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A value orientation approach to assess and compare climate change risk perception among trout anglers in Georgia, USA

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ABSTRACT

Trout in Georgia could experience early impacts from climate change as the streams in the region are located at the southernmost edge of their North American home range. This study surveyed trout anglers in Georgia to understand how anglers perceive the potential impact of climate change on trout, and whether and how their perception and response to declines in trout populations vary among anglers of different value orientations. A multivariate cluster analysis based on anglers' beliefs about protection and use of nature and sport fish yielded four segments, and anglers showed a notable variation in risk perception, as well as behavioral intention to reduce fishing trips to their preferred sites. The "Protectionists", followed by "Pluralists", were relatively more aware of risk and likely to reduce trips to affected fishing sites. The "Distanced" were neither strong believers nor deniers, whereas the "Dominionistic" were the least concerned about climate risk and least likely to change their recreation pursuits with forecast declines in trout populations. Results imply that trout anglers are more concerned about the possible impact of climate change in the future than now. In addition, the differences in social and cultural values may serve as barriers among certain angler groups in perceiving the risk of climate change and adapting to changing resources.

MANAGEMENT IMPLICATIONS

- Trout anglers in Georgia are concerned about the impact of climate change but the level of concern and stated responses to hypothetical changes in trout populations vary across value orientation segments.
- While the anglers are relatively insensitive to small declines in trout populations, sharp reductions due to climate change could mean a drop in visitation rates, resulting in reduced statewide sales of trout stamps, and a shift in type and location of recreation pursuits.
- Agencies may see benefit in climate change education programs to remove social and cultural barriers associated with perception of climate change impact on sport fishing.

1. Introduction

Trout fishing is a popular outdoor recreation activity in Georgia and many other parts of the United States. In Georgia, more than 4000 miles of trout suitable streams and rivers, and a few lakes located in 31 counties provide fishing opportunities for more than 100,000 resident and non-resident anglers (Georgia DNR, 2012). North Georgia is home to three species of trout: Brook trout (*Salvelinus fontinalis*), Brown trout (*Salmo trutta*), and Rainbow trout (*Oncorhyncus mykiss*), of which Brook trout is the only native species. However, trout streams in this region are relatively unproductive due to a high proportion of calcium deficit soils (Georgia DNR, 2012). Of the available trout streams, only 2800

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miles are suitable for reproduction, and only 142 miles is a good habitat for native Brook trout. For this reason, the wild trout population alone are not sufficient to meet the demand for trout fishing in Georgia. In response to the demand, the Wildlife Resources Division of the Georgia Department of Natural Resources (Georgia DNR) and the U.S. Fish & Wildlife Service stock roughly a million catchable-sized trout into North Georgia waters annually (Dallmier, 2010).

In the southern region of the Appalachian Mountains, trout are considered highly vulnerable to the risk of climate change[1] (Ahn, de Steiguer, Palmquist, & Holmes, 2000; Clark, Rose, Levine, & Hargrove, 2001). Trout are very sensitive to increases in temperature and decreases in dissolved oxygen levels. Among the three species of trout, Brook trout is the most sensitive to water temperature (Biagi, 1997; TWRA, 2015), and thus is more vulnerable. In general, trout require water that is less than 22 °C, and a dissolved oxygen level above 6 mg/L. Climate change may affect trout habitat by changing the water levels, increasing the water temperature, decreasing the dissolved oxygen levels, and increasing the toxicity of pollutants (Ficke, Myrick, & Hansen, 2007). Considering the sensitivity of trout to stream temperature and quality of habitat, scientists have predicted that trout populations in the region may decline due to changing climate. For example, Brook and Rainbow trout in the southern Appalachians are predicted to lose up to 24% and 16% of their habitat, respectively, if CO_2 emission level is doubled (Clark et al., 2001). Currently, most streams in Georgia remain cold enough to support trout in the winter months, but only certain mountain streams maintain suitable temperatures during the summer months (Georgia DNR, 2005).

Given that trout in Georgia are maintained more by stocking than natural growth, the initial increase in temperature and associated changes in habitat quality may not create a significant and visible impact. However, beyond a certain threshold, anglers may experience declining catch rates. For example, McMichael and Kaya (1991) found that the percentage of anglers catching no trout increased to 50% or more when water temperature increased to above 19 °C in the lower section of the Madison River in Montana. In put-and-take fisheries, fish growth is not an issue as harvesting quickly follows stocking. However, proportions of harvest and natural mortality of the stocked fish as well as the quality of habitat are fundamental factors to consider in stocking management. A high rate (up to 90%) of natural mortality of stocked trout has been reported in the lower section of the Chattahoochee River in Georgia (Klein, 2003). Thus, a significant increase in temperature and associated change in habitat quality as a result of climate change could make many streams in the lower reaches of North Georgia unsuitable or infeasible for stocking. Reduction in habitat and stockable streams due to changing climate could lead to an increase in the number of anglers per unit area and a decline in trout populations and in catch rates. Such changes may prompt anglers to travel farther in search of suitable fishing sites or fish less frequently. Either case could lead to trip dissatisfaction and/or could induce a gradual decline in trout fishing participation (Responsive Management, 2009).

The general literature on the human dimensions of climate change indicates significant knowledge gaps and misunderstanding about the causes and consequences of climate change among the general public (Heeren, 2012; Leiserowitz, Smith, & Marlon, 2010). Yet, it would be important for managers to know how much anglers themselves perceive the risk of climate change, and whether and how their perceptions vary across the population. Information about anglers' perceptions of risk and potential behavioral responses (e.g., adjustments in recreational pursuits) can be useful in understanding resource management and outreach needs.

By now it is well known that recreation user groups such as anglers differ in their attitudes, behavior, and skills when pursuing their recreation goals (Needham, Vaske, Donnelly, & Manfredo, 2007). Such inherent heterogeneity in the user community could pose additional challenges for planning and implementation of resource management and outreach programs in response to the impacts of climate change. Thus, understanding whether and how knowledge and attitudes vary among different angler groups becomes an important question. While a number of different criteria such as specialization (Chipman & Helfrich, 1988; Fisher, 1997; Hutt & Bettoli, 2007), catch orientation (Kyle, Norman, Jodice, Graefe, & Marsinko, 2007), membership in fishing organizations (Gigliotti & Peyton, 1993), and rural/urban setting (Arlinghaus, Bork, & Fladung, 2008; Hubert & Gipson, 1996) have been used to segment recreationists, little is known about the heterogeneity of recreationists who pursue a specific natural resource such as trout. Moreover, the literature is void about how recreation-resources related value orientations are associated with perception of, and response to, the risk of climate change. This study attempts to fill this knowledge gap by surveying Georgia trout anglers to assess and compare their perception and concern about the risk of climate change on trout and their potential responses to a possible climate change-induced decline in trout populations and catch rates. By doing so, the study investigates whether the perception of risk and potential adjustment in fishing trips vary among value orientation segments of trout anglers. Given the fact that the Appalachian Mountains of Georgia constitute the edge of the natural range of trout, pursuing these research questions in this state seems to be very appropriate.

2. Conceptual background and review of literature

2.1. Theory of cognitive hierarchy

The Cognitive Hierarchy Model of Human Behavior has been a popular theoretical framework for studying attitude, risk perception, and behavioral intention (Fulton, Manfredo, & Lipscomb, 1996; Vaske & Donnelly, 1999). According to this model, values, beliefs, attitudes, and norms are collectively referred to as cognition, the mental processes and dispositions which people use in thinking and understanding situations (Vaske & Manfredo, 2012). Values are commonly defined as one's desirable end state, i.e., modes of conduct, or qualities of life that a person holds dear, such as equality (Rokeach, 1973). Values, albeit in lower order of cognition and few in number, are central in belief, and therefore slow to change. Whereas, attitudes and behaviors, being in higher order of cognition, are high in number, 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 (e.g., attitude) may be changed as a result of social, psychological, and economic factors (Manfredo, Teel, & Bright, 2003; McFarlane & Boxall, 2000).

Even though the study of values has become common in the human dimensions of wildlife and recreation literature, values account for limited variability within a given culture, and thus are 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

[1] Climate change refers to "any change in climate over time, whether due to natural variability or as a result of human activity" (IPCC, 2007, p. 871). Throughout this article we use the term "climate change," as it is a "more scientifically correct term" (Lorenzoni & Pidgeon, 2006, p. 75), except when referring to other studies that have specifically used the term "global warming" in the climate change risk perception literature.

intensity of basic beliefs, and are more powerful in accounting for variations in people's perception/attitudes, norms, and behavior (Vaske & Donnelly, 1999; Whittaker, Vaske, & Manfredo, 2006). Common value orientation continua defined in studies of wildlife values 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) have suggested that the protection-use and biocentric-anthropocentric value orientation continua are conceptually similar. The protection and use orientations are not mutually exclusive, and thus can be arrayed along a continuum. 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). Based on this theoretical notion, several studies have grouped users by their value orientations toward natural resources in recreation and tourism settings. For example, Bruskotter and Fulton (2008) found three value orientations for anglers (utilitarianism, dominance, and protectionism) and examined the relationship between value orientations and norms related to stewardship of aquatic resources and the use of technological aids to angling. Similarly, Needham (2010) identified three segments of users based on value orientations in a recreation setting related to coral reefs. Likewise, McFarlane (2005) operationalized two types of value orientations, biocentric and anthropocentric, and found value orientation as a strong predictor of perception of environmental risk. McFarlane's finding suggested that people with a biocentric value orientation perceived the risk of natural hazards to forest diversity as higher than their anthropocentric counterparts. Similar measures of environmental values and value orientations have been used to understand perceptions and behavior related to environmental risks, such as climate change, wildfire, and nuclear radiation (McFarlane, 2005; O'Connor, Bord, & Fisher, 1999; Slimak & Dietz, 2006; Stern, Dietz, & Kalof, 1993).

2.2. Public perceptions of climate change risk

Recent research on public perceptions of and concerns about climate change shows that a majority of Americans are somewhat aware of the occurrence of global warming, but most of them are not sure about its cause (Leiserowitz et al., 2010). The same study also showed that only eight percent of Americans have climate change knowledge equivalent to A or B grades; whereas 40% have knowledge of C or D grade, and the remaining 52% possess knowledge equivalent to F grade. The grades were measured based on the correct responses to 81 climate change related questions and scores 90% and above was graded as A, 80–89% as B, 70–79% as C, 60–69% as D, and 59% and below as F. A study of Minnesota residents reported that about 70% of the respondents were at least somewhat sure about the occurrence of climate change (Heeren, 2012). In general, the public perceives climate change as a moderate risk, but does not perceive it as 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 such as the polar ice caps (Leiserowitz, 2005; Lorenzoni & Pidgeon, 2006).

Some studies have attempted to compare population segments in terms of their knowledge of climate change and risk perception. For example, Lazo, Kinnell, and Fisher (2000) compared the perceptions of environmental risks (climate change and non-climate change) between experts and lay persons in Pennsylvania. Both laypersons and ecologists perceive the risk of climate change on the ecosystem as less avoidable than the other risks. Compared to laypersons, however, the ecologists perceived risk of climate change as more acceptable, less understandable, and less controllable than the other risks (Lazo et al., 2000). Similarly, Leiserowitz, Maibach, Roser-Renouf, Feinberg, and Howe (2013) and Maibach, Roser-Renouf, and Leiserowitz (2009) analyzed the American public's perception of climate change by segmenting them into six groups: Alarmed, Concerned, Cautious, Disengaged, Doubtful, and Dismissive. The segments differed 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 extreme among the six groups, were fully convinced about the reality and seriousness of climate change and were supportive of taking appropriate action, whereas the Dismissive were extremely dismissive of climate change concerns and were strong opponents of national initiatives to mitigate climate change.

Studies have also found a strong association between risk perception and behavioral intentions related to the risk of climate change (Hidalgo & Pisano, 2010; O'Connor et al., 1999). For example, non-believers of climate change were less likely than the believers to support management actions aimed toward adaptation and mitigation (Heeren, 2012). By the same token, knowledge of the climate change impact and perceived risk to the resource of interest could influence recreational behavior of some natural resource user groups such as trout anglers (Huebner, 2012). In an effort to assess whether and how anglers perceived climate change risk and respond to the impact of climate change on trout fishing, and to understand whether the perception of risk varies by type of values they hold, this study adopted the above-discussed theoretical framework to test the following hypotheses:

1. Trout anglers are aware of and concerned about the potential impact of climate change on trout fishing.
2. The perception of climate change risk varies among value orientation subgroups.
3. The level of concern over risk of climate change will be higher among subgroups of stronger protection orientation compared to their use value counterparts.
4. Subgroups with higher levels of concern about the risk of climate change are more likely to express willingness to reduce fishing trips to affected sites.

3. Methods

3.1. Trout anglers survey

Data were collected using a mixed-mode survey of resident and non-resident trout stamp holders in Georgia. As anglers need a permit to legally fish for trout, trout stamp holders serve as a legitimate sampling frame to contact trout anglers. Contact information for individuals with valid permits to fish trout in 2011 was obtained from the license database at Georgia DNR. Georgia DNR issued 18 different types of licenses to 313,693 anglers, so a computer-assisted stratified random sample was drawn to select 3000 license holders representative of all license types. Sample allocations across license categories were originally determined based on size of each category but some adjustment was made to ensure representation of less represented classes (e.g. non-residents). Following a method modified from Dillman, Smyth, and Christian (2009), survey packets (including a personalized cover letter, a nine-page questionnaire, and a postage-paid business reply envelope) were mailed to the selected anglers. After the initial mail-out, a reminder postcard was sent to those who did not respond. Finally, another personalized letter was sent along with a copy of the survey to each non-responding angler to encourage

Table 1
Reliability analysis of value orientations statements.

Statements[a,b]	Skewness	Kurtosis	Item total correlation	Cronbach's alpha
Use orientation				0.71
1. Sport fishing is a valuable food source.	0.04	−1.04	0.41	
2. Sport fishing is important for human well-being.	−0.62	−0.20	0.51	
3. Sport fishing helps develop social ties.	−0.59	−0.30	0.61	
4. Sport fishing is important for jobs and income.	−0.52	−0.55	0.50	
Protection orientation				0.75
5. Protecting the environment is more important than providing sport fishing opportunities.	−0.43	−0.62	0.54	
6. Fish have as much right as people to exist.	−0.07	−1.28	0.55	
7. Management should focus on doing what is best for nature instead of what is best for people.	−0.20	−0.72	0.65	

[a] Items measured on a scale of 1 (strongly disagree) to 5 (strongly agree).
[b] The following items were removed from the analysis as they did not meet the recommended criteria of skewness or item total correlation or both: Nature's primary value is to provide things that are useful to people (use orientation); humans have a right to change the natural world to suit their needs (protection orientation [reverse coded]); sport fish are a valuable part of nature (protection orientation).

participation. Non-respondents with email addresses in the license database (769, or 36.9% of the non-respondents) were sent an email and invited to complete an online version of the survey created with an online survey tool (surveymonkey.com).

Out of an initial mailing to 3000 anglers, 438 were undeliverable (384 by mail and 76 by email). Among those who received our survey, 533 anglers responded by mail and 94 anglers responded by email, yielding an adjusted response rate of 24%. A 20% response rate was reported in a similar survey of anglers undertaken in another southern state of the U.S. (Kyle et al., 2007). The low response rate in our study may partly be attributable to the fact that not all license holders utilize the trout stamp which is automatically available with the popular sportsman license, either purchased or honorary (military and seniors over 65). Among the 627 returned surveys, 162 were not included in the final analysis because they either did not provide complete information necessary for this study or were considered non-trout anglers. Thus, the final sample of trout anglers included 465 respondents.

3.2. Measurement

The survey included questions about the respondent's trout fishing experience in Georgia, statements regarding sport fishing values, perceived impact of climate change, willingness to adjust trip frequencies in sites affected by climate change (hypothetical scenario), and demographics. Six statements about sport fishing values measured use orientation, while four other statements measured protection orientation (Table 1). These statements were adapted from the existing literature (Bruskotter & Fulton, 2008; Vaske & Donnelly, 1999; Vaske et al., 2001), and in some cases modified to fit our research question and study area context. Similarly, six other questions (Table 2) were used to assess trout anglers' general beliefs about the occurrence of climate change. Finally, another six specific belief statements were used to assess trout anglers' concern about the risk of climate change on Georgia trout (Table 5).

Environmental concern is defined as a perception of risk that an individual attaches to an environmental problem (Slovic, 1987). In the context of farmers' perception about risk of climate change, Arbuckle, Morton, & Hobbs (2013) operationalize concern as "apprehension about the potential negative impacts of climate change." Among different components of environmental concern (e.g., affective, conative), an affective component includes beliefs or attitudes, expressed as awareness or evaluation of seriousness, toward environmental problems (Schaffrin, 2011). Thus, for this context, we have operationalized concern as trout anglers' beliefs or perception about the specific risk of climate change on trout. In a separate question, to assess how trout anglers respond to the risk of climate change, respondents were provided with four hypothetical scenarios of climate change-induced decline in trout populations (10%, 25%, 50%, and 75%) at their most popular trout fishing site, and asked to indicate if and how they would change

Table 2
Respondents' general beliefs about climate change.

Statements	% Of respondents				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Human activity contributes to the increase in GHGs, adding to CC	14.9	11.4	25.8	21.9	26.0
CC is primarily natural and humans have little effect	21.5	22.2	25.2	16.8	14.3
There is evidence that CC is occurring and some action should be taken	12.1	13.8	27.3	23.5	23.3
We don't know enough about CC, and more research is necessary	8.4	9.6	23.8	24.0	34.3
Concern about CC is unwarranted	32.1	25.5	23.8	8.7	9.9
If we reduce our fossil fuel use now, then CC will be reduced	17.8	16.1	36.4	18.2	11.4

GHGs: greenhouse gases; CC: climate change.

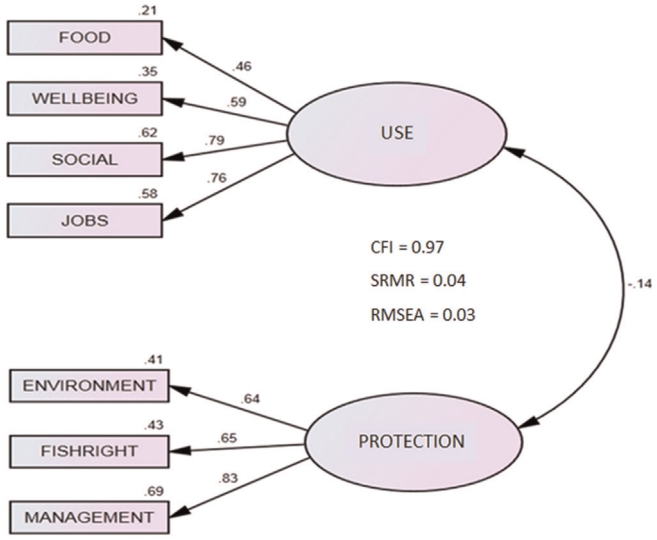

Fig. 1. Factor loadings and model indices showing construct validity of protection and use factors from confirmatory factor analysis.

their fishing trips under each scenario (Appendix A). This set of hypothetical questions was expected to measure how trout anglers would respond (in terms of adjustment in trip frequency) at the time they realize or experience a decline in trout population or catch rate by *X*% at their most popular site. This method of soliciting respondent's intention under hypothetical alternatives is similar to the question previously used by Poudyal, Siry and Bowker (2011)

3.3. Analysis

Most of the statements measuring value orientation were adopted from the existing literature as measures of either protection or use orientation. However, it is essential to examine whether the measure is valid for the population considered in this study (Harrington, 2008). Thus, a confirmatory factor analysis (CFA) was conducted using the AMOS 21 version of SPSS software to test whether the items used to measure value orientations fit well into the expected two latent dimensions of protection and use orientations (Needham, 2010; Vaske, 2008). An assumption in CFA is multivariate normality of the items (statements). So, to be included in the CFA, preference was placed on items with a skewness index between 1 and −1 and a kurtosis index between 2 and −2 (Noar, 2003). Similarly, following Leong & Austin (2006) and Vaske (2008), only items having a total item correlation of ≥0.4 were considered. In addition, Cronbach's alpha was estimated to test the reliability of the items (Cronbach & Shavelson, 2004). An alpha coefficient ≥0.7 indicates acceptable internal consistency among the items to be reliable for measuring respective orientations (George & Mallery, 2003). Three items were removed based on the results from CFA as they did not meet the recommended criteria. The remaining seven items meeting the above mentioned criteria with an acceptable level of Cronbach's alpha are shown in Table 1. Factor loadings of variables and model fit indices were used to evaluate the results of the CFA. Following suggestions of Hu and Bentler (1999) and Kline (2005), comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) criteria were considered in order to select the best fitting model. Values of the CFI ≥ 0.95, RMSEA ≤0.06, and SRMR ≤0.08 suggest the acceptable threshold values for the best fitting models.

3.4. Segmentation

A multivariate clustering technique was applied to segment the sample based on protection–use value orientations. There is no standard rule about the selection of a clustering procedure and clustering algorithms available in different statistical software to identify clusters with certain characteristics. However, it is necessary to identify the algorithm[2] that best fits the data to generate not only statistically valid clusters, but also practical and intuitively meaningful subgroups of subjects (i.e., trout anglers). The clustering process in our analysis began with estimating K-means clustering for $K=2$, 3, 4, and 5 and comparing results to cluster solutions obtained from Ward's clustering algorithms based on the mean score of each variable by clusters. Finally, a four cluster solution from Ward's method was chosen as a final solution as the intuitive interpretation of results from this method provided the most distinct and meaningful subgroups. Meaningfulness of the subgroups was examined by comparing the characteristics of different value orientation subgroups as suggested by the existing value orientations and angler segmentation literatures (Eriksson, 2012; Holland & Ditton, 1992; Kyle et al., 2007). Once the value orientation subgroups were identified, appropriate statistical tests including a Chi-square

[2] 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, Knuth, & Brown, 2001; Fisher, 1997; Kyle et al., 2007). Ward's minimum variance method is based on a least-square criterion, 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, this technique has a few drawbacks. 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, including the present one. Second, this algorithm is effective for large datasets with continuous variables, but its efficiency is poor when variables are categorical (Huang, 1998). In spite of these drawbacks, the K-means algorithm has been widely used in value orientation segmentation studies (Needham, 2010; Vaske, Jacobs, & Sijtsma, 2011).

Table 3
Average response scores on value orientation statements by final cluster solution.

Statements[#]	Sample average	Value orientation subgroups				Levene statistic (Sig.)	ANOVA F/ Welch	η^2
		Protectionist	Pluralist	Distanced	Dominionistic			
Sport fishing is a valuable food source	3.04	2.84[a]	3.21[a,b]	2.18[c]	3.58[b]	1.65 (0.18)	19.40***	0.12
Sport fishing is important for human well-being	3.69	3.14[a]	4.23[b]	2.43[c]	4.00[b]	7.52 (<0.01)	92.88***	0.41
Sport fishing helps develop social ties	3.77	3.62[a]	4.20[b]	2.46[c]	4.00[b]	4.04 (0.01)	91.73***	0.37
Sport fishing is important for jobs and income	3.50	2.76[a]	4.03[b]	2.44[a]	3.87[b]	7.18 (<0.01)	61.49***	0.31
Protecting the environment is more important than providing sport fishing opportunities	3.59	4.35[a]	3.83[b]	3.58[b]	2.19[c]	2.73 (0.04)	83.70***	0.35
Fish have as much right as people to exist	3.12	4.62[a]	3.26[b]	2.94[b]	1.37[c]	16.99 (<0.01)	292.56***	0.48
Management should focus on doing what is best for nature instead of what is best for people	3.33	4.30[a]	3.52[b]	3.07[c]	2.13[d]	5.68 (<0.01)	82.16***	0.33

[#] Items measured on a scale of 1 (strongly disagree) to 5 (strongly agree).
*** Indicates the difference among subgroups was significant at the 1% level.
[abcd] Means followed by the same letter are not statistically significant at the 5% level (Tukey's Post Hoc test for equal variances and Dunnett's C test for unequal variances).

Table 4
Demographic characteristics of respondents by value orientation subgroups.

Variables	Sample average	Value orientation subgroups				ANOVA/Chi-square[a]	η^2/Cramer's V
		Protectionist	Pluralist	Distanced	Dominionistic		
Age (years)	50.4	46.7	51.4	50.5	51.4	2.7**	0.02
Fishing experience (years)	18.4	14.1	19.8	19.2	18.4	2.6**	0.02
Gender (female) %	14.0	30	10	15	6	24.2***	0.24
Education (%)						28.2***	0.15
High school not completed	3.1	9.1	2.1	1.4	1.3		
High school completed	14.1	15.6	11.5	22.2	11.5		
Some college or technical school	31.6	31.2	32.5	38.9	23.1		
College degree	29.7	27.3	283	22.2	42.3		
Post bachelor's degree	21.5	16.9	25.7	15.3	21.8		
Income (%)						12.9**	0.13
$50,000 or less	27.5	38.7	26.4	28.4	18.1		
$50,001–100,000	43.7	37.3	43.4	52.2	43.1		
$100,001 or more	28.8	24.0	30.2	19.4	38.9		

*** & ** Indicate the difference among subgroups significant at 1% and 5% respectively.
[a] ANOVA test (F-statistic) for age and fishing experience and Chi-square test statistic for gender, education, and income.

test of significance and Analysis of Variance (ANOVA) were employed to examine the group differences. A Levene's statistic was used to test for the assumption of equal variance in ANOVA and a Tukey's Post Hoc was used as a multiple comparison test. When the assumption of equal variance was violated, a Welch statistic (as a substitute for an F-statistic) and a Dunnett's C (as a substitute for Tukey's Post Hoc) were used. Effect size was examined using an eta-square (η^2) in ANOVA and Cramer's V (CV) in a Chi-square test. Following Cohen (1988), small (η^2=0.01, CV=0.10), medium (η^2=0.06, CV=0.30), and large (η^2=0.14, CV=0.50) levels were used to interpret the effect sizes.

4. Results

4.1. Sample characteristics

In terms of demographics and fishing characteristics, half of the respondents were 45–65 years old (average age was 50.4 years), 86.0% were male, and 96.4% were Caucasian. Only 3.1% did not complete high school, whereas 51.2% attained at least a college degree. The majorities in the sample (64.3%) were full time job holders and another 25.4% were retirees; 72.5% reported an annual household income of at least $50,000 in 2011. The average fishing experience of the sample was 18.4 years, with an average of 5.3 fishing trips in 2011, and 73.8% reported having fished in Georgia in 2011. Almost all (95.9%) indicated fishing for Rainbow trout, whereas 56.0% indicated fishing for Brook trout.

4.2. Beliefs about the occurrence of climate change

Respondents expressed mixed opinions about climate change (Table 2). The percentage of respondents who expressed agreement with the idea of human-induced climate change, however, was higher than those who expressed skepticism. Close to half of the respondents agreed or strongly agreed with the occurrence of climate change (46.8%) and the human contribution to the increase in greenhouse gases (47.9%). Alternatively, 31.1% of the respondents agreed or strongly agreed that climate change is natural and humans have little effect, and 18.6% agreed or strongly agreed that concern about climate change is unwarranted. More than half (58.3%) of the respondents agreed or strongly agreed that we don't know enough about climate change and more research is necessary, and 29.6% agreed or strongly agreed that reducing the use of fossil fuels now, will reduce climate change.

4.3. Value orientations segmentation and characteristics of subgroups

A confirmatory factor analysis (Fig. 1) shows that the data

Table 5
Average response scores of concerns about risk of climate change on trout fishing in Georgia.

Statements*	Sample average	Value orientation subgroups				Levene statistic (Sig)	ANOVA F/ Welch	η^2
		Protectionist	Pluralist	Distanced	Dominionistic			
Rising stream temperature due to climate change is negatively affecting trout habitat in Georgia now	3.21	3.40[a]	3.38[a]	3.16[a]	2.64[b]	0.59 (0.62)	9.34***	0.06
Rising stream temperature due to climate change will negatively affect trout habitat in Georgia in the future	3.59	3.86[a]	3.76[a]	3.44[b]	2.96[c]	0.28 (0.84)	12.28***	0.08
Rising stream temperatures will eventually destroy trout fishing in Georgia streams	3.29	3.65[a]	3.45[ab]	3.17[b]	2.63[c]	1.11 (0.35)	13.24***	0.09
Trout in Georgia will eventually adapt to higher stream temperatures	2.77	2.71[ab]	2.63[a]	2.90[ab]	3.09[b]	3.49 (0.02)	3.79***	0.03
Rising stream temperatures will have minimal impacts on any species of trout in Georgia	2.34	2.19[a]	2.13[a]	2.57[b]	2.80[b]	0.69 (0.56)	9.31***	0.06
Rising stream temperatures will decrease the streams available for trout stocking in Georgia	3.58	3.68[a]	3.77[a]	3.43[b]	3.13[c]	0.92 (0.43)	7.21***	0.05

* Items measured on a scale of 1 (strongly disagree) to 5 (strongly agree).
*** indicates the difference among subgroups is significant at 1% level.
[abcd] Means followed by the same letter are not statistically significant at the 5% level (Tukey's Post Hoc test for equal variances and Dunnett's C test for unequal variances).

provided an acceptable model fit and seven items supported the construct validity of protection and use value orientations with a CFI=0.97, SRMR=0.04, and RMSEA=0.03. The variance explained by the first factor (Use) was the highest for the variable SOCIAL (62%), whereas variance explained by the second factor (Protection) was highest for the variable MANAGEMENT (69%).

A cluster analysis yielded four subgroups of respondents. An ANOVA test and a post hoc test showed that subgroups of respondents were significantly different in terms of their value orientations with large effect sizes ($\eta^2 \geq 0.14$) in most statements.

Protectionist: The first subgroup included 18% of the respondents. Respondents in this group showed higher agreement than the average with statements expressing strict protection, and lower agreement with statements expressing use orientation (Table 3). For example, they strongly agreed with the statement that fish have an equal right to exist, and protection and management of natural resources is more important than providing sport fishing opportunities to humans. Although their agreement with the statement expressing utilitarian values 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 and Fulton (2008), this subgroup was named "Protectionist." This subgroup included younger and less experienced respondents, a higher proportion of females, and respondents having lower education and income than the other subgroups (Table 4).

Pluralist: the second subgroup included 47% of the respondents. Members of this group agreed with the statements expressing utilitarian values of sport fish for food, jobs and income, social ties, and human well-being (Table 3). Similarly, they also agreed with the statements expressing the equal right of fish to exist and the importance of protection and management of natural resources over providing sport fishing opportunities to human. As respondents in this group showed both strong protection orientation and strong use orientation, this subgroup was named "Pluralist," which is consistent with the nomenclature used in a previous study in wildlife value orientations (Teel et al., 2005). The Pluralist subgroup included well-educated respondents (many with post bachelor's degree), mainly males, elders, and experienced trout anglers (Table 4).

Distanced: The third subgroup included 17% of the respondents, being similar in size to the Protectionist subgroup. In general, respondents in this subgroup expressed disagreement or were neutral with the statements expressing both protection and use orientations (Table 3). For example, they showed relative disagreement with the statement expressing utilitarian values of sport fish for food and human well-being, but did not show strong agreement with the statement expressing the equal right of fish to exist. Following Teel et al. (2005) the term "Distanced" seems to be appropriate for this subgroup that showed neither a mutualism nor a utilitarian orientation toward wildlife. Like the Protectionists, Distanced respondents reported lower education and income levels than the other two subgroups (Table 4).

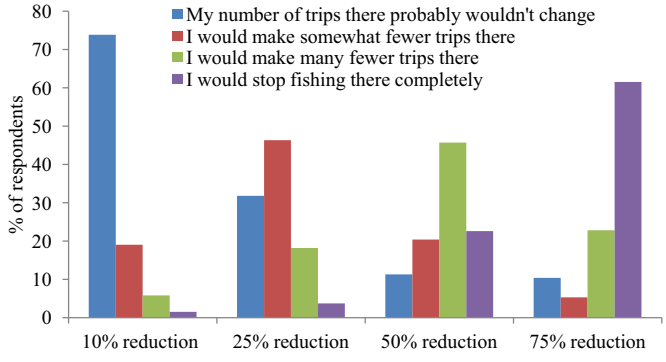

Fig. 2. Respondents' willingness to adjust fishing trips to their most popular trout fishing sites given four hypothetical scenarios of reduction in trout populations and catch rates.

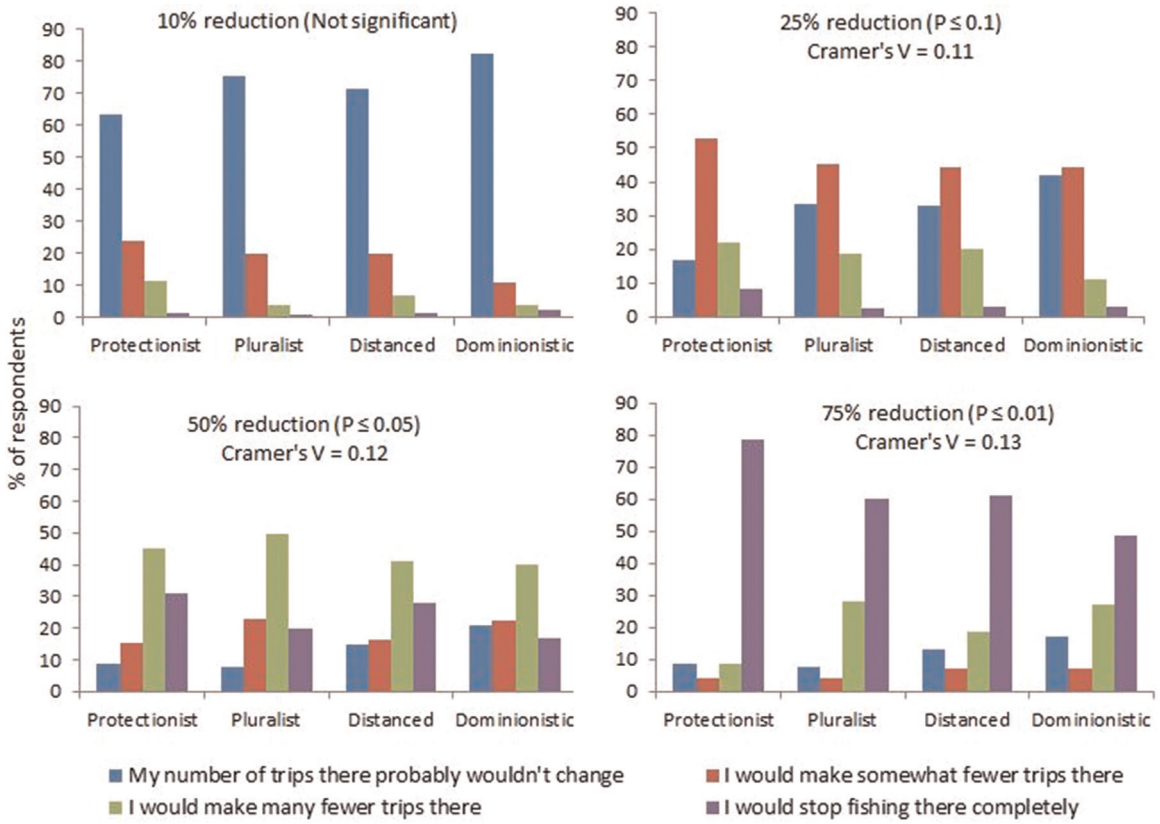

Fig. 3. Value orientation segments-based comparison of reported potential adjustment in trip frequencies given hypothetical scenarios of reduction in trout populations and catch rates at popular fishing sites. Content in parenthesis indicate chi-square test significance of group difference.

Dominionistic: This subgroup included 18% of the respondents, being of similar size to Distanced and Protectionists. Compared to other subgroups, they showed a relatively high level of agreement with the statements expressing strict utilitarian views and disagreement with the statements expressing strict protection. For example, they agree strongly with the statement that fish are a valuable source of food; sport fishing helps develop social ties; sport fishing is important for human well-being; and, sport fishing is important for jobs and income. On the other hand, they showed strong disagreement with the equal rights of fish to exist; and disagreement with the idea that protection and management of natural resources should supersede sport fishing opportunities. Borrowing from Bruskotter and Fulton (2008), this group was named "Dominionistic." The term 'Dominionistic' was used by Kellert (1994) to define a wildlife value orientation that emphasized "mastery and control over wildlife." Compared to the other groups, the Dominionistic subgroup included a higher proportion of male and older respondents, and also respondents with higher education and income (Table 4).

4.4. Concerns about climate change risk

In general, respondents were somewhat concerned about the risk of climate change on trout fishing (Table 5). For example, they expressed high levels of agreement with the statements that climate change has an impact on trout habitat (both now and in future), and climate change limits the area available for stocking trout. Also, they indicated relative disagreement that such an impact will be minimal on any species of trout; and that trout will eventually adapt to rising stream temperatures. Respondents were more concerned about the future impact of climate change than about current impact. For example, a paired *t*-test showed an average agreement with the statement "rising stream temperature due to climate change will negatively affect trout habitat in Georgia in the future" (mean=3.6) that was significantly higher, t (419)=9.03, $p<0.001$, $\eta^2=0.16$, than the average agreement with the statement "rising stream temperature due to climate change is negatively affecting trout habitat in Georgia now" (mean=3.2). Slightly more than half of the respondents (56.6%) were concerned about the future impacts of climate change on trout habitat, whereas only 36.4% were concerned about the current impacts.

Table 5 also compares the value orientation segments with respect to their perception of climate change risk and impact on trout and trout fishing opportunities in Georgia. Respondents in the Protectionist and Pluralist subgroups expressed significantly higher concern than those in the other subgroups. On the other hand, the respondents in the Dominionistic subgroup expressed the least concern over statements regarding climate change risk. The η^2 value for group differences in the six concern statements ranged from 0.03 to 0.09, indicating small to medium effect size. As mentioned earlier, the Protectionist and Pluralist subgroups expressed higher protection orientations than the Distanced and Dominionistic subgroups. This supported our second hypothesis that subgroup(s) with strong protection value orientation is (are) more concerned about risk of climate change than their use value orientations counterparts.

4.5. Potential responses to the risk of climate change

When asked whether and how they would adjust trip frequencies to their most popular fishing sites in Georgia if the sites experienced trout population declines due to climate change

(hypothetical scenarios), respondents reported different levels of potential adjustment depending on the level of impact (Fig. 2). In general, the percentage of respondents who reported not changing their fishing trips significantly declined with expected reductions in trout populations and reduced catch rates. On the other hand, the percentage of respondents who indicated completely stopping fishing at their most popular sites increased from a mere 1.5% in the 10% reduction scenario to 61.5% in the 75% reduction scenario. However, at least 10.4% of respondents indicated that they would not change their fishing trips under any of the reduced population and reduced catch rate scenarios (Fig. 2).

Across the value orientation segments, the stated adjustment in trip frequency to affected fishing sites increased with the reductions in trout populations. Subgroups, however, indicated significantly different potential responses under all but 10% reduction scenario (Fig. 3). Although the effect size was small (Cramer's $V \leq 0.13$), the proportion of respondents who reported reducing or stopping fishing trips in response to trout declines was highest in the Protectionist subgroup and lowest in the Dominionistic subgroup. Respondents in Pluralist and Distanced subgroups were very similar in terms of their stated willingness to reduce fishing trips across reduction scenarios. For example, for the 75% trout decline scenario, 78.6% of Protectionist indicated stopping fishing at their most popular fishing sites, whereas 60.2% of Pluralist and 60.9% of Distanced, and only 48.6% of Dominionistic respondents reported the same. As mentioned earlier, Protectionist and Pluralist subgroups expressed higher concerns, while the Dominionistic subgroup expressed the least concern about risk of climate change. Although, the respondents in the Pluralist subgroup expressed almost the same level of concern as the Protectionists, their reported willingness to reduce fishing trips to affected sites was lower than that of the Protectionists. While our question about the contingent adjustment in trip is admittedly more complicated that a typical contingent valuation question, the differences in the pattern of responses between four value segments are striking.

5. Discussion and conclusion

Results from this study revealed four value orientation-based segments of trout anglers in Georgia along a protection-use continuum. With a few exceptions, demographic variations among value orientations segments were consistent with findings of previous studies. For example, consistent with Bruskotter (2007) and Manfredo et al. (2003), females and users with lower income were more likely to be protection oriented. Similarly, highly educated anglers were found to have more of a dominance orientation (Bruskotter, 2007). Some value orientation studies in the context of National Forests management, however, have found more educated people to take a more protectionist orientation (Manfredo et al., 2003; Vaske et al., 2001). This disparity may come from the different context. Trout fishing, particularly in Georgia, is mostly a consumptive recreation activity, whereas hiking or bird watching are a non-consumptive recreation activities. Thus, it is likely that educated people value sport fish and other natural resources (e.g., forest ecosystems) differently.

According to our sample, about half of the trout anglers in Georgia held a Pluralist value orientation, and the remaining half were divided equally among Protectionist, Distanced, and Dominionistic value orientation subgroups. A similar 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 the sizes of subgroups differed, characteristics of anglers holding protection and dominance value orientations in our study were very similar to those found in the Minnesota study. Another study in South Dakota by Gigliotti (2012) found 55% of anglers held a Utilitarian orientation, 12% held a Mutualist orientation, 24% held a pluralist orientation, and 9% held a Distanced orientation. Although, relative sizes of segments differed, characteristics of Pluralist and Distanced sub-groups were very similar to our results. Some differences in the proportions of value orientation segments between our study and the Minnesota and South Dakota studies may be attributable to the fact that these three studies were conducted in different regions with significant differences in underlying social and cultural characteristics.

Findings regarding trout anglers' beliefs and concerns about the occurrence and risk of climate change were consistent with results from other studies that assessed similar opinions of the general public. For example, a recent public survey by Leiserowitz et al. (2010) also found that about half of Americans believed that global warming is happening and is mostly caused by human activities, while about 35% believed that global warming is caused mostly by nature. Of note, about half of the trout anglers in our study agreed that climate change is happening and human activities are mainly responsible for it, whereas about 30% considered it to be a natural phenomenon with little effect from humans. However, Heeren (2012) found as high as 70% of Minnesota residents agree that climate change is occurring. Part of this difference could be due to the unique sociocultural characteristics of our study area compared to Minnesota.

Georgia trout anglers surveyed in our study expressed a higher level of concern about climate change risk when asked about its specific impact on trout in Georgia, compared to their general beliefs regarding climate change. That is, when the question was specific in terms of the area (Georgia), and resource (trout), more anglers showed concern, indicating the importance of specificity in assessment of risk perception. A study of forest owners in Oregon has also suggested that people will show concern/apprehensions about controversial issues such as climate change when they can relate the risk with their own situation (Grotta, Creighton, Schnepf, & Kantor, 2013).

Respondents were more concerned about risk of climate change in the future than at present. They probably are yet to see or experience the visible impacts of climate change on their recreation resources, which may lead them to think it is not a risk of immediate concern (Spence, Poortinga, Butler, & Pidgeon, 2011; Taylor, Bruin, & Dessai, 2014). The uncertainty about the future, however, may make them believe it to be a factor of potential threat. This observation is in line with the conclusions of previous studies of the general public that found people consider climate change as a moderate risk to their own generation, but a higher risk to the future generations (Leiserowitz, 2005; Lorenzoni & Pidgeon, 2006). The relative insensitivity of anglers to a low reduction in trout populations implies that visitation rate may not be impacted in the immediate future. However, reduction in trip frequency could be substantial if climate change results in a large decline in trout populations in the future.

While this particular study focused on trout anglers in Georgia, it sheds some light on how anglers may perceive the risk of climate change, and potentially respond to resources impacted by climate change. Some trout anglers in our sample were more concerned about risk of climate change and were more prepared than the others to adjust with change in their recreation resource. A discrepancy among the value orientations subgroups could mean that there may be some social and cultural barriers affecting the perception and acknowledgment of

climate change risk. For example, Protectionists who held strong protection orientations toward sport fish, expressed high concern about the risk of climate change on trout, and also reported higher willingness to adjust fishing trips to potentially affected sites. Thus, one of the underlying motivations for Protectionists to reduce trip frequencies to affected sites could be conservation of trout as a unique species in Georgia. Along with a conservation motive, there could be some other factors (e.g., trip costs and substitute activities) that drive such adjustments. Future research should consider examining specific reasons for these trade-offs and potential alternatives. On the other hand, Dominionistics, with strong dominance and utilitarian values toward sport fish, expressed the least concern about the risk of climate change on trout, and were also the least likely to reduce their fishing trips to hypothetically affected sites. While it is not clear why Dominionistics discount the risk of climate change on trout it is possible that a confirmation bias[3] about occurrence and risk of climate change is more dominant among this group. Outreach and extension programs should be able to identify such biases or other possible factors that may serve as barriers to the perception and acknowledgment of climate change risks.

Previous studies have suggested that information about whether and how people perceive climate change as a risk is useful in understanding their vulnerability (in terms of lack of information, poor- or misunderstanding of the risk involved), and in predicting their behavioral responses. 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), while those who do not consider it as an immediate risk may hesitate to accept adaption and mitigation strategies (Browne & Hunt, 2007; Heeren, 2012). Thus, an angler community well aware of the risks associated with climate change can be expected to support natural resources agencies in implementing programs to mitigate the impact of climate change. Such programs may include restoration or expansion of riparian vegetation to buffer stream temperatures, monitoring and evaluation of existing and new stockable areas, adjustment in the frequency and level of stocking, and research to enhance the climate adaptation of trout. Similarly, trout anglers, who are doubtful and dismissive about climate change risk (e.g., Dominionistic and Distanced subgroups) may show some resistance to the climate change related programs. Outreach and extension programs could target these audiences, possibly in focus group settings, to gain a better understanding of their confirmation biases or other possible factors that may be driving their doubts regarding the occurrence of and risk of climate change. Future research could also focus on better understanding the social and cultural characteristics of such segments with a large enough sample so that the appropriate audience could be targeted for climate education.

Examining the quality of specific fishing sites and relating that to the responses of sampled anglers was out of the scope of this study. However, it is possible that current quality of the sites where anglers regularly fish also influence their concern about the risk of climate change. Future research could also consider this possibility. It would be interesting to see whether popular fishing site characteristics make a difference in the perception of, and reported potential responses to, the risk of climate change. As well, the relationship between anglers' value orientations and behavioral responses to the risk of climate change may be better explained by alternative analyses (e.g., structural equation modeling) that can identify possible mediating effects of other higher order cognitive factors (Fulton et al., 1996).

To conclude, differences in risk perception and potential trip adjustments to affected sites among segments of trout anglers imply that value orientations can have some level of influence on anglers' perceptions of climate risks on natural resources. Outreach and extension programs should be able to identify such factors, including other possible barriers, to effectively communicate messages related to the risks of climate change. Future assessments of climate change related risk perceptions should also be specific to the situations of the particular recreation activity for the more accurate and appropriate measurements.

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Appendix A

See Appendix Table A1.

Table A1
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 would not 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	□	□	□	□

[3] A confirmation bias makes people seek information and evidence that is consistent with their existing mindset, while avoiding or dismissing information that will require them to change their minds and behaviors (Center for Research on Environmental Decisions, 2009).

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