



Water Quantity Perceptions In Northwestern North Carolina: Comparing College Student And Public Survey Responses

By: Courtney Cooper and **Kristan Cockerill**

Abstract

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Water Quantity Perceptions in Northwestern North Carolina

Comparing College Student and Public Survey Responses

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Understanding behaviors and perceptions regarding water quantity through carefully designed research is a critical component in producing more effective water management policies. Attitudes and perceptions among young people are understudied in the existing pool of water resource research. This study compared perceptions about water quantity between undergraduate college students at Appalachian State University (ASU) and respondents from two surrounding counties in Northwestern North Carolina. Conservation perspectives, behaviors, and concerns were compared between the two samples. Results indicate that respondents in the public sample expressed higher levels of concern about the water supply but lower agreement with regulatory actions like water metering, water usage restrictions, and fee-assessments during droughts. Respondents in the student sample were more likely to agree with government restrictions and policies that regulate water usage and indicated a stronger willingness to pay for water conservation measures. Both samples expressed moderate levels of concern about water conservation and future water quantity.

Entender los comportamientos y las percepciones con respecto a la cantidad de agua a través de estudios cuidadosamente diseñados es un componente crítico en la producción de políticas de gestión de agua más eficaces. Las actitudes y percepciones entre los jóvenes es un área poco estudiada en la mayoría de las investigaciones sobre los recursos hídricos. Este estudio comparó las percepciones sobre la cantidad de agua entre estudiantes universitarios de pregrado en Appalachian State University (ASU) y los encuestados de dos condados circundantes del noroeste de Carolina del Norte. Se compararon las inquietudes, los comportamientos y las perspectivas de conservación entre las dos muestras. Los resultados indican que los encuestados de la muestra pública expresaron mayor preocupación con el suministro del agua pero poco acuerdo con medidas regulatorias como la medición del agua, las restricciones de uso y las evaluaciones de costo durante las sequías. Los encuestados en la muestra de estudiantes tendían a estar de acuerdo con las restricciones del gobierno y las políticas que regulan el uso del agua e indicaron una mayor disposición a pagar por las medidas de conservación del

agua. Ambas muestras expresaron niveles moderados de preocupación sobre la conservación y la futura cantidad de agua.

KEY WORDS: Percepciones, water management, college students

PALABRAS CLAVE: Percepciones, gestión del agua, estudiantes universitarios

INTRODUCTION

The United States southeast is a wet and humid region. In the 21st century, however, even it faces water shortages caused by both increasing demand and drought. Driven, in part, by expected impacts from climate change, academic and popular literature now exhibit more interest in understanding the potential for water stress in all regions (Swihart 2008; Carter et al. 2014). Understanding the potential for water stress is one key element needed to address management options. Public perception about management and conservation, however, is also important (Stoutenborough and Vedlitz 2014).

Despite evidence of the potential for water stress and a need to think more strategically about how we manage water, even in humid areas (Carter et al. 2014), public perceptions about water quantity in the U.S. southeast remain understudied. In part, this is because of the complex spatial, temporal, and cultural geographies implicit in the study of water resources. Every country, state, watershed, county, community, and household is influenced by different variables at varying degrees of importance and complexity with regard to water resource issues (Auer 2006; Dietz et al. 2003). Perception studies that have been conducted in the Southeast reflect

low to moderate concern expressed by both the public and decision-makers.

Research suggests that the members of the public are not strongly concerned about their community or household water supply (Evans et al. 2011; Borisova et al. 2013). In an extensive survey throughout the Southeast, Borisova and others (2013) found that the majority of residents in Alabama, Arkansas, Louisiana, Mississippi, and Tennessee report that water quantity is *probably* or *definitely not* a problem where they live. Residents in Florida, Georgia and Texas were more evenly divided among those who thought water quantity is *not a problem* and those who believed that it is *a problem*. Despite intense drought conditions in 2007 and a milder drought in 2010, in a survey of Georgia residents, only 22 percent of respondents reported that water quantity is *definitely* a problem in their community, with another 22 percent saying it is *probably* a problem for their community (Evans et al. 2011). Jones and Hunt (2010) conclude that perception is one of the greatest obstacles to implementing rainwater-harvesting systems in the southeastern U.S.

Available research on decision-makers in the American Southeast also reveals low levels of concern about the water supply (Meindl 2011; Bolson et al. 2013; Cockerill 2014). A survey of water managers in Georgia, Florida, and Alabama indicated moderate concern about water system vulnerability to climate change (Bolson et al. 2013). Cockerill (2014) found that rural North Carolina decision-makers (e.g. elected officials, town planners, and water utility personnel) were only moderately concerned about the future of their water supplies and were confident that they could continue to meet

water demand. Meindl (2011) argues that decision-makers in the Southeast have traditionally made development decisions that are favorable to population growth and require the additional expansion of water resources. As this region continues to experience population growth, water stress will likely become a more prevalent topic for research and for policy development. Implementing effective water management policy requires understanding what people know and think about water and its management. In writing specifically about drought management in Georgia, Kohl (2013, p 376) concludes that “. . . it is not enough to examine only how water is managed and used. Stakeholder understanding of water, scarcity, and drought and their perceptions of who maintains the power to manage the resource are also important.” Further, Lewis and Popp (2013) find significant differences between public perceptions about watershed ecosystems and the scientific evidence about those same systems. Not considering public perception in making management decisions risks public opposition to those decisions.

In assessing attitudes about water management, young adults are typically underrepresented, if not entirely ignored. In studies on public concerns by Borisova and others (2013) and Evans and others (2011), the youngest respondents were 25 and the 25–44 age group was underrepresented. Only 21 percent of survey respondents in Borisova and others (2013) were within the 25–44 age group while U.S. Census data suggested the group actually represented 40 percent of the population in the study area.

Findings from research in other regions relating to environmental concerns help

to highlight possible trends in water attitudes and perceptions of young people. In research on expressed environmental concern, there is generally a trend toward younger people showing more concern than older people (Gifford and Sussman 2012). Borisova and others (2013), however, found older respondents more likely to be concerned about water availability and to think that the likelihood of prolonged drought is increasing. There is additional evidence towards a downward trend in expressed environmental concern among high school seniors and college students and an increased trend in materialism and individualized worldviews (Wray-Lake et al. 2009; Gifford and Sussman 2012; Twenge et al. 2012). We expect to find similar trends in regard to water-specific attitudes.

If a downward trend of concern in youth is evident in water-specific attitudes, this carries implications for developing water management policy to address the potential for changing water conditions coupled with increasing demand. Trends toward increased consumption and individualized attitudes can potentially exacerbate impacts from the *tragedy of the commons* or the idea that individuals will take advantage of a common pool resource where property rights for the resource are not well defined (Hardin 1968). Additional work on Hardin's premise concluded that private enterprise and government control were two ways to avoid destroying the commons (Feeny et al. 1990). Subsequent research demonstrates that under certain conditions, communally owned resources can be sustainably managed and well protected (Auer 2006). Feeny and others (1990) demonstrated that many variables are relevant to understanding when and

where common pool resource management may succeed. One such variable is the education and concern found in the culture where the common pool resource problem exists.

Understanding attitudes toward resource availability and management options is pertinent to developing and implementing effective management approaches (Kohl 2013). Here, we utilize a survey to assess and compare attitudes about water availability and to better understand attitudes about water conservation and management in a wet region. Further, because both young adults and the American Southeast are underrepresented in scholarly work on attitudes about water quantity, this study compares college student attitudes to general public attitudes in rural counties in Western North Carolina. College students were surveyed because the college environment ensures that predominantly young adults are sampled. College students are used as a proxy for young adults. With this study, we expand the existing pool of literature on attitudes and perceptions about water resources in the southeastern United States to potentially provide insight into what people might expect and/or accept regarding water resource management.

STUDY AREA

The study area encompasses Ashe and Watauga Counties in the Appalachian Mountains of western North Carolina (Figure 1). The elevation varies between 762 meters to 1676 meters above sea level and the annual mean precipitation is 137 centimeters (NOAA 2014). Headwaters for four major watersheds flow from this region through North Carolina and into

the neighboring states of South Carolina, Virginia, and Tennessee (USGS 2014).

The population in Ashe and Watauga County increased by 11.8 and 19.6 percent, respectively, between 2000 and 2010 (U.S. Census Bureau 2010). Since 2010 population growth has stalled in Ashe County but remains steady at about 2 percent per year in Watauga County (U.S. Census Bureau 2015). Since 2000, several communities in the study area have secured or have begun the process of securing increased water supplies to meet growing demand. In many communities throughout the south, increased demand for water strains water supplies, especially during drought (Patterson et al. 2013). During this same time period, the region experienced several significant drought events (National Drought Mitigation Center 2014). At the time of this study, however, the area did not experience drought conditions and by the end of the study, abnormally wet conditions prevailed.

Watauga County's estimated 2012 population of 52,000 is split evenly between urban and rural residents. Ashe County's population of 27,000 is more rural (U.S. Census Bureau 2010). In Watauga County 36 percent of the population is served by a public water supply and in Ashe County, 19 percent of residents obtain their water from a public supply. Remaining residents have access to a private well or spring (Kenney et al. 2009; HCCOG 2010). Appalachian State University (ASU) is located in Watauga County in the Town of Boone and contributes to recent population growth in Watauga County. The school is one of 16 North Carolina state colleges and universities. Enrollment in 2014 was approximately 16,000 undergraduate and 1800 graduate students (ASU 2014).

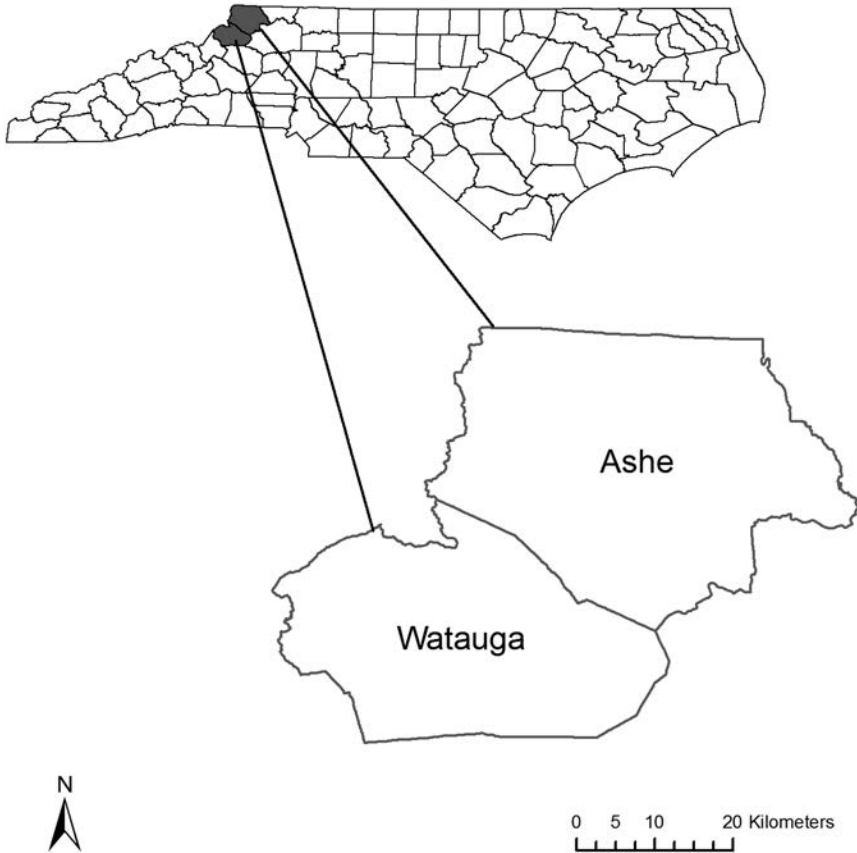


Figure 1. Map of study area.

The campus operates its own water supply. About 34 percent of the undergraduates live on campus (ASU 2014) with the rest living in Boone or surrounding counties.

METHODS

Data were obtained through a 51-question survey, which focused on questions of stated water conservation behaviors, concerns, attitudes, willingness to pay for water conservation, and respondent demographic information. The survey

of public respondents was mailed in May of 2013 to a random sample of 3,000 Watauga and Ashe County residents. A reminder post card and a second mailing were sent to all non-respondents. The survey closed in July of 2013. A response rate of 30 percent (N=714 responses) was obtained.

The survey of student respondents was conducted during the fall of 2013. With the exception of a few demographic questions, the student survey was identical to the public survey. Surveys were distributed

through the use of convenience sampling. Emails were sent to six faculty teaching classes in the Departments of Geography and Planning; Cultural, Gender and Global Studies; and Economics. These three departments represented a diverse array of subject areas and ensured that students from a range of majors were represented. Of the faculty who responded, the lead author selected five classes from the three departments to survey. She visited classes during regular meeting times and asked students to complete the survey. Students were instructed to consider their living situations at Appalachian State rather than their hometowns. This resulted in 349 completed student surveys. Total enrollment in these five classes, as opposed to the actual attendance on the day of the survey, was 480 students, which yielded a response rate of 73 percent. The total number of study participants was 1,065.

RESULTS

Comparing our public sample to U.S. Census data demonstrates that the respondents tend to be older, slightly more educated and report higher income than the overall population. Most pertinent to this study, the median age of (public) participants was 63 years. The projected median ages for Watauga and Ashe counties in 2013 were 30 and 46, respectively (Access NC 2014). Because most ASU students live off campus, they have addresses in Watauga or Ashe County and hence were included in the random sample of the public. The median age of our sample suggests, however, that the student response to the public survey was low. The average income of respondents in the public sample was \$60,000 and 46 percent

reported being retired. Another 45 percent reported some level of employment. For comparison, the average per capita income in 2012 for the Appalachian region was \$35,000 (Appalachian Regional Commission 2014). The majority of respondents indicated an education level of at least *some college*, suggesting that our sample's education level was higher than the surrounding population. Across the Appalachian region, only 21 percent of the population reports an education level of a bachelor's degree or higher. Nationally, this percentage is 28 percent (Appalachian Regional Commission 2014).

The average respondent for the student sample was 20 years old. Underclassmen (freshmen and sophomores) represented 71 percent of the 253 respondents who reported their college year in the survey. A broad range of majors was represented among the 272 respondents reporting their major. Accounting, management, and marketing were the most well represented but more than 30 majors were reported. Students were asked to estimate their family's income and those responding reported a mean income of \$104,000. Of course, this self-reporting may not be reliable because of uncertainty among respondents with regard to their family's income, but the student body at ASU is generally affluent. More than 60 percent of students sampled reported that they were not responsible for paying their own bills. Students responding to the survey were primarily from North Carolina and ASU reports that 90 percent of students are from North Carolina (ASU 2014). Both the public and student sample were predominately white and this finding is consistent with data for both the region and the school.

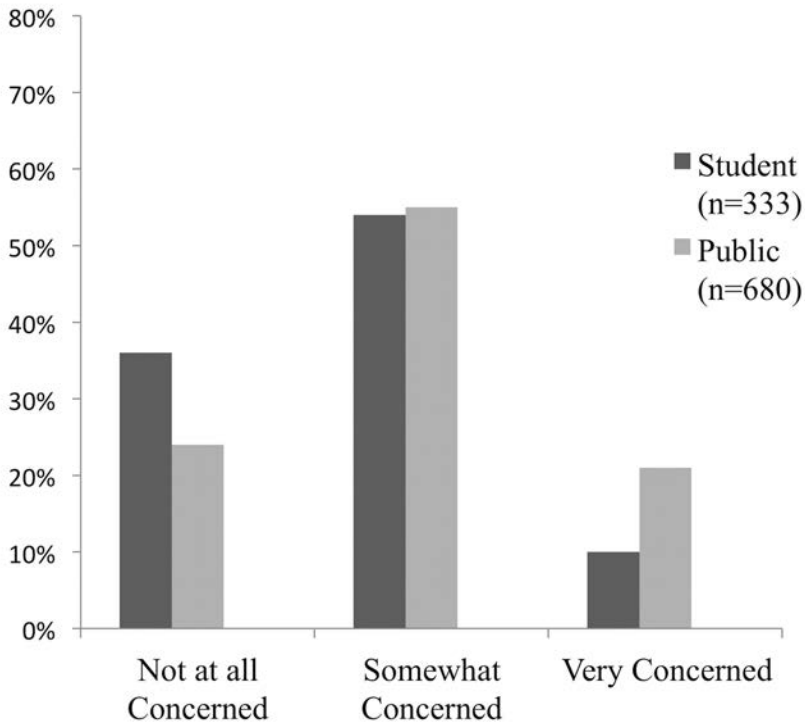


Figure 2. Public and student responses to survey question: What is your level of concern about the future of your household water supply? $p=0.000$

The survey asked respondents to indicate the source of their household water supply. Only 16 percent of the public sample relied on a municipal water source; the remainder used private springs or wells. This finding is consistent with available water utility data for the area. In contrast with the public sample, 63 percent of student respondents claimed to rely on municipal water sources. We expect that the actual percentage of students who rely on municipal water supplies in our sample is higher because many students indicated being unsure of their water source.

Differing household water supply sources may play a role in shaping contrasts

in perceptions between the two samples, especially when considering water as a common pool resource. Median age and household water supply comprised the biggest contrast between the two samples.

General concern about water quantity was assessed through the study. As shown in Figure 2, more than 50 percent of both samples expressed moderate concern about the future of their household's water supply. The public sample reported a higher level of *very concerned* responses at 20 percent compared to the 10 percent found in the student sample. An independent sample T-test indicates that the differences between samples are statistically

significant with the public sample, which expressed more concern. These findings overall, however, indicate that water is not a strong concern for either set of respondents. The surveys were not administered during a time of drought, offering one possible explanation for this finding.

Table 1 includes the results from survey statements regarding perceptions and beliefs about water quantity. The table is subdivided into three categories: statements about water conservation, water quantity management, and water availability. These categories are used to compare findings between samples. As indicated in the table, higher values correspond with stronger agreement. Values range from 1 (strongly disagree) to 4 (strongly agree). Independent samples t-tests were used to identify statistical differences between samples for each statement. Mean differences from ten of the thirteen statements were statistically significant.

Three statements pertained to water conservation concerns. The public sample agreed more strongly to the first statement; that water conservation was an issue that they had thought about frequently in the past year. The public also agreed more strongly to the second statement, that development decisions should include an impact assessment on the water supply. Both samples indicated low levels of agreement to the statement, "in water planning the health of the economy is more important than protecting the environment." Students were slightly more likely to agree but the difference was not significant. In each statement about attitudes towards water conservation, the public sample indicated stronger support for water conservation measures. This may reflect the preponderance of business-oriented majors

who responded to the student survey or that college students are less concerned about or aware of potential water supply problems.

The survey also included five statements about perceived attitudes towards water quantity management (Table 1). Questions about specific household water restrictions and fees resulted in the largest differences between samples. Public sample respondents agreed more strongly that household water restrictions should be voluntary rather than mandated by the government. The public sample expressed less support than students for a one-time fee assessment on water use during drought. These results suggest that college students may be more willing to accept new government regulations and taxes to manage water quantity. This is consistent with the results in the general public survey as the younger respondents among the public survey were more likely to support conservation measures and paying for those measures than older respondents. The student survey results do still raise questions about reliability, as students do not have significant experience in actually paying for public management efforts. As noted, more than 60 percent of this student sample is not responsible for paying their own bills and they self-report that they are affluent. There were no statistically significant differences, however, in survey responses among the students who reported paying their bills and those who were not responsible for their own bills, suggesting that having financial responsibilities was not a strong influence on attitudes.

When asked about the role of state and local government, neither sample expressed strong agreement that these

Table 1. Responses to survey statements about water conservation and the environment. Scale: 1) Strongly Disagree 2) Disagree 3) Agree 4) Strongly Agree; 'Don't Know' responses excluded.

Survey Question Topic	Survey Question	Mean Public	Mean Student	Independent Sample T-test Mean Difference (p-value)
Water Conservation	Water conservation is an issue that I have thought about frequently in the past year.	2.88 n=653	2.24 n=330	-0.64 (0.000)
	Any development decision should include assessing the impact on the water supply.	3.39 n=667	3.12 n=321	-0.27 (0.000)
	In water planning the health of the economy is more important than protecting the environment.	2.01 n=654	2.13 n=305	0.12 (0.048)
	Household water restrictions should be voluntary rather than mandated by the government.	3.13 n=668	2.62 n=305	-0.51 (0.000)
	During serious droughts, like the one in 2007/2008 in North Carolina, I would support a one- time fee assessment on my water use.	1.99 n=641	2.54 n=286	0.55 (0.000)
Water Quantity Management	State public officials should have the final authority to make decisions about how our water supply is managed.	1.87 n=634	2.21 n=282	0.33 (0.000)
	Local public officials (city/county) should have the final authority to make decisions about how our water supply is managed.	2.30 n=628	2.54 n=284	0.23 (0.000)
	Public money should be used to develop or acquire new water sources.	2.89 n=624	2.91 n=289	0.03 (0.530)
	There is enough water in the mountains of Western North Carolina to meet future needs for all the people and business for the next 25 years.	2.64 n=430	2.57 n=180	-0.07 (0.364)
	Community growth should be limited to manage water scarcity.	2.94 n=651	2.34 n=317	-0.60 (0.000)

(Continued)

Survey Question Topic	Survey Question	Mean Public	Mean Student	Independent Sample T-test Mean Difference (p-value)
Water Availability	It is important to meter water use so that we know how much water we are using.	2.82 n=636	3.19 n=332	0.36 (0.000)
	I am satisfied that my current supply provides sufficient water for my use.	3.42 n=699	3.39 n=343	-0.03 (0.463)
	I am concerned that drought will limit the amount of water available to my community or me.	2.69 n=627	2.52 n=295	-0.17 (0.001)

*A minus sign associated with the "mean difference (p-value)" indicates that public respondents agree more with the statement; positive values indicate that student participants agree more with the statement.

entities should have final authority about how the water supply is managed. Students were, however, more likely to agree with both statements suggesting that students are more comfortable with water management decisions made by governing authorities at both the state and local level. Survey responses in both samples indicated stronger agreement in giving local public officials authority than they did with state public officials.

The remaining statement in the water quantity management category pertained to whether public money should be used to develop or acquire new water sources. Both samples moderately agreed with this statement and the differences between them were not statistically significant. Despite not displaying strong agreement for local or state official authority, both students and the public agree that public money should be spent to increase the water supply. This is potentially an artifact of rapid population growth coupled with

low levels of concern about water quantity in the region. As noted, several communities in the study area have expanded their water supply in the past decade and respondents may recognize that this was funded through public monies.

The final category in Table 1 pertains to five statements about water availability. Both samples show slight agreement that there is enough water in the region to meet needs for the next 25 years. The public sample agreed that community growth should be limited to manage water scarcity while the student sample showed slight disagreement. Again, this may reflect the business orientation of the student sample or that college students are less concerned about potential future water shortages. However, the student sample indicated stronger support for metering water usage than the public sample, reinforcing other statements showing student support for increased intervention in water management.

Both samples expressed a high level of agreement that the current water supply provides sufficient water for personal use. Although the public sample is more concerned that drought will limit the amount of water available to communities, the level of agreement with that statement was not strong for either sample. Drought concern is very susceptible to temporal changes in environmental conditions. In addition, because droughts lack a common conceptual understanding (Smakhtin and Schipper 2006), college students may conceptualize drought differently than the rest of the population. When droughts do occur they receive less political and scientific attention than other natural disasters (Kohl 2011). Concern with regard to current water availability is likely to vary depending upon the drought status of the region being characterized. Because the area was not experiencing drought at the time of either survey, the idea of drought was likely less salient with all respondents. In summary, when it comes to water conservation, management, and availability, the student sample was more willing to accept intervention and regulations but less concerned about future water availability than the public sample.

CONCLUSIONS

Respondents in both samples represent a well-educated and affluent subset of the overall population. These similarities allowed us to compare the differences in perceptions and attitudes attributed to age and household water source. Despite the commonalities in demographics between the student and public sample, significant differences were measured in regards to attitudes and perceptions about water

conservation, management and availability. This suggests that differences in age and household water source are important determinants with regard to attitudes and perceptions about issues pertaining to water quantity.

Water conservation perceptions among the student sample in this study support the idea of a downward trend in expressed environmental concern among high school seniors and college students that has been discovered in other studies. (Wray-Lake, Flanagan, and Osgood 2009; Gifford and Sussman 2012; Twenge, Campbell and Freeman 2012). The student sample was less concerned about the future water supply than the public sample. It is important to recognize that despite the lower levels of concern, students were more willing to support government interventions and regulations like water restrictions during drought and water metering. These findings suggest that, although college students are less concerned about water quantity than the public, they are more willing to accept government regulations relating to stricter water conservation measures.

The public sample demonstrated a stronger preference for individualized decisions about their household water management. This might be attributed to the differences in household water sources between samples. As discussed previously, a majority of the public sample reported that their primary household water source was a spring or well. In contrast, the majority of the student sample reported relying on a municipal water supply. People relying on municipal water supplies are subject to a greater level of government intervention while people on a private supply must maintain and regulate their household

supply independently. The general public may have more first-hand knowledge about water issues and have, perhaps, had to deal directly with managing water (e.g. drilling a well or paying a water bill) and coping with water shortages during a drought. College students are less likely to have the same knowledge of these issues. Despite higher levels of concern, the public expresses lower agreement with regulatory actions like water metering, water usage restrictions, and fee-assessments during drought.

A low level of concern about drought was measured in both samples. Findings from this study confirm that perceptions and concerns among college students represent a unique subsection within water resource perception knowledge. However, studies that assess attitudes about water management typically underestimate or ignore young adults because of the unique challenges in surveying young adults. Surveying college students offers one method for explicitly including younger populations. Continuing to ignore young populations could carry significant policy implications as these younger populations age.

Future studies could investigate and compare populations with differing geography, political attitudes and demography. Another option for expanding this research is to explore actual water conservation behavior. Replicating these surveys when drought reoccurs could also produce different results, as temporal differences in water resource perceptions likely exist. Despite significant population growth and the potential impacts of future climate change, concern for the water supply in the case study area was low. Improved understanding

of perceptions will assist decision-makers in forming more strategic policies. The unique characteristics of water resources carry complex spatial, temporal, and cultural geographies, and the humid climate of the American Southeast is no exception (Colten 2008). Results from this study highlight differences in water specific attitudes that may be linked to an individual's age and household water supply.

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