 and the 75% reduction scenario was labeled as REDUCTION_75.

Table 3.6. Percentage of Respondents Indicating Their Behavioral Intentions of Adjustment to Trips Under Given Hypothetical Reduction Scenarios.

Reduction Scenarios	My number of trips there probably wouldn't change (1)	I would make somewhat fewer trips there (2)	I would make many fewer trips there (3)	I would stop fishing there completely (4)
10% reduction	74	19	6	2
25% reduction	32	46	18	4
50% reduction	11	20	46	23
75% reduction	10	5	23	62

Given that responses to concern statements are in order of agreement and responses to behavioral intentions are in order of reduction in fishing trips, an ordered logistic regression was applied on both concern and behavioral intention models. As these variables are non-interval in nature, the analysis using ordinary least square (OLS) regression can result to biased parameter estimates because of the violation of regression assumptions of normal distribution of error with constant variance (O'Connell, 2006).

In the ordered logistic model, there is an observed ordinal variable Y, which in turn, is a function of another unmeasured continuous latent variable Y^*. The value of Y^*, based on various cut-off points, determine what the observed ordinal variable means. For example, if the responses are measured on the five-point Likert scale, then,

$$Y_i = 1 \; if \; Y_i^* \leq k_1 \ldots\ldots\ldots\ldots (3)$$

$$Y_i = 2 \; if \; k_1 \leq Y_i^* \leq k_2 \ldots\ldots\ldots (4)$$

$$Y_i = 3 \; if \; k_2 \leq Y_i^* \leq k_3 \ldots\ldots\ldots (5)$$

$$Y_i = 4 \; if \; k_3 \leq Y_i^* \leq k_4 \ldots\ldots\ldots (6)$$

$$Y_i = 5 \; if \; Y_i^* \geq k_4 \ldots\ldots\ldots\ldots\ldots (7)$$

Where, k_1, k_2, k_3, and k_4 are cut-off points.

The ordered logistic regression model, also known as proportional odds model, assumes a standard logistic distribution of error component; and the estimates are obtained by using maximum likelihood (Borooah, 2002). In addition, ordered logistic regression assumes the relationship between each pair of outcome groups is the same (proportional or parallel odds assumption). Therefore, unlike the multinomial logistic regression, it reports only one set of coefficients. In other words, it assumes the coefficients that describe the relationship between the lowest versus all higher categories of the response variable are the same as those that describe the relationship between the next lowest category and all higher categories. Whether this assumption is violated was tested with Brant test, which compares slope coefficients of the J-1 binary logits implied by the ordered regression model (Long & Freese, 2006). The null hypothesis of this test is slopes are equal. Thus, rejection of null hypothesis indicates violation of this assumption.

Independent variables

1. Cognitive variables:

   The cognitive variables included in both concern models were value orientations, knowledge, and belief. Those included in behavioral intention models were value orientations, and concern.

   I. VALUE ORIENTATION:

      Two components of value orientations, PROTECTION and USE extracted from trout anglers' basic belief statements using PCA, as explained previously, were used as value orientation variables. Past studies suggested general environmental beliefs and values influence perception and concern about risk of climate change, and behavioral intentions (Bord, O'Connor, & Fisher, 2000; O'Connor, Bord, Yarnal, & Wiefek, 2002). A positive relation of protection orientation and a negative relation of use orientation were expected with both concern and behavioral intentions.

II. KNOWLEDGE:

Anglers' knowledge of climate change impact was represented by a dummy variable (SEEN_HEARD), where it took a value of 1 if trout anglers reported having seen or heard that trout in Georgia were dying from increased water temperature, 0 otherwise. Trout anglers, who were more knowledgeable and aware of the consequences of rising water temperature on trout fishing, were hypothesized to be more concerned about the risk of climate change on trout fishing.

III. BELIEF:

Among five statements used to assess basic belief about climate change (B3 in Appendix 1), trout anglers' agreement to a statement 'there is evidence climate change is occurring and some action should be taken' was included as a belief variable. It was hypothesized that trout anglers who agree with this specific statement can relate to a context of trout fishing, and be concerned and intend to change in their fishing behaviors. The statement was labeled as 'BELIEF,' and the measurement scale ranged from one (strongly disagree) – five (strongly agree). Positive relations of general belief about climate change with concern were expected.

IV. CONCERN:

To include multiple statements measuring construct of concern about climate change's impact on trout fishing, and to avoid a possible multicollinearity issue, a summative scale was created by adding responses on four statements. The statements are:

- Rising stream temperature due to climate change is negatively affecting trout habitat in Georgia now.
- Rising stream temperature due to climate change will negatively affect trout habitat in Georgia in the future.
- Rising stream temperatures will eventually destroy trout fishing in Georgia streams.
- Rising stream temperatures will decrease the streams available for trout stocking in Georgia.

The reliability analysis of four statements indicated acceptable level of internal consistency with Cronbach's alpha coefficient of 0.83. Responses in each statements ranged from one (strongly disagree) to five (strongly agree). Thus, the composite scale for four items, labeled "CONCERN" ranged from four (very low concern) to 20 (very high concern). This practice of creating single composite scale by adding multiple similar and correlated variables that measure same construct, with Cronbach's alpha >0.7, is common in related literature (Arbuckle et al., 2013; O'Connor et al., 1999). Trout anglers, more concerned about risk of climate change on trout fishing, could be more intent toward adaptation by changing their fishing trips as accordance with trout populations and catch rates. Past studies also found risk perception and concern as strong predictor of behavioral intentions (O'Connor et al., 1999). Thus, a positive relation of concern about risk of climate change with behavioral intention of reducing fishing trips was expected.

2. Fishing characteristics:

Fishing characteristics variables included in the models were specialization to predict concern, and specialization, and importance of catching many trout to predict behavioral intention.

I. SPECIALIZATION:

A specialization index was created by combining fishing experience, frequency of participation, preference for fishing site, and preference for species. First, four separate dummy variables were created; fished for brook (1, 0), fished in wilderness (1, 0), fished for longer than sample average years of fishing (1, 0), and took more than sample average number of fishing trips (1, 0). Second, these dummies were simply added to create a specialization index, labeled as SPECIALIZATION; values ranged from zero (least specialized) to four (highly specialized). As theories and past studies on specialization suggest, avidity (frequency of participation), resource dependency, and experience are among the major characteristics that determine recreationist's specialization (Bryan, 1977; Choi, Loomis, & Ditton, 1994; Graefe, 1981; Hammitt, Backlund, & Bixler, 2004). A person's specialization in a particular recreation activity usually increases over

the time and dependency on specific resources (e.g., favorite 'fishing holes', preferred species) also increases (Bryan, 1977; Ditton, Loomis, & Choi, 1992). Given that wilderness area offers fishing opportunity of only native and naturally grown trout, and brook trout are native to this region, trout anglers who fished for brook and fished in wilderness were considered resource dependent anglers. Similarly, anglers who had fishing experience more than average were considered experienced or skilled anglers, and those who commuted more than average fishing trips were considered avid anglers. Considering their dedication and passion for the unique experience of fishing for native species in wilderness, specialized anglers may see their values being at stake when steam temperature increased due to climate change. For this reason, a positive effect of specialization on concern was expected. Specialized anglers may have higher place attachment to their fishing sites than the least specialized anglers (Bricker & Kerstetter, 2000) because they look for unique fishing opportunity to fish in wilderness and catch native species that are rarely available elsewhere. Thus, they can be reluctant to reduce trips there even if trout populations decline. For this reason, the relation of specialization with behavioral intention of reduction in fishing trips was hypothesized to be negative.

II. MANY TROUT:

Trout anglers' importance of catching many trout when selecting a place to trout fish in Georgia was assessed with their responses in a scale of one (Not important) to five (very important). The variable was labeled as MANY_TROUT. It was hypothesized that trout anglers who had importance of catching many trout could be more sensitive to decline in trout populations, and perhaps jump early into other alternative sites where they will be able to catch many. Thus a positive relation of it with both concern and behavioral intention was expected.

III. QUALITY_WORSE:

Respondents were asked to indicate their perception of current quality of trout fishing in Georgia compared to when they first began trout fishing here. Response options ranged from one (much worse) to five (much better). A dummy was created as QUALITY_WORSE = 1 if respondents

indicated “much worse” or “worse” and 0 otherwise. Respondents who perceived worse quality of trout fishing could relate quality of trout fishing with potential impact of climate change. They could be more concerned about impact of climate change on trout fishing in Georgia than the other anglers who perceived better or same quality. Thus, a positive relation of perceived worse quality was expected in concern model.

IV. INFORMATION:

Respondents were asked to indicate their source of climate information by providing a list of 12 sources (B6, Annex1). A dummy was created as INFORMATION = 1 if respondents reported Trout Unlimited (TU) or North Georgia Trout Online (NGTO) as a source of climate information, 0 otherwise. Among the list of 12, these two sources are trout related non-profit organizations working in the area of promotion and protection of trout and other cold water fisheries and sustainability of recreational fishing (NGTO, 2012; TU, 2012a) . Availability of information relevant to climate change influences public concern about climate change and its impacts (Pasquaré & Oppizzi, 2012; Semenza, Ploubidis, & George, 2011; Weber & Stern, 2011). Respondents who received climate information from TU and NGTO were expected to be more concerned about climate change impact on trout fishing than the other respondents. Thus, a positive relation of INFORMATION with CONCERN was expected.

V. TROUT_SUBSTITUTE:

Respondents were asked to indicate their option if the place they most often trout fish in Georgia was not available on a typical fishing day. A set of four options were provided as (check one): go somewhere else in Georgia to trout fish, go somewhere else in Georgia for another activity, go out of state to trout fish, stay home, and go to work. A dummy was created as TROUT_SUBSTITUTE = 1 if they indicated going somewhere else in Georgia to trout fish or going out of state to trout fish, 0 otherwise. Respondents who had substitute places for trout fishing in state or out of state were hypothesized to adjust recreation pursuits in their usual fishing

sites if trout populations and catch rates decline by certain percentages. Thus, a positive relation of TROUT_SUBSTITUTE with behavioral intention of adjustment to fishing trips was expected.

VI. NATURE_SCENERY:

Respondents were asked to indicate level of importance of nature and scenery while selecting a place to trout fish in Georgia. Importance scale ranged from one (not important) to five (very important). It was hypothesized that trout anglers who placed higher importance on nature and scenery would be less concerned about decline in trout and hesitate to reduce their trips in a site they fish the most. Thus, a negative relation of NATURE_SCENARY was expected in behavioral intention model.

3. Demographics:

Three demographic variables, age, education, and income were included as the control variables. Gender is another important control variable in literature dealing with public perception of climate change and responses behaviors. Past studies have found women to be more concerned about the risk of climate change and supportive toward climate change mitigation programs than men (O'Connor et al., 1999; Semenza et al., 2008; Stedman, 2004). Unlike the case in this study, the samples of those studies were general public, and thus included higher percentages of females than in this study. For example, sample in Semenza et al. (2008) included more than 60% females and sample in O'Connor et al. (1999) included about 40% females. In the case of this study in trout anglers, females accounted for only 13% of the sample. Thus, gender was not included in the regression models of this study expecting fewer variations in concern and behavioral intention as a result of gender difference.

I. AGE:

Trout anglers' age ranged from 20 – 78 years with an average of 50.4 years. Studies on national sample of American public have found older people showed less concern about occurrence and impact of climate change on diverse issues (e.g., health, environment) (Kellstedt et al., 2008; Malka et al., 2009; McCright & Dunlap, 2011). Thus, a negative relation between concern about

risk of climate change and age of respondents was expected; although, the sample of this study included only trout anglers. Older respondents, having fewer concerns about risk of climate change than the younger ones, could less intend to reduce trout fishing trips under the given hypothetical scenario of decline in trout population. Thus, a negative relation was expected between age of respondent and behavioral intention of reducing trout fishing trips to the affected sites.

II. EDUCATION:

Trout anglers' educational attainment measures the highest level of education attained, ranging from one (high school not completed) to five (post bachelor's). Some past studies found positive relationship between a person' level of education and his concern about climate change (Hamilton, 2008), while others found a negative relationship (Malka et al., 2009; McCright & Dunlap, 2011). In general, among republicans, education was found negatively related with concern about climate change and global warming; whereas among the democrats, a reverse was found (Krosnick, Holbrook, Lowe, & Visser, 2006; Pew, 2007). Trout anglers with higher education could possess more information about science behind the climate change and its consequences. Thus, they could be more concerned about the impact of climate change on trout fishing and be interested to adjust their fishing behavior as accordance with change trout population. For this reason, a positive relation of education was expected with both concern and behavioral intention.

III. INCOME:

Trout anglers' annul household incomes was measured with an index, which ranged from one (less than $25,000) to five (more than $100,000) in increments of $25,000. Observations (n=34) with missing of income information were recoded with median household income from the respondent's zip code. Studies have found a negative relation of higher income with concern about climate change and its impacts from general samples of American public (Hamilton & Keim, 2009; McCright & Dunlap, 2011; Semenza et al., 2008). Trout anglers with higher income

may consider them as less vulnerable to climate change and thus are less likely to be concerned and take immediate actions against the potential impacts. For this reason, income was expected to be negatively related with both concern and behavioral intentions.

The correlation matrix of the independent variables used in the concern model and behavioral intention model are given in Appendix 3 and Appendix 4 respectively. Although, many of the correlation coefficients are statistically significant, relationships of most variables are weak. Table 3.7 shows the summary of variables included in the models.

Table 3.7. Summary of Independent Variables Included in the Ordered Logistic Regression Models

Variables	N	Description	Coding/values	Mean	Std. Dev.
PROTECTION	430	Factor score of PROTECTION component		0.00	1.00
USE	430	Factor score of USE component		0.00	1.00
SEEN_HEARD	430	Whether or not seen or heard trout in Georgia are dying from increased water temperature	1, if seen or heard, 0 otherwise	0.41	0.49
BELIEF	429	There is evidence that climate change is occurring and some action should be taken	1 (strongly disagree) – 5 (strongly agree)	3.32	1.30
CONCERN	418	Composite score of four concern statements	4 (very low concern) – 20 (very high concern)	13.65	3.62
SPECIALIZATION	430	Specialization index	0 (least specialized) – 4 (highly specialized)	1.63	1.13
MANY_TROUT	403	Importance of catching many trout	1 (Not important) – 5 (very important)	3.51	1.14
QUALITY_WORSE	430	Perceived quality of trout fishing	1 if "worse" or "much worse", 0 otherwise	0.26	0.44
INFORMATION	430	Source of climate information	1 indicated TU or NGTO, 0 otherwise	0.15	0.35
TROUT_SUBSTITUTE	430	Trout substitute	1 if indicated going somewhere else in Georgia or out of state to trout fish, 0 otherwise	0.58	0.49
NATURE_SCENERY	402	Importance of nature and scenery while selecting a place to trout fish in Georgia	1 (Not important) – 5 (very important)	4.20	0.92
AGE	438	Age	20 – 78 years	51.0	12.8
EDUCATION	430	Highest level of education attainment	1 (high school not completed) – 5 (post bachelor's)	3.52	1.07
INCOME	430	Index representing annual household income in 2011	1 ($25000 or less) – 5 ($100,001 or more)	3.38	1.29

CHAPTER 4

RESULTS AND DISCUSSION

This chapter begins with descriptions of respondents' characteristics. Then, it presents the results from Principal Component Analysis (PCA), Confirmatory Factor Analysis (CFA), and Cluster Analysis. It then compares the demographic and fishing characteristics of respondents by different value orientation segments. Finally, it presents results of trout anglers' perception of climate change risks and their behavioral intentions to adjust fishing activities under various hypothetical climate change scenario.

Characteristics of respondents

Table 4.1 shows demographic characteristics of the sample. About half of the respondents were 45 to 65 years old, and average age was 51 years. Females accounted for 13% and Caucasian (97%) dominated the sample. Some 3% did not complete the high school, whereas about half attained at least college degree. Majority were full time job holders (65%) followed by retirees (25%) and about 75% had annual household income of at least $ 50, 000 in 2011.

Table 4.2 shows the general fishing characteristics and preferences of respondents. Among 465 respondents, about 73% reported to have fished in Georgia in 2011. Average fishing experience of respondents was 19 years and they made 6 fishing trips in average in 2011. Almost all (97%) indicated fishing for Rainbow, whereas only about a half of them (57%) indicated fishing for Brook. Close to 60% of respondents eat and equal proportions release their catch, while 3% keep it for trophy. High percentages (approx. 60%) preferred to fish in year-round or seasonal streams, whereas lower percentages (24%) preferred to fish in special regulation streams, such as delayed harvest or trophy. More than 80% of

respondents preferred to fish whenever they had time and when spots were less crowded. Bait was the most preferred gear type (63%) followed by lure (60%) and fly (49%) (Table 4.2).

Table 4.1. Demographic Characteristics of Respondents

	Descriptive Statistics	
Demographics	Mean (SD)	% of Respondents
Average Age (years) (N=438)	51.0 (12.8)	
Age Group (N=438)		
18 - 30		3
30 - 45		30
45 - 65		52
≥ 65		16
Gender (female) (n=439)		13
Race (N=435)		
Caucasian		97
Other		3
Education (N=430)		
High school not completed		3
High school		14
Some college or technical school		31
College degree		30
Post bachelor's		21
Employment Status (N=433)		
Full time job		65
Part time job		6
Unemployed		4
Student		2
Retired		25
Military		3
Annual Household Income (N=430)		
$50,000 or less		28
$50001 to 100000		43
$100001 or more		29

Table 4.2. Fishing Characteristics of Respondents

	Descriptive Statistics	
Fishing Characteristics	Mean (SD)	% of Respondents
Fishing Experience (years) (N=423)	18.8 (15.2)	
Fishing Trips in 2011 (N=418)	6.4 (12.3)	
Species Fished (N=440)		
Brook		57
Brown		77
Rainbow		97
Catch Preference (N=446)		
Eat		57
Release		57
Trophy		3
Stream Type Preference (N=434)		
Year round		64
Seasonal		62
Tail water		27
Wilderness		41
Stocked		47
Special regulation		24
Time of Preference (N=431)		
Opening day		8
First three days after stocking		20
Stocking day		6
Other#		83
Gear Preference (N=431)		
Fly		49
Bait		63
Lure		60

[#]*When time is available or when less crowded*

Respondents' values about sport fish and nature

Percentages of respondents by level of agreement with various types of value statements are given in Table 4.3. In general respondents did not agree with the statements expressing strong dominance views; rather they showed mixed agreement toward both protection and use. For example, more than 80% of respondents agreed with the statement expressing values of sport fish as a valuable part of nature and more than 70% disagreed with the statement expressing humans' right to change natural world to suit their needs. Similarly, more than 50% agreed with the statement expressing the importance of protecting the environment over providing sport fishing opportunities and about 60% agreed with the statements expressing the importance of sport fishing for human wellbeing or social ties.

Principal component analysis

As discussed in the method section, among ten statements that measured trout angler's values about sport fish and nature, only seven statements met the criteria to be included in the PCA. Table 4.4 shows that factor loadings in all statements crossed the minimum threshold value of 0.4 (Vaske, 2008). The first four statements that represent use orientation were significantly loaded in the first component, which was therefore called as USE. Similarly, rest of the statements representing the protection orientation, were significantly loaded in the second component, which was named as PROTECTION. These two components together explained 61% of the variance in the data. Results indicate that respondents' values measured with seven statements represent the latent construct of protection-use value orientation continuum.

Table 4.3. Distribution of Respondents by Values About Natural Resources and Sport Fishing

	Percent of Respondents by Levels of Agreement				
Values Statements	1	2	3	4	5
Nature's primary value is to provide things that are useful to people.	18	16	28	17	21
Sport fishing is a valuable food source.	14	22	28	19	17
Sport fishing is important for human well-being.	4	9	27	35	26
Sport fishing helps develop social ties.	2	10	24	36	27
Sport fishing is important for jobs and income.	8	12	26	31	23
Humans have a right to change the natural world to suit their needs.	42	29	18	5	6
Sport fish are valuable part of nature	2	3	12	33	50
Protecting the environment is more important than providing sport fishing opportunities.	6	10	31	24	28
Fish have as much right as people to exist.	19	15	25	16	24
Management should focus on doing what is best for nature instead of what is best for people.	8	14	36	21	21

1 (strongly disagree) to 5 (strongly agree).

Table 4.4. Factor Scores by Each Variable from the Result of Principal Component Analysis

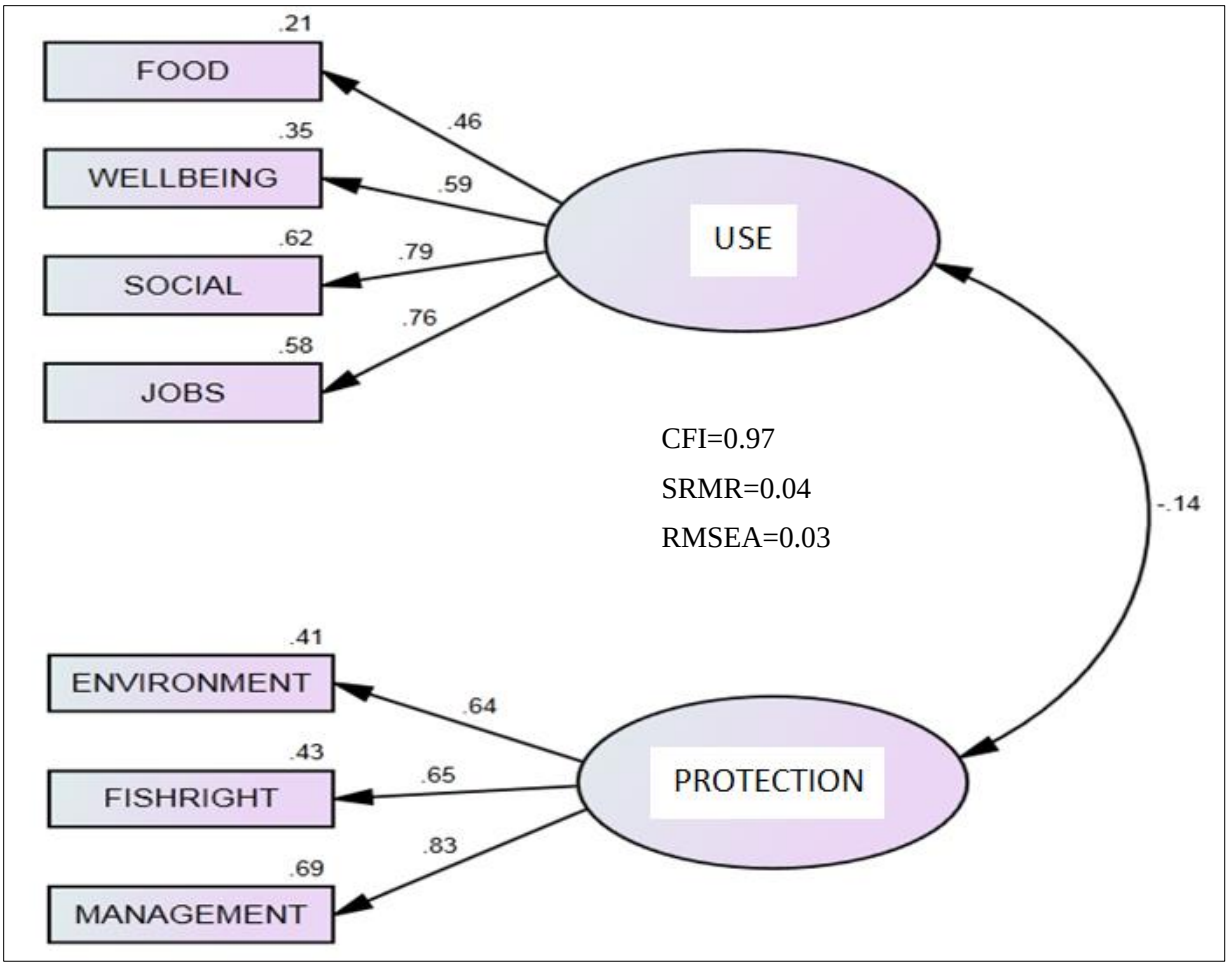
	Components	
Values Statements	1 (USE)	2 (PROTECTION)
Sport fishing is a valuable **FOOD** source.	**0.72**	0.02
Sport fishing is important for human **WELL-BEING**.	**0.71**	-0.01
Sport fishing helps develop **SOCIAL** ties.	**0.78**	0.01
Sport fishing is important for **JOBS** and income.	**0.74**	-0.17
Protecting the **ENVIRONMENT** is more important than providing sport fishing opportunities.	-0.05	**0.73**
FISH have as much **RIGHT** as people to exist.	0.02	**0.88**
MANAGEMENT should focus on doing what is best for nature instead of what is best for people.	-0.06	**0.83**

Note: for the use in further analysis, these statements are coded as the words shown in bold.

Confirmatory factor analysis

Once the PCA showed the best fit of the data to represent latent construct of protection-use value orientation continuum, construct validity of this continuum was further checked with CFA. The results of CFA are given in figure 4.1.

Factor scores in all variables crossed the minimum threshold limit of 0.4 (Vaske, 2008). The model shown in Figure 4.1 shows the data provided an acceptable model fit and seven variables supported the construct validity of protection and use value orientations with CFI = 0.97, SRMR = 0.04, and RMSEA = 0.03. The acceptable threshold limits of these indices are CFI $\geq$ 0.95, SRMR $\leq$ 0.08, and RMSEA $\leq$ 0.06 (Hu & Bentler, 1999). The factor scores (standardized regression weights) ranged from 0.46 (FOOD) to 0.79 (SOCIAL) in the first factor (USE) and 0.64 (ENVIRONMENT) to 0.83 (MANAGEMENT) in the second factor (PROTECTION). The variance explained by the first factor (USE) was the highest for the variables SOCIAL (62%), whereas variance explained by the second factor (PROTECTION) was highest for the variable MANAGEMENT (69%).



Note: Values above the arrow line are factor loadings, and values above the variables (in rectangles) are squared multiple correlation coefficients (R^2).

Figure 4.1. Factor Loadings and Model Indices Showing Construct Validity of Protection and Use Components from Confirmatory Factor Analysis

Cluster analysis

The seven variables that showed the latent construct of protection-use value orientation from PCA, and also confirmed the construct validity of this value orientation continuum from CFA, were fed into the cluster analysis procedure. Table 4.5 and Table 4.6 show the results of cluster analysis using Ward's (hierarchical) method and K-means (non-hierarchical) method respectively. To identify the meaningful clusters, two to five cluster solutions from each method were compared.

Ward's method: In two cluster solution from Ward's method, average scores in use statements were higher in the first cluster, and average score in protection statements were higher in the second cluster. While going from two clusters to three clusters solution, the first cluster appeared as new cluster showing relatively higher average score in both protection statements and use statements. The second and third clusters represented use and protection orientation similar to the first and second clusters of two clusters solution. In four clusters solution, similar to the three clusters solution, the first cluster scored high with both protection and use orientation statements, the second cluster scored high on use orientation statements, and the fourth cluster scored high on protection orientation statements. However, the third cluster appeared as a new cluster with a distinct character of relatively low score in both protection and use orientation statements (Table 4.5).

Going from the four cluster solution to the five cluster solution, all clusters showed similar distinct characters as in four cluster solution except the second cluster, which did not show a meaningful or unique character to stand alone. This cluster was partially similar to the first cluster in use orientation statements and exactly similar to the fourth cluster in protection orientation statements. Thus, two, three, and four cluster solutions are distinct and meaningful. Choosing the two cluster solution over three cluster solution may result in a loss of a subgroup with a distinct character for both protection and use orientation. Similarly, choosing three clusters solution over four cluster solution may result to a loss of a subgroup with a distinct character of none protection and use orientation, i.e. low score in both protection and use orientation statements. As the idea of clustering is to segment a heterogeneous sample into as

many homogenous subgroups as possible so that the similarity is maximized within the segment and minimized among the segments, the four cluster solution appeared to best fit the data.

Table 4.5. Average Response Scores (Rounded to Zero Decimal) from Ward's Two to Five Clusters Solutions.

	Cluster solutions														
	2		3			4				5					
Variables	1	2	1	2	3	1	2	3	4	1	2	3	4	5
FOOD	3	3	3	4	3	3	4	2	3	4	2	4	2	3
WELLBEING	4	3	4	4	3	4	4	2	3	4	4	4	2	3
SOCIAL	4	3	4	4	3	4	4	2	4	4	4	4	2	4
JOBS	4	3	4	4	3	4	4	2	3	4	4	4	2	3
ENVIRONMENT	3	4	4	2	4	4	2	4	4	4	4	2	4	4
FISHRIGHT	3	4	3	1	4	3	1	3	5	4	3	1	3	5
MANAGEMENT	3	4	4	2	4	4	2	3	4	4	3	2	3	4

Note: Responses were measured in a scale of 1 (strongly disagree) to 5 (strongly agree)

Table 4.6. Average Response Scores (Rounded to Zero Decimal) from K-means Two to Five Clusters Solution.

	Cluster solutions														
	2		3			4				5					
Variables	1	2	1	2	3	1	2	3	4	1	2	3	4	5
FOOD	3	3	3	3	2	4	2	3	3	4	2	4	2	3
WELLBEING	4	4	4	4	3	4	3	4	3	4	3	4	4	3
SOCIAL	4	4	4	4	3	4	3	4	3	4	3	4	4	3
JOBS	3	4	4	4	2	4	3	4	3	4	2	5	4	3
ENVIRONMENT	4	3	4	3	4	4	4	3	3	4	4	3	3	3
FISHRIGHT	4	2	4	2	3	4	4	2	2	4	4	2	3	2
MANAGEMENT	4	3	4	2	3	4	4	2	3	4	4	2	3	2

Note: Responses were measured in a scale of 1 (strongly disagree) to 5 (strongly agree)

K-means method: Two to five cluster solutions from a K-means clustering algorithm are given in Table 4.6. Although, these clusters were very similar to the solutions from Ward's method, clusters formed from Ward's method were more distinct in average score of values statements. For example, in case of a four cluster solution, the second cluster from K-means appeared similar to the fourth cluster from Ward's method, however, unlike in Ward's method, average scores in protection orientation statements were not clearly different in first cluster and second cluster. For this reason, a four cluster solution from Ward's method was considered as the final cluster solution.

Characteristics of final clusters

In general, respondents held a variety of values in terms of protection and use of sport fish and nature. The majority of respondents expressed mixed protection and use value orientation (Figure 4.2). Table 4.7 shows the average responses on values statements by anglers of different value orientation subgroups. An Analysis of Variance (ANOVA) test to compare among subgroups on the null hypothesis "there is no difference among the subgroups" is also presented in the table. F-statistic associated with each of the values statement was significant ($p<0.001$), rejecting the null hypothesis. Thus, as expected, respondents formed distinct segments of value orientations.

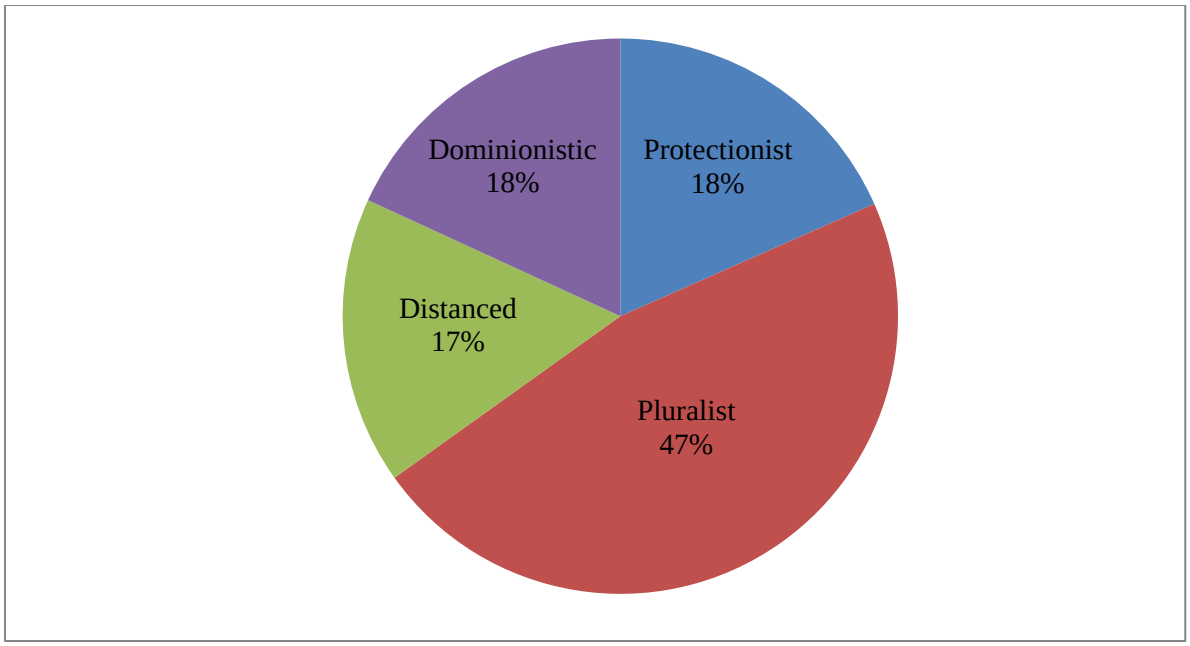


Figure 4.2. Percentages of Respondents by Subgroups of Value Orientations

Table 4.7. Average Response Scores on Value Orientation Statements by Final Cluster Solution

	Value Orientation Segments					
Statements	Protectionist	Pluralist	Distanced	Dominionistic	Sig.	Sample Average
Sport fishing is a valuable food source.	2.8	3.2	2.2	3.6	***	3.0
Sport fishing is important for human well-being.	3.1	4.2	2.4	4.0	***	3.7
Sport fishing helps develop social ties.	3.6	4.2	2.5	4.0	***	3.8
Sport fishing is important for jobs and income.	2.8	4.0	2.4	3.9	***	3.5
Protecting the environment is more important than providing sport fishing opportunities.	4.4	3.8	3.6	2.2	***	3.6
Fish have as much right as people to exist.	4.6	3.3	2.9	1.4	***	3.1
Management should focus on doing what is best for nature instead of what is best for people.	4.3	3.5	3.1	2.1	***	3.3

Note: Responses were measured in a 5-point Likert scale of 1 (strongly disagree) to 5 (strongly agree)
**** ANOVA test significance <0.001*

Protectionist: The first cluster included 18% of respondents (Figure 4.2). Respondents in this group showed higher agreement with statements expressing strict protection, and expressed lower agreement with statements expressing use orientation (Table 4.7). For example, they strongly agreed with the statement that fish have an equal right to exist, and also showed higher agreement with the statements expressing importance of protection and management of natural resources over providing sport fishing opportunities to humans. Although their agreements with the statement expressing utilitarian value of sport fishing for social ties was fairly high, they expressed lower agreement with the statements expressing value of sport fishing as a source of food, jobs, and income. Thus, following (Bruskotter & Fulton, 2008)), this subgroup was named as "protectionist." Protectionist included young and least experienced respondents, higher percentage of females, and respondents having lower education and income in comparison to pluralist and dominionistic subgroups (Table 4.8).

Pluralist: The second cluster included almost half (47%) of all respondents (Figure 4.2). Respondents in this group agreed with the statements expressing utilitarian values of sport fish for food, jobs and income, social ties, and human well-being. Similarly, they also agreed with the statements expressing equal right of fish to exist and importance of protection and management of natural resources over providing of sport fishing opportunities to human (Table 4.7). Because anglers of this group showed both strong protection orientation and strong use orientation, this subgroup was named as "Pluralist," which is consistent with the nomenclature used in a previous study in wildlife value orientation (Teel et al., 2005). They used this name to explain a group of people who hold both a mutualism and a utilitarian value orientation toward wildlife. As explained by the same authors, pluralist as a value orientation group indicates the transition between protection orientation and use orientation; and the influence of either of the value orientations is contingent upon a situation. Elders and experienced trout anglers were dominant in pluralist subgroup (Table 4.8).

Table 4.8. Demographic Characteristics of Respondents by Value Orientation Segments

	Value Orientation Segments				
Variables	Protectionist	Pluralist	Distanced	Dominionistic	Sig.
Age (SD)	46.7 (13.6)	51.4 (12.3)	50.5 (14.4)	51.4 (12.2)	**
Years of Fishing Experience (SD)	14.1 (14.1)	19.8 (15.0)	19.2 (17.0)	18.4 (13.6)	**
Gender (Female) %	30	10	15	6	***
Education (%)					***
High school not completed	9	2	1	1	
High school completed	16	12	22	12	
Some college or tech. school.	31	32	39	23	
College degree	27	28	22	42	
Post Bachelor's degree	17	26	15	22	
Income (%)					**
$50000 or less	39	26	28	18	
$50001 to 100000	37	43	52	43	
$100001 or more	24	30	19	39	
Membership of Trout Interest Group (%)	11	21	15	14	ns

*Note: Test of significance is ANOVA test for age and fishing experience and Chi-square test for other measurements. ***Significant at 1%, ** Significant at 5%, and * Significant at 10%, ns = "Not significant"*

Distanced: The third cluster included 17% of respondents, and was the smallest subgroup among the four value orientations segments. In general, anglers of this group expressed disagreement or neutral responses with the statements expressing both protection and use orientation. For example, they disagreed with the statement expressing utilitarian value of sport fish for food and human well-being, and also did not agree with the statement expressing equal right of fish to exist (Table 4.7). This subgroup was named as "Distanced" following Teel et al. (2005), who used this term to explain a subgroup that do hold neither a mutualism nor a utilitarian orientation toward wildlife. Because this group of respondents neither considered the sport fish with utilitarian values nor expressed importance of protection, it is likely that certain anglers, albeit small in number, may take fishing just as a family tradition or just a means of their regular recreation activities regardless of considering through either orientation. In comparison to other three groups, distanced subgroup included majority of respondents having less than bachelor's degree of education (Table 4.8).

Dominionistic: This cluster included 18% of all respondents. Respondents in this group agreed with the statements expressing strictly utilitarian views and disagreed with the statements expressing strict protection. For example, they agreed fish are a valuable source of food, and sport fishing helps develop social ties, human well-being and provide jobs and income. On the other hand, they strongly disagreed that fish has an equal right to exist, and disagreed on the protection and management of natural resources over providing sport fishing (Table 4.7). Borrowing from Bruskotter and Fulton (2008), this group was called "Dominionistic" The term 'dominionistic' was used by Kellert (1994) to define a wildlife value orientation that emphasize on "mastery and control over wildlife." The dominionistic group included a higher proportion of male and elders. This group also included a higher proportion of respondents with high education (i.e. college degree at least) and high income (i.e., more than 100,000 per year) (Table 4.8).

Findings of four segments of respondents and distinct characteristics of these segments supported the first hypothesis (H1). Assuming the sample represents the population of trout anglers, Georgia trout anglers form distinct segments based on their nature/sport-fish related value orientations. Results are

consistent with the findings in some of the previous studies that natural resources related value orientations can be organized into a protection-use continuum (Bright et al., 2000; Manfredo & Fulton, 1997; Needham, 2010). With a few exceptions, results of demographic variations among value orientation segments are fairly consistent with findings of other studies. For example, consistent with other studies, this study also found females and users with lower income are more likely to be protection oriented (Bruskotter, 2007; Manfredo et al., 2003). Unlike the finding in this study, some previous value orientation studies in national/federal forest management contexts have found more educated people to have more protection orientation (Manfredo et al., 2003; Vaske et al., 2001). However, as found in this study, a similar study has also found highly educated anglers to take more dominance orientation (Bruskotter, 2007). Therefore, it is likely that educated people hold different perspectives toward protection of fish and protection of forest.

Results of this study indicated about half of the respondents hold pluralist value orientation, and the rest were distributed among protectionist, distanced, and dominionistic value orientations with almost equal proportions. However, a study in Minnesota identified three value orientations of anglers with 67% of respondents holding protection orientation, 27% utilitarian, and 34% dominance (Bruskotter & Fulton, 2008). Although sizes of subgroups heavily differed, characteristics of anglers holding protection and dominance value orientation in this present study are very similar to those of corresponding segments found in Minnesota study. However, in comparison to this study, the study in Minnesota has some limitations or differences that justify the variation in number of value orientation groups and percentage of anglers holding each orientation. First, unlike only the trout anglers in this sample, Minnesota study included all types of anglers. Second, Minnesota study did not segment individual anglers into a value orientation groups, rather reported the percentages of anglers with the agreement above the median value in each orientation (sum of percentages of anglers in all three group goes beyond 100%). In other words, similar to this study, Bruskotter and Fulton (2008) used CFA and PCA to identify the number of factors that best fitted the responses of anglers; however, they did not use further segmentation techniques to identify value orientation of each angler (factors are not mutually exclusive). Third, these two studies

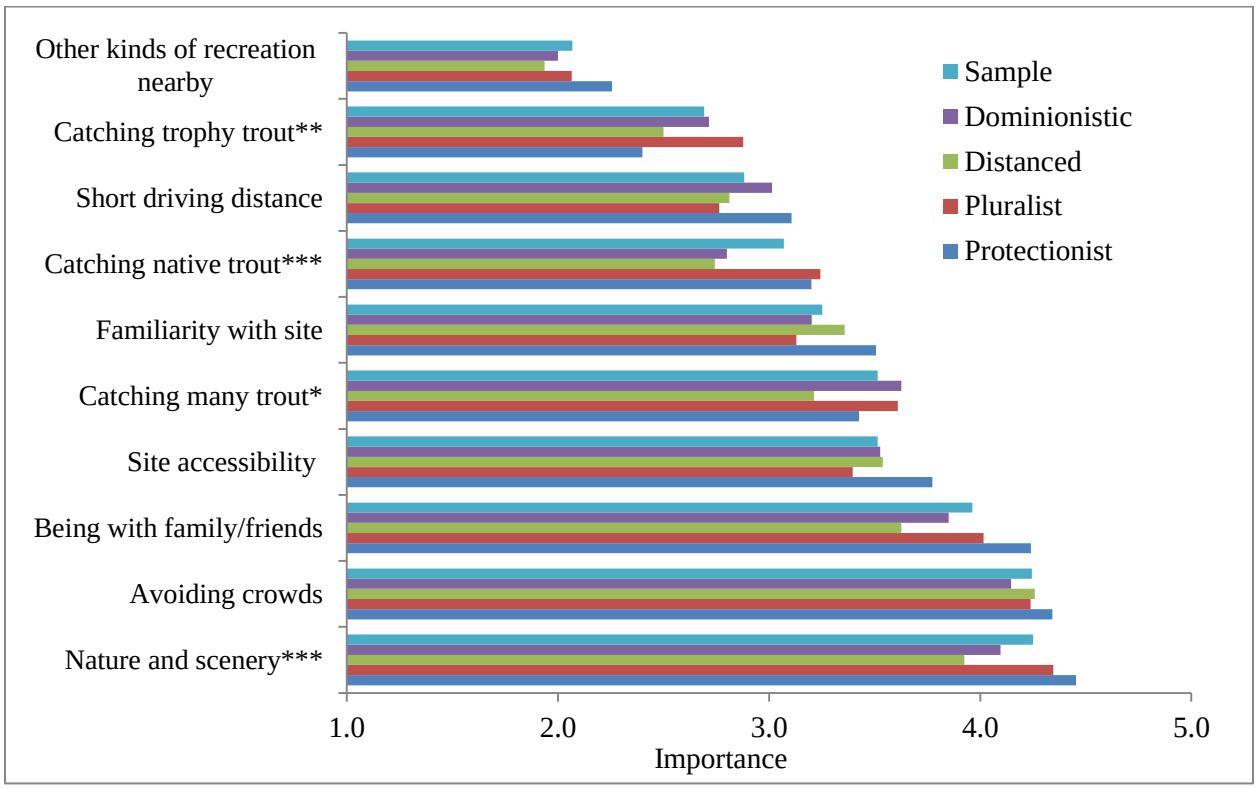
were conducted in two different regions with significant differences in underlying social and cultural characteristics.

Gigliotti (2012) segmented South Dakota public into four sub-groups of wildlife-related value orientations. Gigliotti found 55% of anglers holding utilitarian orientation, 12% holding mutualist orientation, 24% holding pluralist orientation, and 9% holding distanced orientation. Although, proportions of segments are different, characteristics of pluralist and distanced sub-groups of this study are very similar to those in South Dakota study. Researchers of wildlife value orientations (Manfredo, Teel, & Henry, 2009; Teel & Manfredo, 2010) argue that the mutualist view wildlife as capable of living in relationships of trust with humans. Thus, protectionist and mutualist share the conceptual similarity (Bruskotter & Fulton, 2008). However, humans don't face similar conflict with fish as they face with other wildlife. Thus, in the context of sport fishing, naming a particular value orientation segment as protectionist could be more meaningful than mutualist. The utilitarians believe that wildlife should be used and managed primarily for human benefit (Gigliotti, 2012). Similar to the finding of Gigliotti (2012), study presented in this thesis also found the smallest percentage of respondents in distanced subgroup. However, unlike his finding, the pluralist segment accounted for the highest proportion of the sample in this study. This variation might also have come from variation in regional differences in socio-cultural structure and values. Another reason could also be the modification of values statements in this study to represent the recreation and sport fishing context in comparison to general wildlife related context in Gigliotti's study.

Important factors while selecting a place to trout fish in Georgia

When asked about the factors that are important in selecting a trout fishing site in Georgia, respondents reported various level of importance on different factors. For the sample, highest level of importance was placed on having nature and scenery, followed by avoiding crowds, whereas as the lowest level of importance was placed on having other kind of recreation nearby. Value orientation segments of

respondents were also different in terms of their reported importance of certain factors for selecting a place to trout fish.



Note: scale ranged from 1 (not important) to 5 (very important)
*ANOVA tests: ***significant at 1%, ** significant at 5%, and *significant at 10%*

Figure 4.3. Respondents' Importance of Given Factors for Selecting a Place to Trout Fish in Georgia.

An ANOVA test of significance (asterisks) given along certain factors (Figure 4.3) indicates at least one of the value orientation segment was different from the other for that particular factor at given significance level. For example, importance of catching native trout and having nature and scenery were relatively higher for protectionist and pluralist respondents than dominionistic and distanced respondents ($p<0.01$). Similarly, importance of catching trophy trout was higher for pluralist than for protectionist respondents ($p<0.05$). Likewise, importance of catching many trout was higher for pluralist and dominionistic respondents than protectionist and distanced respondents ($p<0.1$). For the same factor,

different levels of importance among subgroups of respondents mean that certain group of trout anglers desire different fishing experience than the others.

Perceived quality of trout fishing over time

When asked how would they rate the quality of trout fishing in Georgia now compared to when they first began trout fishing here, about 40% reported that quality of trout fishing was the same, whereas the other 30% reported it to be worse.

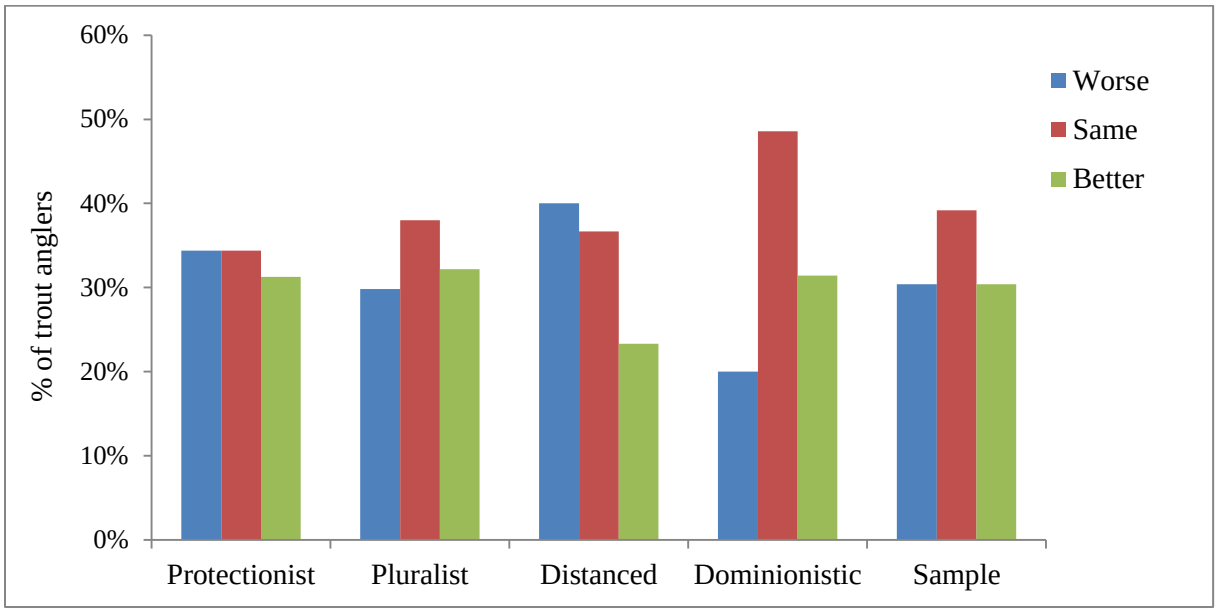


Figure 4.4. Respondents' Perception Regarding Quality of Trout Fishing in 2011 Compared to When They Began Trout Fishing.

Value orientation segments did not differ statistically in terms of respondents' perceived quality of trout fishing over time. However, about 40% of distanced and only about 20% of dominionistic respondents perceived the worse quality. Percentages of protectionist and pluralist respondents reporting worse quality were in between distanced and dominionistic respondents as shown in figure 4.4.

Knowledge, beliefs, and attitudes about climate change

When asked whether they had witnessed or heard that trout in GA streams are dying from increased water temperature, some 47% of respondents reported they had either seen or heard about it, whereas remaining 53% had neither seen nor heard. More than 90% of respondents fished for rainbow trout in comparison to 56% of respondents who fished brook trout. Rainbow trout is relatively tolerant to increase in water temperature than brook trout. Thus, it is reasonable that relatively lower proportion of respondents had knowledge about current consequences of rising water temperature. Compared to dominionistic respondents, significantly ($p<0.05$) higher percentages of protectionist and pluralist respondents reported having seen or heard about it. Percentages of distanced respondents who had seen or heard this issue were higher than the dominionistic respondents and lower than the protectionist and pluralist respondents (Table 4.9).

Table 4.9. Percentages of Respondents Who Had Either Seen or Heard That Trout in GA Streams are Dying from Increased Water Temperatures.

	Value orientation segments				Chi-sq.	
	Protectionist	Pluralist	Distanced	Dominionistic	sig.	Sample
Seen or heard	47	53	43	32	**	47
Neither seen nor heard	53	47	53	68	**	53

Chi-square test of significance at 5% level

Respondents' beliefs and attitudes toward occurrence and causes of climate change were assessed through their agreement/disagreement with different statements as shown in Table 4.10. In general, respondents' average beliefs and attitudes about climate change were close to neutral. However, they disagreed with the statement "concern about climate change is unwarranted" and agreed with the statement "we don't know enough about climate change and more research is necessary." This indicates

Georgia trout anglers were neither strong believer nor denier of occurrence of climate change and human contribution to it. About 50% of respondents believed that climate change is occurring, and almost equal percentages of them believed on human contribution to increase in greenhouse gases adding to climate change (Appendix 5).

Table 4.10. Respondents' General Beliefs and Attitudes about Occurrence and Causes of Climate Change.

	Value Orientation Segments					
Statements	Protectionist	Pluralist	Distanced	Dominionistic	Sig	Sample
There is evidence that CC is occurring and some action should be taken.	3.8 (1.1)	3.5 (1.2)	3.3 (1.2)	2.3 (1.2)	***	3.3 (1.3)
Human activity contributes to the increase in greenhouse gases, adding to CC.	3.8 (1.2)	3.6 (1.3)	3.2 (1.2)	2.3 (1.2)	***	3.3 (1.4)
CC is primarily natural and humans have little effect.	2.3 (1.3)	2.7 (1.3)	2.7 (1.2)	3.7 (1.3)	***	2.8 (1.3)
We don't know enough about CC, and more research is necessary.	3.8 (1.3)	3.6 (1.3)	3.6 (1.0)	3.8 (1.3)	ns	3.7 (1.3)
Concern about CC is unwarranted.	2.1 (1.2)	2.2 (1.2)	2.4 (1.2)	3.3 (1.4)	***	2.4 (1.3)
If we reduce our fossil fuel use now, then CC will be reduced.	3.2 (1.2)	3.1 (1.2)	2.9 (1.0)	2.1 (1.1)	***	2.9 (1.2)

Values represent mean score of responses measured along a 5-point Likert scale where 1= strongly disagree and 5 = strongly agree. Figures in parenthesis indicate standard deviation.
**** ANOVA test significance at 1% level, ns = "Not significant"*

Compared to dominionistic and distanced respondents, protectionist followed by pluralist showed significantly ($p \leq 0.01$) higher level of agreement with the statement that climate change is occurring, and human activities are responsible for this (Table 4.10). Distanced respondents were almost neutral with all statements, whereas dominionistic anglers expressed disagreement with the occurrence of climate change and human contribution to it. Conversely, dominionistic anglers agreed that climate change is natural and human have little effect on it, but other subgroups of anglers either disagreed or expressed neutral responses to this statement. For example, agreement of protectionist respondents and pluralist respondents with the statements "there is evidence that climate change is occurring and some action should be taken" and "human activity contributes to the increase in greenhouse gases, adding to climate change" were significantly higher ($p<0.01$) than the responses of dominionistic respondents. However responses of all group of respondents were almost equal with the statement "we don't know enough about climate change, and more research is necessary."

The dominionistic anglers were almost neutral with the statement "concern about climate change is unwarranted," but other subgroup of respondents disagreed with this statement. This result indicates certain groups of trout anglers (e.g., protectionist) are believer of both occurrence of climate change and human's contribution to it, whereas other subgroups of trout anglers (e.g., dominionistic) held opposite views of climate change. Although, agreement of protectionist and pluralist respondents were significantly ($p \leq 0.01$) higher than dominionistic respondents, none of the subgroups of respondents were strongly optimistic toward reducing climate change in future by reducing fossil fuel use now (Table 4.10). All groups of respondents wanted to understand more about climate change through research. This result suggests the need of further study on consequences of climate change on diverse areas and dissemination of information to public. It also calls for importance of climate education and outreach programs to trout anglers.

Concerns about specific risks of climate change

Respondents' concerns about risk of climate change on trout fishing were assessed with their agreement/disagreement with the seven statements as shown in Table 4.11. In general, they expressed higher agreement toward potential impact of climate change on trout habitat (M=3.6) and stocking streams in Georgia (M=3.6), and showed disagreement with the statements expressing minimal potential impact of rising stream temperatures on any species of trout in Georgia (M=2.3).

Results suggest trout anglers were somewhat concerned about risk of climate change on trout fishing, but their levels of concern were specific to the given cases. Perhaps, they were more concerned about the future impact of climate change than about current impact. For example, average agreement with a statement "rising stream temperature due to climate change will negatively affect trout habitat in Georgia in the future" (M=3.6) was significantly higher ($p<0.001$) than the agreement with a statement "rising stream temperature due to climate change is negatively affecting trout habitat in Georgia now" (M=3.2). About 60% were concerned about the future impacts, whereas only about 40% were concerned about its current impacts (Appendix 6). Although context is different, this result is comparable with findings of some of the previous studies that general public perceives climate change as a moderate risk to their own generation but as a higher risk to their future generation (Leiserowitz, 2005; Lorenzoni & Pidgeon, 2006).

Value orientations segments were different from each other in regard to respondents' concerns about the impact of climate change on trout fishing. Protectionist and pluralist respondents consistently showed higher level of concern toward impact of climate change than distanced and dominionistic respondents (Table 4.11). For example, average agreement of protectionist and pluralist respondents with the statements "Rising stream temperature due to climate change is negatively affecting trout habitat in Georgia now" and "Rising stream temperature due to climate change will negatively affect trout habitat in Georgia in the future" were significantly ($p<0.01$) higher than the average agreement of dominionistic respondents (Table 4.11). Similarly, average agreement of protectionist and pluralist respondents with the statements "Rising stream temperatures will eventually destroy trout fishing in Georgia streams" and

"Rising stream temperatures will decrease the streams available for trout stocking in Georgia" were significantly ($p<0.01$) higher than the average agreement of the dominionistic respondents (Table 4.11). Likewise protectionist and pluralist respondents disagreed with the statement "Rising stream temperatures will have minimal impacts on any species of trout in Georgia" but dominionistic respondents were close to neutral (Table 4.11).

Table 4.11. Respondents' Specific Beliefs about Risk Associated With Climate Change Impact on Trout Fishing

	Value Orientation Segments					
Concerns	Protectionist	Pluralist	Distanced	Dominionistic	Sig.	Sample
Rising stream temperature due to CC is negatively affecting trout habitat in Georgia now.	3.4 (1.0)	3.4 (1.1)	3.2 (1.1)	2.6 (1.1)	***	3.2 (1.1)
Rising stream temperature due to CC will negatively affect trout habitat in Georgia in the future.	3.9 (1.0)	3.8 (1.1)	3.4 (1.1)	3.0 (1.2)	***	3.6 (1.1)
Rising stream temperatures will eventually destroy trout fishing in Georgia streams.	3.6 (1.0)	3.4 (1.1)	3.3 (1.1)	2.6 (1.2)	***	3.3 (1.2)
Rising stream temperatures will hurt some species of trout in Georgia, but not others.	3.1 (1.1)	2.9 (1.0)	3.1 (1.0)	2.6 (1.0)	ns	2.9 (1.0)
Trout in Georgia will eventually adapt to higher stream temperatures.	2.7 (1.1)	2.6 (1.1)	2.9 (0.9)	3.1 (1.1)	***	2.8 (1.1)
Rising stream temperatures will have minimal impacts on any species of trout in Georgia.	2.2 (1.1)	2.1 (1.0)	2.6 (1.0)	2.8 (1.2)	***	2.3 (1.1)
Rising stream temperatures will decrease the streams available for trout stocking in Georgia	3.7 (1.1)	3.8 (1.0)	3.4 (1.0)	3.1 (1.1)	***	3.6 (1.1)

Note: values represent mean score of responses measured along a 5-point Likert scale where 1= strongly disagree and 5 = strongly agree. Figures in parenthesis indicate standard deviation.
**** ANOVA test of significance at 1% level, ns = "Not significant"*

No significant differences among segments were found with respect to the level of agreement with the statement "Rising stream temperatures will hurt some species of trout in Georgia, but not others" (Table 4.11). One potential reason for not showing higher agreement by any of the subgroups could be a difference in perspective of interpretation. For example, protectionist may not have indicated a very high level of agreement with this statement thinking that rising stream temperature in fact could hurt all species. On the other hand, dominionistic respondents may not have indicated high level of disagreement thinking that rising stream temperature would hurt none of the species. Except this case, in general, protectionist and pluralist respondents were almost equally concerned, but both of them were more concerned than respondents in the remaining two subgroups. However, between the other two subgroups, distanced respondents were more concerned than dominionistic respondents.

Behavioral intention to adjust fishing trips

When asked whether and how their trip taking would change if trout populations and catch rates at their preferred sites in Georgia decline due to climate change, respondents showed a variety of intentions under scenarios of different levels of reduction in trout populations and catch rates.

Percentages of respondents who reported not changing their fishing trips significantly declined with expected reduction in trout populations and catch rates as a result of climate change. On the other side, percentage of respondents who reported stopping fishing there increased from 2% in 10% population reduction scenario, to 62% in 75% population reduction scenario. However, at least 10% of respondents indicated not changing their fishing trips under any of the given reduction scenarios (Figure 4.5).

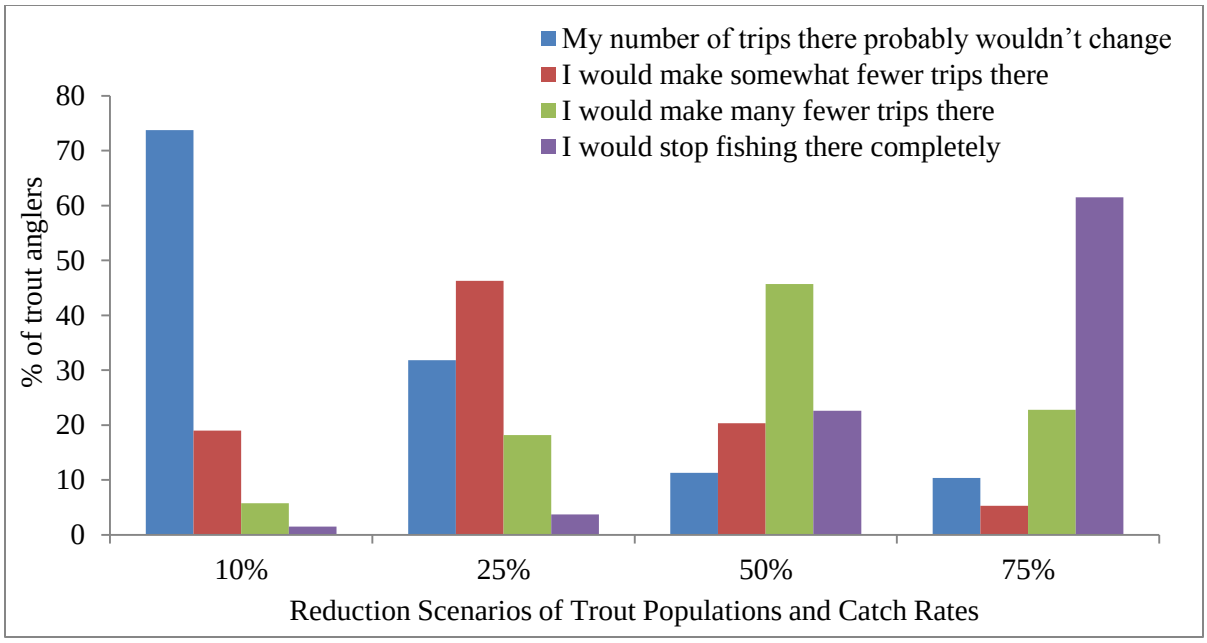


Figure 4.5. Respondents' Reported Intention to Adjust Fishing Trips in Response to Hypothetical Scenarios of Decline in Trout Populations and Catch Rates.

Respondents' potential adjustments in trip frequencies varied not only by reduction scenarios but also by value orientations segments in each reduction scenario, except in the case of ten percent reduction in trout population and catch rates, where the intention was not found significantly different among subgroups. Figure 4.6 shows how respondents of different value orientations reported adjusting their fishing trips in response to reduction in trout populations and catch rates.

The reported potential reduction in trout fishing trips increased among all subgroups of respondents with increase in reduction of trout populations and catch rates. However, highest proportion in protectionist subgroup and lowest proportion in dominionistic subgroup expressed the intention to reduce trips or stop fishing. Respondents in pluralist and distanced subgroups were very similar in terms of their intentions to reduce fishing trips in each reduction scenario. For example, about 80% of protectionist reported stopping fishing if trout population declined by 75% at their most frequent site, whereas only about 60% each of pluralist and distanced and only about 50% of dominionistic respondents reported stopping fishing given the same reduction scenario.

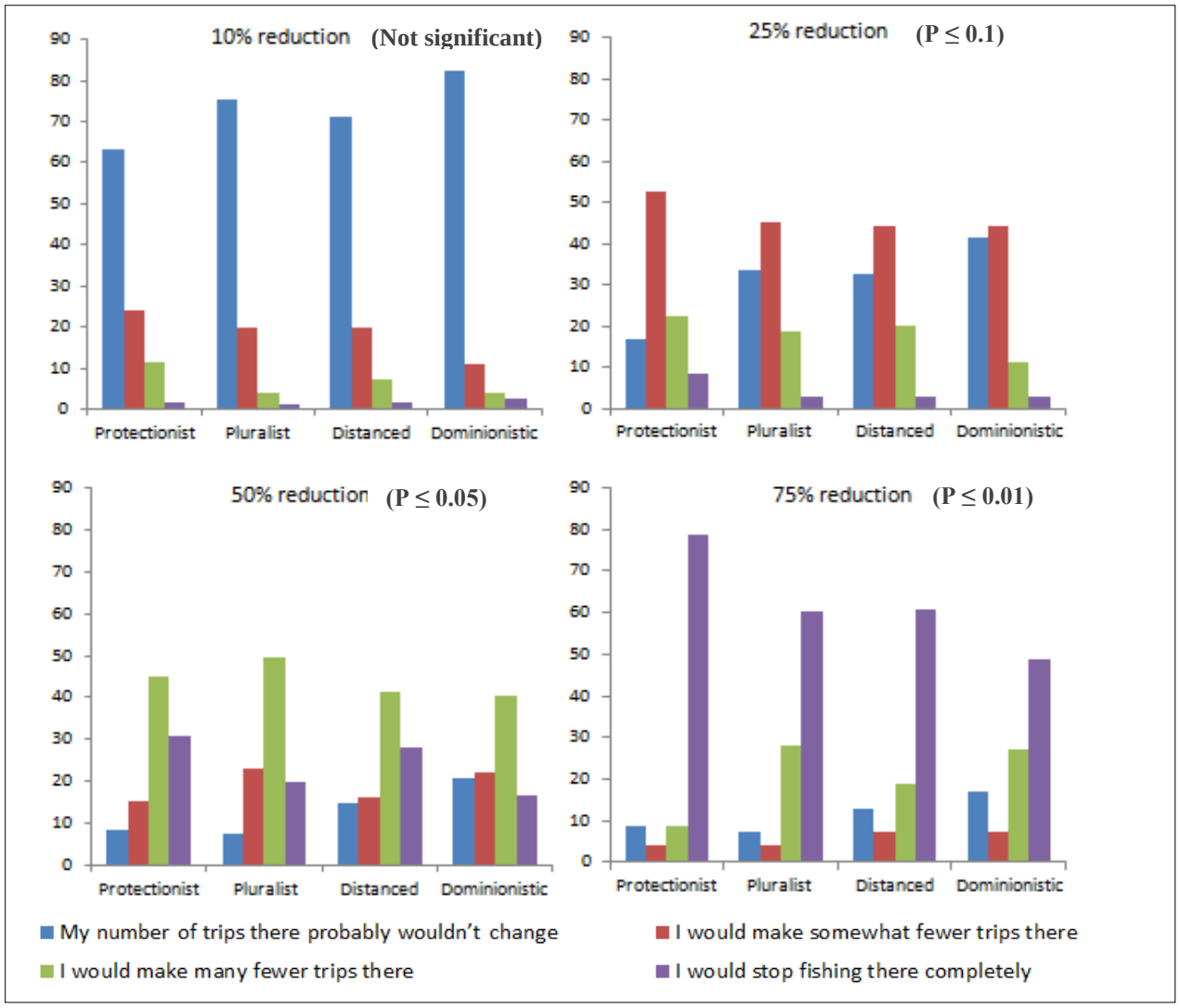


Figure 4.6. Respondents' Reported Adjustment in Trip Frequencies by Value Orientation Segments in Response to Hypothetical Scenarios of Decline in Trout Populations and Catch Rates.

While the respondents fairly agreed with the occurrence of climate change, and human being responsible for this, they perceived the associated risk differently. Moreover, the difference in perception of risk was consistent with the underlying difference in value orientations. This difference among subgroups of respondents could mean value orientations can have some level of influence on individual's perception of change risk and associated behavioral intentions. As results indicated, value orientation may

serve both as barrier and bridge for trout anglers in understanding and appreciating cause and consequences of climate change, perception of it as a risk to their recreation resources, and associated behavioral intentions as a response to the risk. Protection orientation, being in one end of value orientation continuum, is more likely to increase acceptance of occurrence and human contribution to climate change, concern toward its risk, and also the willingness to adjust recreation pursuit as a response to the risk. On the other hand, dominionistic orientation, being in the other end of value orientation continuum is less likely to help in appreciating the occurrence and consequences of climate change and adjusting with the change in recreation resources. For example, McFarlane (2005) also found people having biocentric value orientation perceive risk of natural hazards to forest diversity with higher risk rating than their anthropocentric counterparts.

Potential adaptations to climate change impact on trout fishing

When asked what they would do if the place they most often trout fish in Georgia is not available on a typical fishing day, more than half reported going somewhere else in Georgia to trout fish, and about 15% reported going somewhere else in Georgia for another activity (Table 4.12). It is likely that about 30% of respondents were highly dependent upon their frequent trout fishing site, as they reported staying home or going for work over going somewhere else in Georgia for same activity or another activity. This result indicates the possibility of decline in trout fishing participation among certain anglers if certain fishing sites are not available due to the impact of climate change or some other possible reasons. Value orientations segments were not statistically different in terms of respondents' potential adoption of sites and activity substitutions as adaptive strategies to change in resources.

Table 4.12. Respondents' Preferred Alternative Activities if the Place They Most Often Trout Fish in GA Was Not Available on a Typical Fishing Day

	Value Orientation Segments					
Activities	Protectionist	Pluralist	Distanced	Dominionistic	Sig.	Sample
Go somewhere else in GA to trout fish	59	57	50	43	ns	54
Go somewhere else in GA for another activity	17	17	15	12	ns	16
Go out of state to trout fish	7	9	8	5	ns	8
Stay home	17	21	30	32	ns	24
Go to work	8	2	6	7	ns	5

Note: ns = "not significant"

Similarly, when asked what alternative activities they would participate if they spent less time trout fishing at their most frequented site in Georgia, highest percentages of respondents indicated going for fishing in Georgia for warm water species, followed by going for fishing in other streams in Georgia for trout, and camping. Other preferred major alternative activities were hiking (38%), fishing in other states/countries for trout (37%), and hunting (37%) (Table 4.13).

Value orientation segments were significantly different from each other in the cases of fishing in other states/countries for trout, hunting, target shooting, and bird/nature viewing. Compared to other segments (26 – 35%), significantly higher proportion of respondents in pluralists (44%) reported going for fishing in other states for trout ($P \leq 0.05$). Since the pluralist accounted for half of all trout anglers, a significant portion of fishing economy could be affected in this state, if they reduce their trout fishing trips in fishing sites here in Georgia. Similarly, significantly ($p \leq 0.1$) higher percentage of dominionistic respondents (45%) in comparison to protectionist respondents (25%) indicated going for hunting instead. On the other side, significantly ($p \leq 0.05$) higher percentages of protectionist (25%) indicated going to bird/nature viewing than the dominionistic respondents.

Table 4.13. Alternative Recreation Activities Respondents Would Spend More Time Doing if They Spent Less Time Trout Fishing at The Place in Georgia They Fish The Most.

	Value Orientation Segments					
Activities	Protectionist	Pluralist	Distanced	Dominionistic	Sig.	Sample
Fishing in Georgia for warm water species	42	49	42	59	ns	48
Fishing in other streams in Georgia for trout	46	49	40	38	ns	45
Camping	49	43	44	42	ns	44
Hiking/Walking/Running	44	37	42	32	ns	38
Fishing in other states/countries for trout	32	44	26	35	**	37
Hunting	25	37	40	45	*	37
Canoeing/Kayaking/Swimming/Sailing	38	29	32	27	ns	31
Target Shooting	28	22	21	38	**	26
Fishing in Georgia for saltwater species	19	22	17	18	ns	20
Motor boating	15	16	21	19	ns	17
Golf	19	15	21	17	ns	17
Bird/Nature viewing	24	13	11	9	**	14
Indoor activities	22	12	13	9	ns	13
Off-road ATV/4-wheeling	13	11	19	10	ns	13
Bicycling	16	10	15	9	ns	12
Outdoor team sports	5	4	8	1	ns	5

*Note: values indicate percentage of trout anglers, ** Chi-square test significance at 5% level, *Chi-square test significance at 10% level, ns = "Not significant"*

When asked where they typically obtain climate information, majority of respondents indicated Weather Channel (71%), followed by ABC/CBS/NBC (34%), and Fox News (30%). Percentages of respondents by each sources of climate information are given in Appendix 7. Consistent with their value orientations, respondents showed variation in selection of certain media as well. For example, higher percentages of protectionist than dominionistic respondents obtained their climate information from Weather Channel ($p \leq 0.05$). Similarly, higher percentages of dominionistic respondents than those of other subgroups obtained climate information from FOX News and AM Talk radio ($p \leq 0.01$). Previous researchers have highlighted the importance of media and public agencies on influencing individual's perception of climate change risk (Grothmann & Patt, 2005; Shao, 2012). Perhaps one's value orientation and pre-existing attitude about climate change influence his/her trust over certain media among many available to seek climate information. In other perspective, perhaps different media interpret cause and consequences of climate change differently. As a result, their audiences possess a diverse level of knowledge and attitudes with respect to climate change and its potential impacts.

Factors associated with concerns about risk of climate change

As outlined in objective three, multiple regression models were employed to understand how value orientations and other factors such as a knowledge and belief about climate change, and fishing characteristics were related with the respondents' concern regarding the climate change impact on trout fishing. Results from regression estimates are presented in table 4.14. Of note, Model 1 (NOW) models the respondents' concern about impact of climate change on trout fishing in Georgia now, whereas the Model 2 (FUTURE) models the same for future.

The chi-square tests on the log-likelihood ratios were significant ($p<0.01$) for both NOW and FUTURE, suggesting the joint significance of regression model in each case. The p-values in Brant test appeared to be 0.44 for the variable NOW and 0.20 for the variable FUTURE, failing to reject the null that proportional odds assumption of ordered logistic regression was violated (Long & Freese, 2006).

Table 4.14. Results From Ordered Logistic Regression Explaining Factors Related to Anglers' Concerns About Risk of Climate Change.

		Model 1: Dependent Variable NOW		Model 2: Dependent Variable FUTURE	
VARIABLES	Description	Coefficient	Std. error	Coefficient	Std. error
PROTECTION	Factor score of PROTECTION component	0.2968**	0.1273	0.4066***	0.1286
USE	Factor score of USE component	0.0003	0.1102	0.0797	0.1118
SEEN_HEARD	Whether or not seen or heard trout in Georgia are dying from increased water temperature	0.9631***	0.2277	0.5186**	0.2243
BELIEF	Climate change is occurring and some action should be taken	0.5593***	0.1009	0.8253***	0.1034
QUALITY_WORSE	Perceived quality of trout fishing	0.7938***	0.2318	0.4209*	0.2300
SPECIALIZATION	Specialization index	0.1009	0.0906	0.1690*	0.0936
MANY_TROUT	Importance of catching many trout	0.2157**	0.0959	0.1153	0.0951
INFORMATION	Source of climate information	0.7654***	0.3070	0.8403***	0.3266
AGE	Age	-0.0004	0.0083	-0.0041	0.0084
EDUCATION	Highest level of education attainment	0.0823	0.1068	0.1551	0.1085
INCOME	Index representing annual household income in 2011	0.0262	0.0895	-0.0774	0.0911
McFadden's Pseudo R^2		0.1353		0.1770	
N		343		344	

*** p<0.01, ** p<0.05, * p<0.1

As expected, the coefficient on the PROTECTION variable appeared positive and significant ($p<0.05$), suggesting that concerns of respondents about effect of climate change on trout fishing, both now and in the future, increases with the increase in their protection values. However, the coefficients of USE variable were insignificant in both models. The respondents of the pluralist subgroup valued both protection and use of sport fish and nature but reported higher concern about risk of climate change than the dominionistic. Thus, the reason behind insignificant relationship between use orientation and concern could be the big size of pluralist subgroup. In human dimension literature, basic beliefs, environmental values or worldviews have been consistently found to be predictors of environmental concern or skepticism (Dietz et al., 2007; Leiserowitz, 2006; Whitmarsh, 2011). Respondents, who had higher protection orientation than the others may have considered trout as not only a source of recreation but also as a unique species in the nature. Thus, anglers' concern about risk of climate change on trout fishing is more likely to increase with increase in their protection values.

As expected, coefficient of the variable SEEN_HEARD appeared positive and significant ($p<0.01$ for NOW and $p<0.05$ for FUTURE). This indicates respondents who had either seen or heard of the evidence of climate change impact in Georgia were more likely to be concerned than those, who did not have such knowledge. Similarly, as expected, basic belief about evidence of climate change was positively and significantly ($p<0.01$) related with respondents' concerns, indicating that respondents who showed higher agreement with occurrence of climate change were more likely than others to have higher level of concern over the risk of climate change.

These results are consistent with a previous study by Leiserowitz (2006), which found that experiential factors, such as "affects" and "imagery" largely influence public perception of climate change as a risk. Affects refers to a person's feeling (good or bad, positive or negative) about specific objects, ideas, or image, and imagery refers to a mental representation of seen, heard, or felt object or issue (Leiserowitz, 2006). Thus, in this context, affects about occurrence of climate change and imagery about existing consequences of rising water temperature on trout fishing are likely to positively and significantly influence concern about risk of climate change.

As hypothesized, the relationship between perceived quality of trout fishing and concern about risk of climate change was positive and significant ($p<0.01$ for NOW and $p<0.10$ for FUTURE). Results indicate respondents who had perceived the poor quality of trout fishing in 2011 compared to when they first began trout fishing in Georgia were more likely to be concerned about risk of climate change. Perhaps, certain trout anglers could relate their perceived worse quality of trout fishing with the impact of climate change than the other trout anglers.

As expected, the coefficient of the variable SPECIALIZATION appeared positive and significant ($p\leq0.1$), suggesting with the increase in specialization, trout anglers' concern about future risk of climate change was likely to increase. Perhaps, strong attachment and dependence to resources are the underlying reasons behind positive and significant relationship of specialization with concern about risk of climate change. The relationship between specialization and concern was not significant in the case of current impact of climate change on trout fishing. This may indicate that trout anglers perceived current risk of climate change almost equally regardless of their specialization, but in the case of future impacts, highly specialized anglers were more likely to be concerned than their least specialized counterparts. In an another perspective, significance of this variable at only 10% confidence level in one model (FUTURE) and non-significance in another model (NOW) could also mean that specialization may not have been measured very well by the construct being used.

As expected, importance of catching many trout was positively and significantly ($p<0.05$) related with respondents' concerns about current risk of climate change. The relationship was not significant in the case of concern about risk in the future. Perhaps, respondents having higher importance of catching many trout care more about now than about the future.

The coefficient of the variable INFORMATION appeared positive and significant ($p<0.01$) in concern models regressing both NOW and FUTURE. Results indicate trout anglers who obtained climate information from Trout Unlimited or North Georgia Trout Online were more likely to be concerned about both current and future risk of climate change. Perhaps, web visitors of organizations working in the area of protection and management of trout and trout fishing trust these organizations for the information

about potential risks of climate change on trout fishing. As results suggested, availability of relevant information could help trout anglers understand the risk of climate change.

None of the demographic control variables, age, education, and income appeared significantly related with concern about risk of climate change. Removal of any or all demographic variables did not improve or harm the model. Despite their insignificance, those variables were kept as control variables as literature in risk perception suggest ability to perceive risk significantly differ among various demographic groups (Hamilton, 2008; Semenza et al., 2008). Perhaps, trout anglers' concerns associated with the risk of climate change on trout fishing can be predicted more with value orientation, first-hand knowledge of impact, belief about occurrence of climate change, perceived quality of trout fishing, specialization, importance of catching many trout, and source of climate information than their demographics.

Although the study population was different than trout anglers, several studies found age to be negatively related with concern associated with risk of climate change (Kellstedt et al., 2008; Malka et al., 2009; McCright & Dunlap, 2011). Previous findings about relationship of education and income with concerns about risk of climate change are rather mixed, with some studies finding a significant positive relationship (Hamilton, 2008), and others finding a significant negative relationship (Malka et al., 2009; McCright & Dunlap, 2011), and yet others finding non-significant relationship (Brody et al., 2008; Kellstedt et al., 2008).

Factors associated with behavioral intentions of adjustment to trips

Estimates of behavioral intentions of adjusting fishing trips from ordered logistic regression are presented in Table 4.15. The chi-square tests of the log-likelihood ratio, which test the null hypothesis of all of the regression coefficients in the model are equal to zero, were significant ($p<0.01$) for both reduction scenarios considered in the models. Significance of p-values indicates the joint significance of the models. The p-values in Brant test were 0.11 for the 25% reduction scenario and 0.64 for the 75%

reduction scenario, failing to reject the null that proportional odds assumption of ordered logistic regression model was violated.

Eight respondents reported some sort of odd responses regarding their intentions to adjust their recreation pursuits. For example, they reported stopping fishing in a particular site in 50% reduction in trout population, but reported only making few trips there if trout populations decreased by 75%. It was assumed that those respondents either did not understand the series of questions or responded without giving much thought. Thus, those eight respondents were removed from the final regression model of behavioral intention. Alternative model was estimated by including those observations, but result presented here was robust.

The second and third columns respectively show the regression results for two selected scenarios of the reduction in trout populations, low (25%) reduction and high (75%) reduction, respectively. As expected, the coefficient of the protection orientation appeared positive and significant ($p<0.1$) in both scenarios. Results indicate respondents with higher protection orientation were more likely to adjust their recreation pursuits if the trout population and catch rates declined in their preferred fishing sites. Perhaps, trout anglers with higher protection orientation are more sensitive about potential impact of climate change on trout populations than the other trout anglers not only because of the recreation value to them but also due to the protection value toward trout (e.g., values that trout has equal right to exist).

The coefficient on the use orientation variable did not appear significant in either scenario. This indicates intentions to reduce fishing trips in accordance with decreased trout population may not differ among respondents having higher use orientation and lower use orientation. The dual characteristics of pluralist respondents (e.g., both protection and use) and big size of the pluralist subgroup could be the reason for insignificant relationship of use orientation with behavioral intention.

Table 4.15. Results from Ordered Logistic Regression Explaining Factors Related with Respondents' Intentions to Reduce Fishing Trips in Two Hypothetical Scenario of Reduction in Trout Population.

		Low Reduction: Dependent Variable REDUCTION_25		High Reduction: Dependent Variable REDUCTION_75	
VARIABLES	Description	Coefficient	Std. error	Coefficient	Std. error
PROTECTION	Factor score of PROTECTION component	0.2021*	0.1182	0.2285*	0.1256
USE	Factor score of USE component	0.0254	0.1078	-0.0754	0.1196
CONCERN	Composite score of four concern statements	0.0863***	0.0318	0.1225***	0.0354
SPECIALIZATION	Specialization index	-0.2052**	0.0959	-0.2260**	0.1019
MANY_TROUT	Importance of catching many trout	0.2560***	0.0956	0.2917***	0.1030
TROUT_SUBSTITUTE	Trout substitute	0.1342	0.2149	0.3545*	0.2332
NATURE_SCENERY	Importance of nature and scenery	-0.1882	0.1199	-0.2452*	0.1365
AGE	Age	0.0043	0.0080	0.0042	0.0089
EDUCATION	Highest level of education attainment	-0.0397	0.1054	-0.1210	0.1206
INCOME	Index of annual household income in 2011	-0.0379	0.0867	0.0699	0.0966
McFadden's Pseudo R^2		0.0385		0.0533	
N		361		356	

*** p<0.01, ** p<0.05, * p<0.1

As expected, the coefficient on concern index appeared positive and significant ($p<0.01$) in both reduction scenarios. This indicates more concerned trout anglers were more likely than less concerned ones to reduce trips or stop fishing completely at their favorite sites in case of trout reduction due to climate change. Although the context was different from outdoor recreation, a recent study of climate change adaptation behavior among farmers also found that farmers' intention to adopt climate adaptive farming practices was positively and significantly related with their concern about impact of climate change on agriculture (Arbuckle et al., 2013). The coefficient on the specialization variable appeared negative, as expected, and significant ($p<0.1$) in each reduction scenario. Results indicate intention to reduce trips decreases significantly with increase in respondents' specialization index. The difference in intention to reduce trips with difference in specialization level may be attributed to the difference in avidity, place attachment, and other factors that develop specialized trout anglers' connection with their fishing sites (Bryan, 1977; Ditton et al., 1992; Graefe, 1981).

As expected, importance of catching many trout was positively and significantly related with intention of adjusting recreation pursuits under each hypothetical reduction scenarios considered in the model ($p \leq 0.01$). This indicates with increase in importance of catching many trout, intention of reducing fishing frequencies were likely to increase. If trout population declines, trout anglers' expected ability to catch as many trout as they want may decrease. Thus, trout anglers with higher importance of catching many trout may decrease their fishing trips in their usual sites if trout populations decline there. Perhaps, they are early bird to seek alternatives sites or activities. On the other hand, the coefficient of the variable NATURE_SCENERY was negatively significant ($p<0.1$) at 75% reduction scenario, indicating respondents who placed higher importance on nature and scenery while selecting a place to trout fish were less likely to reduce their fishing trips even if trout population decline by 75%. Anglers, who derive trip satisfaction from more than just a catch, are less likely to reduce their trip even if the trout population declines in climate change scenario.

The coefficient on TROUT_SUBSTITUTE variable was positive, as expected, and was significant ($p<0.1$) for 75% reduction scenario. This indicates respondents having alternative sites in state

or out of state for trout fishing were more likely to reduce their trips in their usual fishing sites if trout population there decreased by 75% due to climate change. However, the relationship between trout substitute and intention to reduce trips was not significant at low (25%) reduction scenario. Perhaps, low reduction in trout population would not be enough for trout anglers for considering substitute sites. One possible reason could be an increase in expenses in getting to the alternative site. However, if the catch rates become really low (high reduction scenario) then trout anglers might reduce trips to their common fishing sites and jump to the alternative sites.

None of the demographic characteristics in this study were significant in either model. However, those were not removed from the model because they are commonly used control variables in models examining behavioral intentions of adaptation and impact mitigation, and policy support related to climate change (Arbuckle et al., 2013; O'Connor et al., 1999; Zahran et al., 2006). To sum up, trout anglers' behavioral intention to reduce fishing trips to sites affected by climate change could be better predicted by their perception of specific risk on trout habitat, reported importance of catching many trout and nature and scenery, level of specialization in trout fishing, and availability of trout substitutes than their demographics characteristics.

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

This chapter presents conclusions from the study along with some discussion of management implications for state and federal natural resource agencies involved in trout fishery management in Georgia and elsewhere. Limitations of the study are discussed as well.

Multivariate cluster analysis of survey responses to nature and sports fish value orientations questions revealed four subgroups of trout anglers- pluralist (47%), protectionist (18%), dominionistic (18%), and distanced (17%). Trout anglers of each subgroup retained unique characteristics in terms of how they value natural resources and sport fish. Subgroups were also different in terms of their basic demographic characteristics such as age, gender, education, and income, as well as their fishing characteristics such as preference for native trout, and years of fishing experiences. Further, significant differences were also observed among subgroups regarding their knowledge, belief, concern regarding climate change indicating a considerable heterogeneity among trout angling population.

Results from regression analysis showed that trout anglers' perceived risk of climate change on trout fishing could be better predicted by variables representing their value orientation (protection), knowledge about consequences of climate change, belief about occurrence of climate change, perception of trend in quality of trout fishing, and sources of climate information than their demographics characteristics. Depending upon the time of reference, specialization and importance of catching many trout also were related to angler's perception of risk associated with climate change impact. Similarly, trout anglers' behavioral intentions to adjust their trip frequency to sites affected by climate change could be better predicted by their value orientation (protection), perception of specific risk on trout habitat (concern), importance of catching many trout, and level of specialization in trout fishing, than their

demographics. Also related with their intention to adjust the trip frequency were the availability of trout fishing substitutes and importance placed on natural scenery at fishing site.

Findings of the current study are consistent with the Cognitive Hierarchy Model of Human Behavior (Fulton et al., 1996; Vaske & Donnelly, 1999) which suggests that values being in lower order of human cognition determine higher order cognitions (e.g., attitudes and behavioral intentions). Similarly, consistent with the Theory of Planned Behavior (Ajzen, 1991), attitude (concern) about risk of climate change on trout fishing was significant predictor of behavioral intention of reducing trout fishing trips to affected sites.

Noticeable gap was observed among value orientation subgroups of trout anglers in understanding the risks of climate change and intending to adjust in recreation pursuits with change in resources due to climate change. This may make certain subgroups of trout anglers bear higher impact of climate change in the future than the others. For instance, certain trout anglers (e.g., protectionist and pluralist) seemed to have knowledge of potential risk, whereas others (e.g., dominionistic) seemed to lack climate risk knowledge.

Georgia trout anglers' levels of concern over climate change impact on trout fishing varied by time of reference. In general, the level of concern over the potential impact of climate change was more for future than now. These results are consistent with the existing literature that suggest people perceive climate change as a moderate risk but do not consider it to be an immediate risk rather believe it will eventually cause harm to future generations (Lorenzoni & Pidgeon, 2006). Trout anglers, many of whom are perhaps yet to see the direct impact, and existing scientific notion of climate change being a long-term phenomenon leads them to not think it as a threat of their lifetime but the future uncertainty may make them believe it to be a potential threat.

Management implications

Variations in climate change knowledge, risk perception, and intention of adjustment to the change in resources among the subgroups of respondents could suggest that there exists heterogeneity

among the trout anglers in responding to changing climate. In other words, certain trout anglers are more prepared than the others to adjust with the potential impacts of climate change, while certain others are yet to appreciate the occurrence and threats of climate change. This information could be in the best interest of natural resource agencies like Georgia Department of Natural Resources (DNR) in designing and implementing climate change education/awareness and resources management programs. Certain groups of anglers (e.g., protectionist and pluralist) showed higher intention than others to reduce their fishing trips to the climate change affected sites. With the information about what proportion of trout anglers are likely to reduce their trips or are likely to stop trout fishing completely at their regular fishing sites, GA DNR and their stocking units could come up with long-term planning of stocking programs to offset the loss in stockable streams.

Georgia trout anglers were likely to adopt a variety of alternative outdoor activities if they spent less time on trout fishing. Some trout anglers may move to alternative sites within the state or out of state, while others may switch to other alternative activities. This may create complication to GA DNR and other management agencies to manage trout and other recreation resources. Information provided by this study could be useful to minimize the loss of economic benefit and keep fishing revenue within Georgia. For instance, at least half of trout anglers reported they would go for fishing in Georgia for warm water species, or fishing in other streams in Georgia for trout, or camping regardless of their value orientations if they reduced their trips to their fishing sites. By finding stockable areas that are relatively safe from early impact of climate change might also help to keep trout anglers within the state. Similarly, certain subgroups of trout anglers (e.g., protectionist) were more likely to go for alternative non-consumptive recreation activities (e.g., bird/nature viewing) whereas other groups (e.g., dominionistic) were more likely to go for similar consumptive recreation activities (e.g., hunting). Thus appropriately managing those resources in accordance with proportion of trout anglers likely to go on each alternative site and activity could help fulfill recreation demand of trout anglers within the state.

Trout anglers, who placed higher importance on catching many trout, were more likely than others to reduce fishing trips to their popular site, if trout populations decline. Perhaps, these anglers will

jump to other fishing sites more quickly than the others with a hope of harvesting enough trout in new location. Considering more than half of trout anglers indicated catching many trout as important site selection criteria, GA DNR may have to consider stocking certain areas frequently and with higher numbers of trout to offset any reduction in trout stock due to climate change impact. However, specialized anglers were less likely to reduce their fishing trips with decline in trout population. Based on the description adopted here, specialized anglers tended to fish in wilderness streams, preferred brook, had relatively longer fishing experience, and fished more frequently than an average angler. They may have placed unique value on the fishing experience and also developed a sense of place attachments to the site (Bryan, 1977; Graefe, 1981). Because of the place attachment and desire for unique experience in fishing in such sites, they may not find alternative sites that meet their expectation or could be reluctant in moving away from their favorite place. Although adjusting stocks to reduce certain level of impacts due to climate change might be possible in some trout streams, a different management approach may be needed for wilderness streams as those streams are not stocked but allowed for natural growth of native trout. GA DNR and other agencies may consider expanding research and management to maintain sheds along the rivers so as to help keep temperatures at tolerance levels to native species of trout.

Results suggested trout anglers' concern about risk of climate change could affect their intention to adjust fishing trips. Trout anglers, who obtained their climate information from TU or NGTO, were more likely to be concerned about risk of climate change. Perhaps, information these non-profit organizations provide help trout anglers appreciate the risk. Thus, making trout anglers aware of specific risks, perhaps through climate change education and awareness and information dissemination through their trusted web resources, may inform them of potential risk surrounding their favorite sport activity. Informed client base could be more supportive of any mitigation actions that require public support for successful implementation.

Research implications and limitations

This study is the first to study the climate change knowledge, attitude, and risk perception among a specific resource user group. While this particular study focused on trout anglers in Georgia, it sheds some lights on how recreationists may perceive the risk of climate change, and potentially respond to (or adapt to) the impact of climate change on their recreation resource. Findings could serve as important reference to guide future research in concern and behavioral intention of outdoor recreationists facing declines in recreation resources due to changing climate. Discrepancy in knowledge and risk perception about climate change among the subgroups of anglers could suggest that certain value orientation could be barriers/limitations in public understanding of climate risk. The idea that value orientation could play a significant role in understanding the risk or accurately perceiving the threat could be interesting to wider social science community.

This study found a significant relation of value orientation (protection) with attitude (concern) at least at 5% significance level but with behavioral intention at 10% significance level. As Cognitive Hierarchy Model of human behavior suggests, in a hierarchical chain of human cognitive behavior, value orientations determine behavioral intentions through a mediating effect of attitudes (Fulton et al., 1996). Perhaps, relation between trout anglers' value orientation and behavioral intention could be better explained by alternative model that can report mediating effect (e.g., structural equation modeling) (Fulton et al., 1996). However, this mediating effect was not examined in this study. So, for the further improvement of our understanding about association between recreationists' value orientation and their behavioral intentions of adjustment in recreation pursuits with change in resources due to climate change, future research should also consider the mediating effect of attitudes.

The value orientation statements used in this study were heavily adopted from existing literature. However, as explained more detail in method section, some statements were reworded and few statements were introduced in this study to better reflect the context of interest (trout fishing). Although, modification of established value orientation scales to fit the study context is fairly common (Needham,

2010), future research should consider examining the validity and reliability of these statements in measuring associated construct in diverse recreation contexts.

The protection orientation appeared significant predictor of both concern about risk of climate change and behavioral intention of reducing trout fishing trips in affected sites; however, use orientation was not significant in either model. This result is consistent with the finding in similar studies. For example, Bruskotter and Fulton (2008) also found a stronger relationship of anglers' higher order cognitions (e.g., normative belief of using technological aids in angling) with protection value orientation than with other value orientations. This result might apparently indicate only the protection orientation was useful in predicting trout anglers' concerns and behavioral intentions related to climate change impact on trout fishing. A large proportion of trout anglers, the pluralist subgroup (49%), exhibited a dual characteristics, both strong protection and strong use orientation. However, this subgroup reported both higher concern about risk of climate change and behavioral intention of reducing trips to the affected sites. This could be the reason for non-significant relationship of use orientation with both concern and behavioral intention. Thus, caution should be taken to generalize this result in other contexts and geographic locations where distribution of value orientations could be different (Manfredo & Fulton, 1997; Vaske et al., 2011).

This study used only four criteria to define trout anglers' specialization level: fished for brook, fished in wilderness, above average fishing experience, and above average trout fishing trips in 2011. These indices were considered as proxies of resource dependency, avidity, and experience (Bryan, 1977; Choi et al., 1994; Graefe, 1981; Hammitt et al., 2004). However, expenditure in fishing equipment is also considered an important indicator of specialization (Bricker & Kerstetter, 2000; Bryan, 1977; Chipman & Helfrich, 1988). Future research could improve the generalizability of their findings by including expenditure in recreation equipment as an additional index in defining specialization.

The GA DNR sells 18 types of permits that give privilege to fish for trout as well as do other outdoor recreation activities (GA DNR, 2013a). For this reason, the survey included all people who had trout fishing privilege in Georgia in 2011. Certain respondents returned survey without any data, but

indicating they did not trout fish. Many of them were not even aware of the fact that their license included trout fishing privilege. It is likely that many of the survey recipients did not return the survey, as the topic was not relevant to them (Pearl & Fairley, 1985). This could be a reason for a relatively low response rate. However, response rate of mail surveys have declined over the years (Connelly, Brown, & Decker, 2003). Nevertheless, the response rate of this survey is on par with some recent surveys of anglers conducted recently elsewhere. For example, a survey of South Carolina anglers had a response rate of 20% (Kyle et al., 2007). Because of the lack of funding, non-response bias check was not conducted in this study. Population of interest in this study included trout anglers in Georgia, for whom demographic information was not available to apply post-stratification weighting.

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APPENDICES

Appendix 1. Questionnaire survey

Georgia Angler Survey
Climate Change & Trout Fishing in Georgia

1785
The University of Georgia

Warnell School of Forestry and Natural Resources
2012

You have been randomly selected as a Georgia trout stamp holder to participate in this survey. The survey is intended to help managers better understand Georgia trout anglers' knowledge and opinions of climate change and its potential impact on trout fishing. If you are less than 18 years old, please do not complete the survey

Section A: Current and Past Trout Fishing in Georgia

A1. For which species of trout do you fish? *(Check ALL that apply)*
☐ Brook ☐ Brown ☐ Rainbow ☐ Other (specify)_____

A2. If you fish in streams, what type of streams do you fish? *(Check ALL that apply)*
☐ Year-round ☐ Seasonal
☐ Tailwater ☐ Wilderness
☐ Heavily stocked ☐ Special regulation (i.e., delayed harvest,

A3. What do you typically do with your catch? *(Check ONE)*
☐ Eat ☐ Release
☐ Trophy ☐ Other (please specify)_____

A4. Did you fish for trout in Georgia in 2011?
☐ Yes, go to question **A7**. ☐ No, go to question **A5**.

A5. Which best describes your reason for answering 'No'?
☐ I usually go every year, but 2011 was an exception; go to question **A7**.
☐ I quit trout fishing altogether; go to question **A6.**
☐ I don't use the trout stamp that comes with my license **(SKIP TO B1)**

A6. Which of the following best describes the reasons you do not trout fish? *(Check ALL that apply)*
☐ Crowding ☐ Not enough trout
☐ Lack of time ☐ Too expensive
☐ Long commute ☐ Unfavorable weather (drought, low water levels)
☐ No fishing partners ☐ I only fish trout outside of Georgia

A7. Where do you typically begin your Georgia trout fishing trips?
☐ Permanent residence (zip code) _____ ☐ Non-permanent residence (zip code)

A8. Approximately, how far is the place in A7 from the place in Georgia you trout fish most often?
one-way distance _____miles AND/OR one-way commute time

A9. What type of vehicle do you typically use when traveling to fish for trout in Georgia. *(Check ALL that apply)*
☐ Full-size Pick- ☐ Small Pick- ☐ Small ☐ Medium Car ☐ Large Car/Van

A10. When do you take your trout fishing trips in Georgia? *(Check ALL that apply)*
☐ Winter (Dec-Feb) ☐ Spring (Mar- ☐ Summer (June-Aug) ☐ Fall (Sept-Nov)

A11. How many people usually travel in the same vehicle with you during a typical Georgia trout fishing trip?
_____ # people in vehicle INCLUDING MYSELF

A12. How many trips in total did you take for the primary purpose of trout fishing in Georgia in 2011?
_____ # trips

A13. Please indicate on the map the number of trips you made in 2011 to any Georgia counties shown below or outside Georgia for the primary purpose of trout fishing.

Map 1: Trout Counties in Georgia

A14. How many of your trout fishing trips indicated in **A12** above were overnight trips?

☐ _____# trips ☐ No overnight trips (Go to **A17**)

A15. On your last overnight trout fishing trip in Georgia, how many total nights were you away from home?

_____# nights

A16. During your last trout fishing **OVERNIGHT TRIP** in 2011, how much did you personally spend on the following items both INSIDE and OUTSIDE the 31 Georgia counties shown in Map 1?

Items related to your last trout fishing OVERNIGHT TRIP	Amount spent **WITHIN** 31 Georgia counties named in Map 1	Amount spent **OUTSIDE** 31 Georgia counties named in Map 1
Fees/Stamps/Entrance	$	$
Transportation expenses (gas, etc.)	$	$
Restaurants/bars	$	$
Groceries	$	$
Fishing equipment and supplies	$	$
Lodging (hotel, campground)	$	$
Guide services	$	$
Souvenirs/Gifts/Apparel	$	$
Entertainment	$	$
Miscellaneous other expenses	$	$

A17. During your last trout fishing **DAY TRIP** in 2011, how much did you personally spend on the following items both INSIDE and OUTSIDE the Georgia counties shown in Map 1?

Items related to your last trout fishing DAY TRIP	Amount spent **WITHIN** 31 Georgia counties named in map 1	Amount spent **OUTSIDE** 31 Georgia counties named in map 1
Fees/Stamps/Entrance	$	$
Transportation expenses (gas, etc.)	$	$
Restaurants/bars	$	$
Groceries	$	$
Fishing equipment and supplies	$	$
Lodging	$	$
Guide services	$	$
Souvenirs/Gifts/Apparel	$	$
Entertainment	$	$
Miscellaneous other expenses	$	$

A18. What gear do you use when trout fishing? *(Check ALL that apply)*

☐ Fly ☐ Bait (worms, corn, etc.) ☐ Lure

A19. Which of the following times do you most prefer to fish? *(Please check ONE)*

☐ Opening day ☐ First three days after stocking

☐ Stocking day ☐ Other (e.g., when I have time, when less crowded)

A20. How important are following to you when selecting a place to trout fish in Georgia? *(Check ONE box per ROW)*

	Not Important ← 1	2	3	4	**Important** → **Very** 5
Catching many trout	☐	☐	☐	☐	☐
Catching trophy trout	☐	☐	☐	☐	☐
Catching native trout	☐	☐	☐	☐	☐
Avoiding crowds	☐	☐	☐	☐	☐
Site accessibility	☐	☐	☐	☐	☐
Familiarity with site	☐	☐	☐	☐	☐
Being with family/friends	☐	☐	☐	☐	☐
Nature and scenery	☐	☐	☐	☐	☐
Short driving distance	☐	☐	☐	☐	☐
Other kinds of recreation nearby	☐	☐	☐	☐	☐

A21. How long have you been trout fishing in Georgia?

_____# years ☐ 1st year (Go to **A23**)

A22. How would you rate the quality of trout fishing in Georgia now compared to when you first began trout fishing here?

☐ Much Worse ☐ Worse ☐ Same ☐ Better ☐ Much Better

A23. If the place you most often trout fish in Georgia is not available on a typical fishing day, what would you do instead? *(Check ONE)*

☐ Go somewhere else in Georgia to trout fish _____ # one-way miles from residence

☐ Go somewhere else in Georgia for another activity _____ # one-way miles from residence

☐ Go out of state to trout fish _____ # one-way miles from residence

☐ Stay home

☐ Go to work

A24. On most days, which would you rather catch? *(Check only ONE)*

☐ 8 trout/9 inches each ☐ 4 trout/12 inches each

☐ 6 trout/10 inches each ☐ 2 trout/16 inches each

Section B: Perspectives about Sport Fishing, Nature and Climate Change

---

NOW, WE WOULD LIKE TO LEARN ABOUT YOUR PERSPECTIVES ON NATURE, AND YOUR UNDERSTANDING OF CLIMATE CHANGE AND ITS POSSIBLE RELATION TO TROUT FISHING.

B1. Please indicate your level of disagreement/agreement with each of the following statements.

	Strongly Disagree ← → Strongly Agree				
	1	2	3	4	5
Nature's primary value is to provide things that are useful to people.	☐	☐	☐	☐	☐
Sport fishing is a valuable food source.	☐	☐	☐	☐	☐
Sport fishing is important for human well-being.	☐	☐	☐	☐	☐
Sport fishing helps develop social ties.	☐	☐	☐	☐	☐
Sport fishing is important for jobs and income.	☐	☐	☐	☐	☐
Sport fish are a valuable part of nature.	☐	☐	☐	☐	☐
Protecting the environment is more important than providing sport fishing opportunities.	☐	☐	☐	☐	☐
Humans have a right to change the natural world to suit their needs.	☐	☐	☐	☐	☐
Fish have as much right as people to exist.	☐	☐	☐	☐	☐
Management should focus on doing what is best for nature instead of what is best for people.	☐	☐	☐	☐	☐

B2. Have you seen or heard that trout in Georgia streams are dying from increased water temperatures?

☐ Seen ☐ Heard ☐ Neither seen nor

B3. Please indicate your level of disagreement/agreement with each of the following statements.

	Strongly Disagree ◄——► Strongly Agree 1	2	3	4	5
Human activity contributes to the increase in greenhouse gases, adding to climate change.	☐	☐	☐	☐	☐
Climate change is primarily natural and humans have little effect.	☐	☐	☐	☐	☐
There is evidence that climate change is occurring and some action should be taken.	☐	☐	☐	☐	☐
We don't know enough about climate change, and more research is necessary.	☐	☐	☐	☐	☐
Concern about climate change is unwarranted.	☐	☐	☐	☐	☐
If we reduce our fossil fuel use now, then climate change will be reduced.	☐	☐	☐	☐	☐

THIS FOLLOWING SECTION FOCUSES ON HOW TROUT ANGLERS PERCEIVE IMPACTS OF CLIMATE CHANGE ON TROUT ANGLING IN GEORGIA.

B4. Please indicate your level of disagreement/agreement with each of the following statements.

	Strongly Disagree ◄——► Strongly Agree 1	2	3	4	5
Rising stream temperature due to climate change is negatively affecting trout habitat in Georgia <u>now</u>.	☐	☐	☐	☐	☐
Rising stream temperature due to climate change will negatively affect trout habitat in Georgia in the <u>future</u>.	☐	☐	☐	☐	☐
Rising stream temperatures will eventually destroy trout fishing in Georgia streams.	☐	☐	☐	☐	☐
Rising stream temperatures will hurt some species of trout in Georgia, but not others.	☐	☐	☐	☐	☐
Trout in Georgia will eventually adapt to higher stream temperatures.	☐	☐	☐	☐	☐
Rising stream temperatures will have minimal impacts on any species of trout in Georgia.	☐	☐	☐	☐	☐
Rising stream temperatures will decrease the streams available for trout stocking in Georgia	☐	☐	☐	☐	☐

B5. If the trout population and your catch rate at the places in Georgia you fish the most were reduced by the following amounts due to rising stream temperatures. How your trips to those places would change.

	My number of trips there probably wouldn't change	I would make somewhat fewer trips there	I would make many fewer trips there	I would stop fishing there completely
10% reduction in trout	☐	☐	☐	☐
25% reduction in trout	☐	☐	☐	☐
50% reduction in trout	☐	☐	☐	☐
75% reduction in trout	☐	☐	☐	☐

B6. If you spent less time trout fishing at the place in Georgia you fish the most, in which of the following activities would you spend more time? *(Check ALL that apply)*

☐ Fishing in other states/countries for trout
☐ Fishing in other streams in Georgia for trout
☐ Fishing in Georgia for saltwater species
☐ Fishing in Georgia for warm water species
☐ Hunting
☐ Bicycling
☐ Camping
☐ Outdoor team sports
☐ Motor boating
☐ Off-road ATV/4-wheeling
☐ Bird/Nature viewing
☐ Indoor activities
☐ Canoeing/Kayaking/Swimming/Sailing
☐ Hiking/Walking/Running
☐ Golf
☐ Target Shooting

B7. Where do you typically obtain your climate information? (*Check ALL that apply*)

☐ AM Talk Radio
☐ The Weather Channel
☐ National Public Radio (NPR)
☐ North Georgia Trout Online
☐ Fox News
☐ Other Internet Fishing Bulletin/Website
☐ ABC/CBS/NBC
☐ Family/Friends
☐ Other cable news (MSNBC, CNN, etc.)
☐ Surfing Internet
☐ Newspapers/Magazines
☐ Trout Unlimited

THE FOLLOWING TWO QUESTIONS LIST ITEMS RELATED TO TROUT MANAGEMENT PROGRAMS, INITIATIVES, AND OTHER ISSUES. IN B8, PLEASE INDICATE HOW IMPORTANT EACH ITEM IS TO YOU, AND IN B9, INDICATE HOW WELL YOU THINK EACH ITEM IS BEING PERFORMED IN GEORGIA.

B8. How important are the following to your trout angling in Georgia?

Trout Fishing	Importance **Not Important** ← → **Very Important** 1	2	3	4	5
Publishing of stocking report/schedule	☐	☐	☐	☐	☐
Reports on water quality/conditions	☐	☐	☐	☐	☐
Mitigation/restoration (riparian zones, headwaters)	☐	☐	☐	☐	☐
Accessibility to streams	☐	☐	☐	☐	☐
Stocking appropriate waters	☐	☐	☐	☐	☐
License pricing	☐	☐	☐	☐	☐
Maintaining wild trout population	☐	☐	☐	☐	☐
Hatchery supported streams	☐	☐	☐	☐	☐
Bait restrictions	☐	☐	☐	☐	☐
Special regulation streams	☐	☐	☐	☐	☐
Scientific research on trout species	☐	☐	☐	☐	☐
Enforcement of fishing regulations	☐	☐	☐	☐	☐
Recruitment of new anglers	☐	☐	☐	☐	☐
Retention of current anglers	☐	☐	☐	☐	☐

B9. How well do you think the following are currently being done in Georgia?

Trout Fishing	Performance **Poor** ← → **Excellent** 1	2	3	4	5
Publishing of stocking report/schedule	☐	☐	☐	☐	☐
Reports on water quality/conditions	☐	☐	☐	☐	☐
Mitigation/restoration (riparian zones, headwaters)	☐	☐	☐	☐	☐
Accessibility to streams	☐	☐	☐	☐	☐
Stocking appropriate waters	☐	☐	☐	☐	☐
License pricing	☐	☐	☐	☐	☐
Maintaining wild trout population	☐	☐	☐	☐	☐
Hatchery supported streams	☐	☐	☐	☐	☐
Bait restrictions	☐	☐	☐	☐	☐
Special regulation streams	☐	☐	☐	☐	☐
Scientific research on trout species	☐	☐	☐	☐	☐
Enforcement of fishing regulations	☐	☐	☐	☐	☐
Recruitment of new anglers	☐	☐	☐	☐	☐
Retention of current anglers	☐	☐	☐	☐	☐

B10. Some factors that could threaten statewide trout habitat are listed below. Please indicate the threat level you believe these factors pose on trout populations in Georgia.

	No Threat ← → Very High Threat **1**	**2**	**3**	**4**	**5**
Disposal of storm water runoff	☐	☐	☐	☐	☐
Fishing pressure (too many anglers)	☐	☐	☐	☐	☐
Illegal fishing practices	☐	☐	☐	☐	☐
Reduction of shoreline vegetation	☐	☐	☐	☐	☐
Rising water temperature	☐	☐	☐	☐	☐
Industrial/residential pollutants	☐	☐	☐	☐	☐
Agricultural runoff	☐	☐	☐	☐	☐
Land development (sprawl)	☐	☐	☐	☐	☐
Forestry practices	☐	☐	☐	☐	☐

Section C: Demographics

These questions will help us to ensure that the people we are surveying are representative of all trout anglers in Georgia. **All answers will be kept strictly confidential.**

C1. What is your age? _____years
C2. What is your gender? _____Male _____Female
C3. Are you of Hispanic, Latino, or Spanish origin? _____Yes _____No
C4. Which of the following category best describes your race/ethnicity? *(Check ALL that apply)*

☐ Caucasian
☐ Asian or Pacific Islander
☐ African American
☐ American Indian
☐ Other

C5. How many people live in your household?

☐ _____# total
☐ _____# under 18years
☐ _____# trout anglers

C6. What is your highest level of education?

☐ High school not completed
☐ High school completed
☐ Some college or technical school
☐ College degree completed
☐ Post Bachelor's education

C7. What is your current employment status? (*Check ALL that apply*)

☐ Full-time job ☐ Part-time job ☐ Unemployed ☐ Student ☐ Retired ☐ Military

C8. Did you vote in the most recent presidential election? _____Yes _____No
C9. Are you a member of any of the following outdoor sporting associations/groups? *(Check ALL that apply.)*

☐ Trout Unlimited
☐ The Sierra Club
☐ Ducks Unlimited
☐ The Wildlife Society
☐ Quail Unlimited
☐ National Rifle Association
☐ North Georgia Trout Online
☐ Other (please specify)

C10. In 2011, in what range was your annual household income from all sources before taxes?

☐ $ 25,000 or less
☐ $ 75,001 to 100,000
☐ $ 25,001 to 50,000
☐ $ 100,001 or more
☐ $ 50,001 to 75, 000

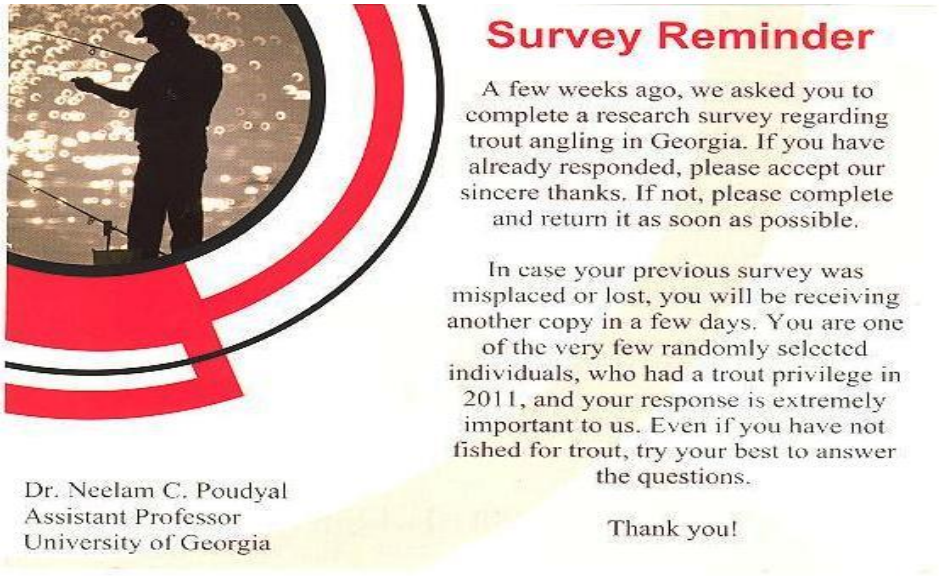
Please use the space provided below for any additional comments.

Thank you for completing this survey. If you have any additional questions, please contact
Dr. Neelam Poudyal – 706.583.8930; npoudyal@warnell.uga.edu
Adrienne Dorison – 954.558.6399; adorison@warnell.uga.edu

Please return this survey in the enclosed postage-paid envelope. If you have misplaced the envelope, please return the survey to:

Dr. Neelam Poudyal
Warnell School of Forestry and Natural Resources
University of Georgia
180 East Green Street
Athens, GA 30602

Additional questions or problems regarding your rights as a study participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 612 Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone (706) 542-3199; E-Mail Address irb@uga.edu



Appendix 2. Follow-up reminder post card

Appendix 3. Correlation matrix of independent variables in concern model

	PROTEC..	USE	SEEN_H.	BELIEF	QUALITY_W..	SPECIAL..	MANY_T..	INFOR..	AGE	GENDER	EDU..	INCOME
PROTECTION	1											
USE	-.082	1										
SEEN_HEARD	.163**	.026	1									
BELIEF_OCCUR	.502**	-.062	.243**	1								
QUALITY_WORSE	.058	-.128*	.144**	.106*	1							
SPECIALIZATION	.017	.050	.116*	.055	.110*	1						
MANY_TROUT	-.051	.240**	-.103*	.013	-.044	-.084	1					
INFORMATION	.117*	-.035	.186**	.080	-.002	.102*	-.148**	1				
AGE	-.114*	-.026	-.116*	-.051	.039	.068	-.153**	-.004	1			
GENDER	.152**	-.062	.033	.127**	.000	-.115*	-.020	.006	-.062	1		
EDUCATION	-.136**	.003	.035	-.046	-.097	-.039	-.079	.167**	.039	-.074	1	
INCOME	-.182**	-.024	-.060	-.102*	-.135**	.032	-.090	.168**	.101*	-.125**	.456**	1

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Appendix 4. Correlation matrix of independent variables in behavioral intention model

	PROTECT..	USE	CONCERN	SPECIAL..	MANY_TR..	Trout subs	NAT_SCEN	AGE	GENDER_	EDU..	INCOME_
PROTECTION	1										
USE	-.082	1									
CONCERN	.386**	.004	1								
SPECIALIZATION	.017	.050	.124*	1							
MANY_TROUT	-.051	.240**	-.029	-.084	1						
TROUT SUBSTITUTE	.105*	-.014	.101*	.279**	-.075	1					
NAT_SCENERY	.189**	.147**	.136**	.051	-.008	.002	1				
AGE	-.114*	-.026	-.056	.068	-.153**	-.002	-.010	1			
GENDER_	.152**	-.062	.033	-.115*	-.020	.093	.052	-.062	1		
EDUCATION	-.136**	.003	.015	-.039	-.079	-.029	.103*	.039	-.074	1	
INCOME_	-.182**	-.024	-.004	.032	-.090	.018	.023	.101*	-.125**	.456**	1

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Appendix 5. Respondents' agreement with climate change and global warming related statements

Belief and attitude	Value orientation segments																				Chi-sq. sig.	Average				
	Protectionist					Pluralist					Distanced					Dominionistic										
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5		1	2	3	4	5
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		%	%	%	%	%
I	6	5	33	15	41	11	11	19	28	31	13	11	35	24	18	36	19	28	10	6	***	15	11	26	22	26
II	35	24	23	9	9	22	25	24	17	11	20	24	34	14	8	8	12	22	26	33	***	21	22	25	17	14
III	4	10	22	28	37	7	14	27	24	28	14	6	38	26	17	32	25	25	14	4	***	12	14	27	24	23
IV	10	6	14	29	41	10	11	24	24	32	1	13	36	25	25	9	6	22	19	44	**	8	10	24	24	34
V	43	20	28	4	5	38	26	23	8	6	25	37	23	7	8	12	21	24	17	27	***	32	25	24	9	10
VI	9	15	37	23	15	14	14	37	21	16	10	19	50	15	6	44	21	23	10	3	***	18	16	36	18	11

Note: Values indicate percentage of respondents of each corresponding segments

I. Human activity contributes to the increase in greenhouse gases, adding to climate change.
II. Climate change is primarily natural and humans have little effect.
III. There is evidence that climate change is occurring and some action should be taken.
IV. We don't know enough about climate change, and more research is necessary.
V. Concern about climate change is unwarranted.
VI. If we reduce our fossil fuel use now, then climate change will be reduced.

Response scale: 1 (Strongly Disagree) – 5 (Strongly Agree)

****Chi-square significance at 1% level, **Chi-square significance at 5% level*

Appendix 6. Respondents' agreement with statements expressing specific belief (concern) about risk of climate change on trout fishing

Concerns	Value orientation segments																				Chi-sq. sig.	Average				
	Protectionist					Pluralist					Distanced					Dominionistic										
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5		1	2	3	4	5
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		%	%	%	%	%
I	4	9	49	21	18	6	11	39	26	17	10	10	46	23	11	19	24	40	9	8	***	9	13	42	22	15
II	3	5	29	30	33	5	7	23	40	26	7	7	34	37	14	16	15	40	16	13	***	7	8	29	34	23
III	3	11	28	35	23	5	13	34	30	18	9	14	43	20	14	23	23	36	7	12	***	8	15	34	25	17
IV	9	17	42	22	10	12	16	45	23	4	7	13	51	21	7	19	20	47	11	3		12	17	46	20	5
V	19	16	42	21	3	17	27	36	17	4	4	26	50	16	4	9	15	45	19	12	***	14	23	41	18	5
VI	33	28	27	9	3	33	30	29	6	2	16	29	43	9	4	17	18	39	17	8	***	27	27	33	9	3
VII	5	8	33	23	32	4	6	30	32	29	3	13	39	30	16	9	17	38	22	13	***	5	9	33	28	24

Note: Values indicate percentage of respondents of each corresponding segments

I. Rising stream temperature due to climate change is negatively affecting trout habitat in Georgia now.
II. Rising stream temperature due to climate change will negatively affect trout habitat in Georgia in the future.
III. Rising stream temperatures will eventually destroy trout fishing in Georgia streams.
IV. Rising stream temperatures will hurt some species of trout in Georgia, but not others.
V. Trout in Georgia will eventually adapt to higher stream temperatures.
VI. Rising stream temperatures will have minimal impacts on any species of trout in Georgia.
VII. Rising stream temperatures will decrease the streams available for trout stocking in Georgia

1= Strongly Disagree, 2= Disagree, 3= Undecided, 4= Agree, and 5= Strongly Agree

****Chi-square significance at 1% level*

Appendix 7. Sources of climate information

Source of climate information (%)	Value orientation segments					
	Protectionist	Pluralist	Distanced	Dominionistic	Sig.	Sample
The Weather Channel	80	70	76	60	**	71
ABC/CBS/NBC	39	33	39	28		34
FOX News	27	27	25	47	***	30
Newspaper/Magazines	20	25	21	32		25
Surfing internet	18	25	14	30	*	23
AM Talk Radio	11	13	15	41	***	18
National Public Radio	20	16	18	14		17
Family/Friends	20	15	15	18		17
Cable news (MSNBC, CNN etc.)	24	15	15	14		17
Fishing bulletins	8	14	10	10		11
North Georgia Trout online	9	10	7	5		9
Trout Unlimited	8	10	8	5		8

*Note: *Chi-square test significance at 10% level, **Chi-square test significance at 5% level, ***Chi-square test significance at 1% level*