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Survey Says: Implications of a Public Perception Survey on Stormwater Education Programming

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Abstract: Effective watershed and stormwater education and public involvement programs strive to increase awareness of watersheds and landscape connectivity and also encourage behavior changes that may be contributing to water quality and quantity problems within a targeted basin. According to new guidance from the US Environmental Protection Agency on stormwater permit improvement, regulators are looking for programs to utilize targeted issues relevant to a community to guide the development of a comprehensive outreach program. In an effort to collect information on public perception, knowledge, behaviors and willingness to get involved in improved stormwater management, a telephone survey was implemented. This manuscript presents the results of this survey and offers insight on stakeholders' attitudes, knowledge, and behaviors related to watershed and stormwater, critical factors in the initial development of effective stormwater education and public involvement programs.
Keywords: Stormwater, survey, behavior

Effective watershed and stormwater education and public involvement programs strive to increase awareness of watersheds and landscape connectivity and also encourage behavior changes that may be contributing to water quality and quantity problems within a targeted basin. As stated by Costanzo et al. (1986), "behavior change is the only goal of consequence." Clemson University's Carolina Clear program is implementing regional stormwater education and involvement programs in more than three dozen communities across South Carolina. These efforts have been spurred by the National Pollutant Discharge Elimination System (NPDES) Small Municipal Separate Storm Sewer Systems (MS4) General Permit, effective in South Carolina in March 2006. Outreach activities serve two general purposes: expand awareness of stormwater and its impacts on water resources and modify known behaviors that contribute to stormwater pollution. More information specific to this program is available online at www.clemson.edu/carolinaclear.

According to new guidance from the U.S. Environmental Protection Agency (EPA) on stormwater permit improvement, "The public education and outreach program must be tailored and targeted to specific water quality issues of concern in the relevant community. These community-wide and targeted issues must then guide the development of the comprehensive outreach program, including the creation of appropriate messages and educational materials (p. 20)" (U.S. EPA 2010). The Carolina Clear survey effort described in this paper was initiated to identify the "targeted issues" that need to be addressed in future stormwater education efforts in four regions of South Carolina. The survey results have revealed additional information related to target audiences, potential modes for delivery, and social marketing tools that could potentially improve effectiveness of stormwater outreach.

Research has indicated that environmental knowledge and environmental concern are important antecedents for engaging in environmentally friendly behaviors (Tarrant et al. 1997; Hines et al. 1986/1987; Bamberg and Moser 2007). In the context of stormwater education, these is a need to better understand how residents'

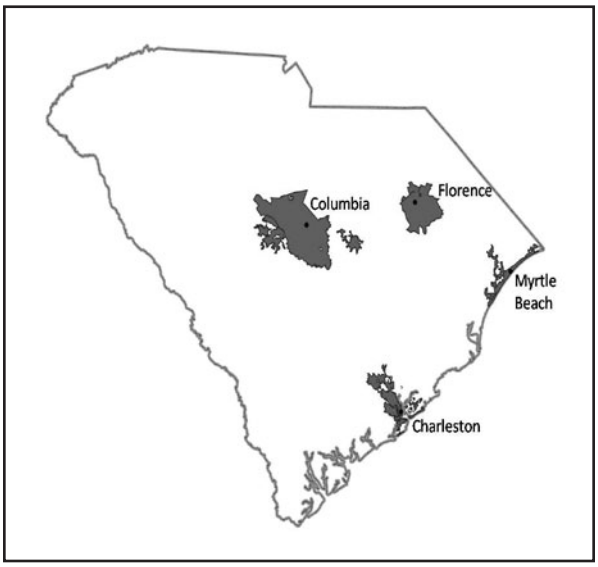

Figure 1. Four surveyed regions of South Carolina.

attitudes shape household behaviors, especially as so many of these behaviors contribute to nonpoint source pollution, which has been identified as one of the most significant threats to water quality (Sleavin and Civco 2000).This manuscript presents data helpful in understanding society's attitudes, knowledge, and behaviors related to watershed management, critical factors in the development of effective stormwater education, and public involvement programs.

Purpose of Study

In the summer and fall of 2009, a telephone survey of residents (n=1,599) from four regions of South Carolina was conducted. The four regions include two coastal (urban areas surrounding Myrtle Beach and Charleston) and two inland regions (urban areas surrounding Columbia and Sumter and, separately, Florence); see Figure 1 and Table 1. Responses from Columbia and Sumter were combined in this survey effort so that results could be summarized as representing the "Midlands" of South Carolina, a common reference to the geographic center of the state.

The foremost goal of the survey was to obtain information about residents' attitudes, knowledge, behaviors and intentions as they relate to watershed issues. More specific objectives include the following:

- Determine the overall level of concern about water quality;
- Ascertain stakeholder knowledge of environmental concepts and issues;
- Gain an accurate understanding of individual behaviors and actions that are relevant to water quality;
- Identify openings and barriers to participation in water quality improvement efforts; and
- Document the willingness of the public to become involved in water quality issues.

Table 1. Profile of general demographic characteristics for the metropolitan statistical areas (MSA) of surveyed regions.

Geographic Area	Total Population	Per Capita Income ($)	Median Household Income ($)	Median Home Value ($)	Top Three Employing Industries (in order of greatest number employed)
Columbia MSA	536,697	20,902	41,677	101,800	Education, health and social services; manufacturing; retail trade
Sumter MSA	104,646	15,657	33,278	78,700	Manufacturing; education, health and social services; retail trade
Florence MSA	125,761	17,876	35,144	85,200	Education, health and social services; manufacturing; retail trade
Charleston-North Charleston MSA	549,033	19,772	39,491	111,500	Education, health and social services; retail trade; manufacturing
Myrtle Beach MSA	196,629	19,949	36,470	119,700	Arts, entertainment, recreation, accommodation and food services; retail trade; educational, health, and social services

Source: U.S. Bureau of the Census 2000.

These four regions have been exposed to one to five years of targeted watershed and stormwater education in which Carolina Clear has been a participating presence at community festivals, classroom education, rain garden installations at schools, mass media (billboards, radio and television commercials), coordinated web pages, and streamside clean-ups. In this paper, we report on findings that have particular relevance for refining these educational efforts in the coming years. This information collection effort will also formulate baseline data for measuring effectiveness of future stormwater education efforts in these four areas of South Carolina. We also anticipate that other regions engaged in stormwater education may benefit from the lessons learned from and application of our survey results.

Methods

The survey instrument was developed based on programmatic goals for stormwater education, knowledge about behaviors that can be modified as a result of education, and previous surveys conducted in South Carolina (Mobley and Witte 2005; SC Department of Health and Environmental Control 2003). The full survey and results are available online at www.clemson.edu/carolinaclear and upon request.

Survey questions were organized into the following categories: 1) environmental concern; 2) environmental knowledge about concepts and practices and the causes of pollution; 3) participation in recreational activities; 4) participation in environmentally positive and negative behaviors; 5) willingness to get involved in efforts to improve water quality; and 6) familiarity with ongoing targeted stormwater and watershed education efforts.

The survey was conducted using Computer Assisted Telephone Interviewing (CATI) software. Random lists of phone numbers based on target zip codes were purchased from a reputable national vendor of telephone samples. The majority of calls were made during evening hours, weekdays between 5:00 pm and 9:00 pm. Limited daytime and weekend calling was also conducted as to not exclude potential respondents. Interviews were typically fifteen minutes in length. On average, the survey cooperation rate, which measures the willingness of individuals to complete the survey, was 13.4 percent across all four regions. The cooperation rate considers both completed and partially completed surveys. This low rate could be attributed to a number of factors including timing of the survey (during summer months when fewer permanent residents are available), incorrect or non-working numbers and other factors. In some cases, however, respondents were not able to participate, despite their willingness. For example, a respondent may have had to end the interview because of an interruption or because (s)he ran out of time. Or, in some cases, respondents would complete a portion of the interview before it was determined they were ineligible (e.g., because they were not a resident of one of the 23 zip code areas surveyed). Additionally, cooperation rate includes individuals that were not willing to participate in the survey.

To better reflect the demographic characteristics of residents in the surveyed areas, the data for each region were adjusted for demographic differences per individual region between telephone sample and 2000 U.S. Census data by using standard statistical weighting procedures. Weights are calculated by dividing the census proportions by the survey proportions for the demographic categories of gender, race, age and education. Thus, data presented herein are weighted data, as this serves as a better representation of views of respondents in the surveyed regions.

Survey Results

In this paper, we report on four main findings that are particularly relevant for future stormwater education efforts: environmental concern, environmental knowledge, assessment of environmental impacts and engagement in potentially negative environmental behaviors.

Environmental Concern

This research effort sought to identify relationships between respondents' concern for environmental quality of local waterways (Figure 2) and with respondents' perceptions of the impact of practices on local water quality (Figure 3). Across all four areas, survey respondents expressed relatively high levels of concern about pollution

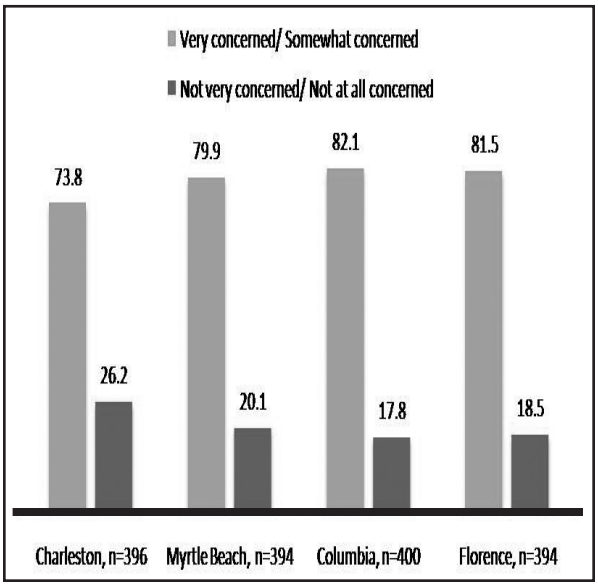

Figure 2. Responses to the question, "I'd like to know how concerned you are with pollution and environmental quality in your local streams and waterways?"

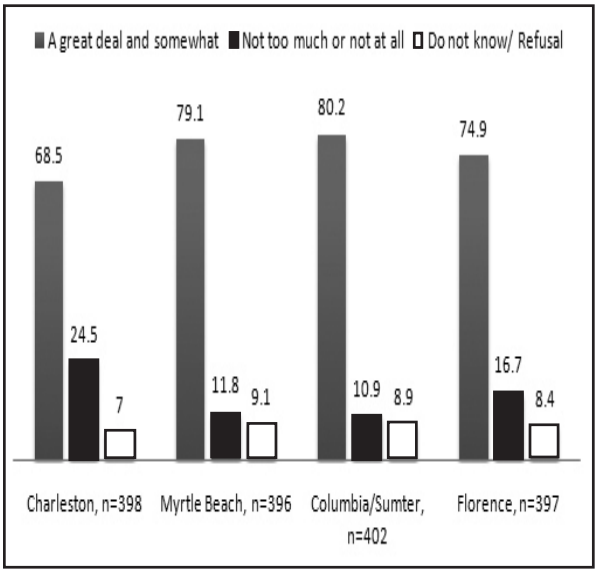

Figure 3. Responses to the question, "In general, how much does what people do on the land affect the quality of their local streams and waterways?"

and the environmental quality of local waterbodies (Figure 2). Overall, these levels of concern are comparable to the extent of concern found in other watershed-related studies (Center for Watershed Protection 1999).

It should be noted that respondents from coastal counties expressed slightly lower levels of concern than residents of inland counties. Though this difference is not statistically significant, this finding supports Zahran et al.'s (2006) study that documented residential differences in environmental concern, with at-risk coastal residents expressing less concern about a host of environmental risks including genetically modified organisms and pollution. One explanation is that, due to their proximity to the ocean, coastal residents may be more likely than inland residents to view natural resources (in this case, water resources) to be unlimited in supply. Thus, there is limited concern on their part (Vernberg and Vernberg 2001). However, our findings run counter to other research (Berk and Favel 1999) that indicates coastal residents were more concerned than inland residents about the environment.

When asked the extent to which people's actions affect water quality, a large proportion of residents indicated that such actions affect water quality a great deal or somewhat (Figure 2). Thus, not only are residents across the four areas concerned about water quality, but they also recognize that human actions on the landscape can impact water quality.

Environmental Knowledge

As described below, environmental knowledge was measured in several ways. The following series of questions and tabulated data and graphs shows the percent of weighted responses to questions regarding environmental knowledge.

Stormwater Knowledge

To gauge knowledge about stormwater, respondents were provided with a basic definition of stormwater as "runoff from yards and roads during storm events or from irrigation; it drains to ditches and storm sewers along roadways." Following this, respondents were then asked to indicate "yes" or "no" in response to the question, "Do you believe that this stormwater is treated before reaching our lakes, streams and beaches?" Table 2 displays the responses.

Of particular interest in the context of stormwater management, a significantly higher proportion of residents from the coastal counties near Myrtle

Table 2. Stormwater treated or untreated before discharge to waterways.

Survey Region	Percent Yes (Incorrect Response)	Percent No (Correct Response)	Do not know
Coastal: Charleston n=399	18.7	77.0	4.3
Coastal: Myrtle Beach n=397	6.1	87.9	6.0
Inland: Columbia/ Sumter n=402	16.0	74.1	9.9
Inland: Florence n=353	24.4	63.8	11.8

Beach selected the correct response, as compared to the inland urbanized area of Florence. Residents of Florence were also more likely to indicate "do not know" for this particular survey item. The Myrtle Beach region is the area that has had the most exposure to regional stormwater education efforts in which Carolina Clear is a participant (greater than four years); whereas, Florence is the area that has most recently been targeted for Carolina Clear's outreach efforts (greater than one year). Without baseline data, it is difficult to assess whether this difference between the two regions is due to programmatic stormwater-related efforts. However, these results do provide a foundation for assessing the impact of future targeted, regional education efforts and for comparing future survey results across the four regions.

Watershed Knowledge

To ascertain respondents' familiarity with basic environmental concepts, respondents were asked to select the correct definition of a watershed, "all of the land area that drains to a specific river or lake" (Figure 4). Residents of the inland region surrounding Columbia and Sumter were most likely to select the correct response. These results do not compare as favorably with results of other studies. In a survey of Chesapeake Bay region, nearly 48 percent of respondents chose the correct definition (McClafferty 2002); nearly 40 percent of respondents to a 1997 Roper survey identified the correct definition (as cited in McClafferty 2002). However, the results of our study of South Carolina residents were similar to a survey of Upstate South Carolina residents – only 27.3 percent of respondents selected the correct answer (Mobley and Witte 2005).

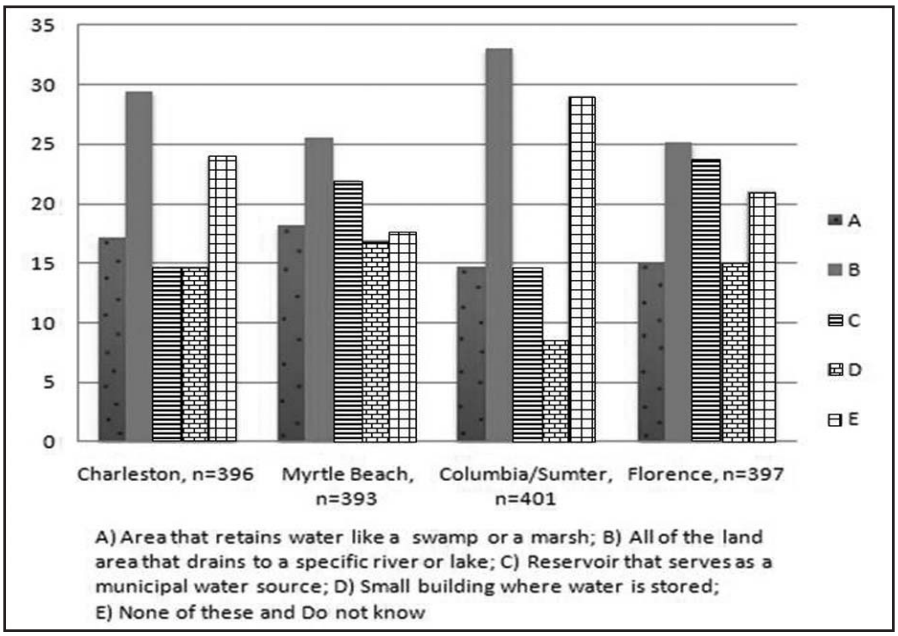

Figure 4. Responses to survey item: "Can you tell me which best fits your definition of what a watershed is?"

Given that Myrtle Beach respondents were most likely to correctly indicate that stormwater is not treated before discharge to waterways (Table 2), but were less likely to choose the correct watershed definition (Figure 4), future education efforts should relate stormwater concepts at the property management scale as well as the subwatershed and watershed scales. This emphasis could potentially foster greater awareness of connectivity to the landscape. Generally, stormwater is an easier concept to grasp than the concept of watersheds. As stated by Thoms (2006), watersheds are complex entities at a range of scales; along the coast, watersheds can be increasingly abstract entities due to lack of substantial changes in elevation and tidal influences. Interestingly, respondents in the coastal areas were also more likely to choose incorrectly "area that retains water like a swamp or marsh" as the definition of watershed in comparison to the inland respondents.

Assessment of Environmental Impacts

Respondents were also asked to indicate whether several sources of pollution each had a great impact, some impact, very little impact or no impact on streams and lakes in their region. Specific sources of possible pollutants offered in the survey included fertilizers and lawn chemicals, fuel and oil leaks from automobiles, pet waste, runoff from people washing their cars, industrial sites, farm operations, sediment or dirt from construction sites and parking lot runoff. Figure 5 depicts the proportion of respondents, in each of the four regions, who indicated that nonpoint sources of pollution and industrial sites had a "great impact" on water quality.

Between 53.3 percent and 63.9 percent of respondents in the areas surveyed indicated that industrial sites and fuel and oil leaks from automobiles had a great impact on local water quality. A smaller proportion of respondents were less likely to rate sediments from construction sites (between 21.1 percent and 36.7 percent), parking lot runoff (between 26.4 percent and 35.3 percent) and pet waste (between 16.8 percent and 28.5 percent) – typical stormwater pollution concerns – as having a great impact on local water quality. These results expose the misconception that point sources of pollution are the most significant threat to regional water quality. Though greater than 68 percent of respondents in all four regions understood actions on the landscape have an impact on water resources (Figure 3), there is a resistance to identifying and recognizing that perhaps their own practices may have a negative impact on the environment. Thus, these findings suggest a need for educating individuals on how individual behaviors can influence water quality and how, with changes in behaviors, they can have a positive impact on water quality. The following section provides additional insights into respondents'

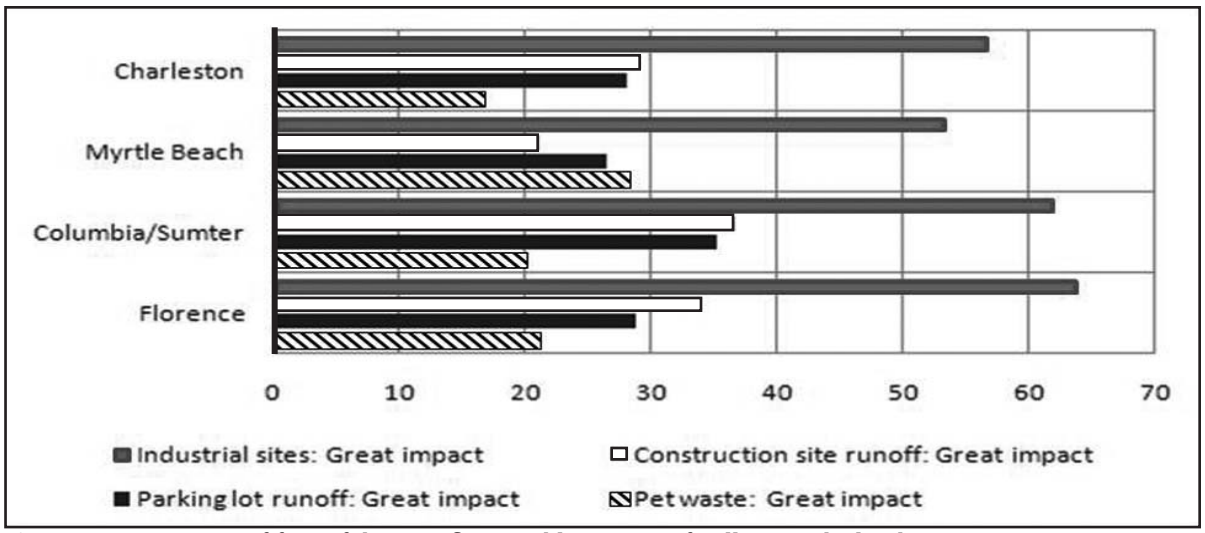

Figure 5. Comparison of four of the specific, possible sources of pollution asked as having great impact, some impact, very little impact or no impact on local streams and lakes in survey region.

current household practices that may have an effect on water quality of receiving waters.

Participation in Environmentally Positive and Negative Behaviors

An important goal of stormwater education is to provide information to residents about the impact of their current household behaviors. This survey included a number of questions that will allow researchers and their Clemson Extension colleagues to track changes in household behaviors over time. Respondents were asked to indicate the extent to which they engaged in a variety of practices, which may or may not have intended or unintended positive or negative effects on water quality. The survey items included activities which are typically targeted in stormwater education campaigns. Table 3 provides a summary of the findings.

Discussion of Results and Implications for Stormwater Education

In the context of stormwater education and public involvement, there is a need to better understand how residents' attitudes shape household behaviors and what behaviors require targeted education. Furthermore, for educational messages to lead to behavioral change, environmental educators now also need to better understand their public's motivations. Several themes from our survey have particular relevance for Carolina Clear's educational efforts.

For instance, greater than 60 percent of populations in each of the four regions surveyed felt septic system care and maintenance were related to water quality. Of those respondents who also are owners of a septic system (n=504), at least 34 percent in each region had not pumped their systems in the past five years. The relationship between knowing what is important for water quality and inaction for water quality may be improved upon by "prompts." As McKenzie-Mohr and Smith (1999) point out in Fostering Sustainable Behavior, "Numerous actions that promote sustainability are susceptible to the most human of traits: forgetting (p. 26)." Prompts can be utilized to remind the target audience to engage in sustainable behavior.

Several sources suggest that pet waste has significant impacts on water quality of urban and rural waterways (Aldersario et al. 1996 and Trial et al. 1993). Thus, the practices and beliefs of pet owners are of special concern to stormwater educators. Charleston residents were less likely than residents in the other three areas to agree that pet waste is a source of water pollution. Yet, Charleston residents who indicated they were pet owners were most likely of the three areas to

Table 3. Participation in environmentally positive and negative behaviors.

Survey Region	Always/nearly always considered likelihood of rain before treating a lawn with fertilizer or pesticides	If owner of a pet, always/ nearly always picked up after the pet when on a walk	Always/ nearly always disposed of oil, paint or other chemical down storm drains	Always/ nearly always washed car on lawn or gravel instead of pavement	Always/ nearly always dumped grass clippings or leaves down storm drains or into backyard creeks
Coastal: Charleston	73.9 (n=171)	86.5 (n=183)	3.4 (n=387)	22.4 (n=387)	4.6 (n=375)
Coastal: Myrtle Beach	62.6 (n=171)	71.1 (n=212)	1.6 (n=388)	21.0 (n=365)	0.1 (n=378)
Inland: Columbia/ Sumter	51.9 (n=178)	67.7 (n=187)	0.8 (n=391)	21.1 (n=382)	1.1 (n=389)
Inland: Florence	77.6 (n=135)	55.5 (n=161)	2.1 (n=386)	32.9 (n=377)	0.7 (n=377)

indicate they always or nearly always picked up after their pet when on a walk. These rates for Charleston (86.5 percent) are higher than rates reported in other studies in other areas of the country (Hardwick 1997; Swann 1999). Such findings imply that current pet owners could be the most effective educators for other pet owners, new pet owners and non-pet owners through the emphasis of social norms and conformity. McKenzie-Mohr and Smith (1999) explain that emphasizing high percentage participation rates sends a clear message to the larger audience of the perceived importance of the sustainable action so many others are taking. Training existing pet owners to engage others in discussing pet waste disposal in a positive light could be a worthwhile outreach pilot project for this region. In addition, using messages of conformity such as "Eighty-six percent of Charleston residents pick up after their pets to protect water quality. Do you?" could promote this sustainable behavior as a social norm, urging others to conform for a greater purpose.

As shown in Table 3, Charleston residents were more likely than residents in the other three surveyed areas to indicate they "always" or "nearly always" pour hazardous chemicals down storm drains. Similarly, a greater percentage of this surveyed region "always" or "nearly always" dumped grass clippings down the storm drain or into backyard creeks (Table 3). These are important findings as the Charleston economy relies heavily on tourism, including water-based tourism and shrimp and oyster harvesting. In 2008, more than four million visitors came to the greater Charleston area; the economic impact of tourism is estimated to be greater than $3 billion annually (Charleston Metro Chamber of Commerce 2009). Degradation of water resources could significantly harm the local economy. However, emphasizing the relationship between hazardous chemicals and leaf debris, environmental impacts and impact to the local economy may not be enough to sustain a change in behavior. Research on energy conservation campaigns and their success has shown that using the rational-economic model, which assumes that people will perform conservation behaviors that are economically advantageous, underestimates the complexity of influence process and behavior change (Costanzo et al. 1986). Through this survey effort, though, a potential behavioral concern has been identified, and its impact on water quality, priority for education and next steps can be further evaluated.

Finally, parking lot runoff was perceived by greater than 10 percent (and up to 18 percent) of respondents in each region as having no impact on local water quality. Yet fuel and oil leaks from automobiles were consistently perceived as having a great impact on local water quality by more than 54 percent of respondents in each surveyed region. This may be further testament to the misperception that stormwater is treated. This finding may also be related to research on human information processing that has indicated that people will give a disproportionate weight to "vivid" information (Borgida and Nisbett 1977; Hamill, Wilson and Nisbett 1980; as cited in Costanzo et al.1986). In regard to improving the awareness that parking lot runoff consists of pollutants including those related to auto leaks, vivid imagery may be critical in ensuring that the educational message is perceived. Research has shown that citizens and decision makers are influenced by visual imagery related to environmental challenges, including endangered species (Witte et al. 2004) and decisions related to landscape design and degradation (Mobley and Witte 2005).

Conclusion

As identified by Eidson (2008), there exists a disconnect between a watershed and its stakeholders. Further, Eidson reports that this disengagement with local and regional environmental issues is due to factors including the lack of readily accessible and understandable information and the complexity of watershed issues. In the context of stormwater education and education campaign development, the level of knowledge, identification of target behaviors and target audiences and an understanding of motivation behind behavior change are critical considerations for success. This described survey instrument was initiated to discover these elements for a specific program's stormwater education efforts in South Carolina, but hopefully these early findings can be useful to stormwater educators in other areas of the country. Our findings do demonstrate that in the area

with the most long-term stormwater education in which Carolina Clear is a participant, respondents were more likely to identify that stormwater is not treated before discharge to local waterways when compared to the most new area receiving this education through this program. This baseline information can be more fully evaluated in future years when this survey is repeated.

Eidson (2008) states, "As each citizen plays an individual and collective role as both a consumer of natural capital and a steward of the environment, capacity building must be designed to welcome the input of the general stakeholder (p. 1)." And, our survey results suggest that residents are willing to assist in efforts to improve the quality of local waterways. In an effort to identify what situation would be most motivating for each region's public, respondents were asked how likely they would be to get involved in water resource issues if various examples of messages were delivered and through various media sources. A high proportion of respondents across all four areas indicated they would "very likely" become involved with water resource issues, especially in response to local media coverage of positive actions taken by residents to improve water quality; respondents were less likely to become involved in response to media coverage of water pollution problems. This finding seems to support the research about social norms and conformity, cited earlier (McKenzie-Mohr and Smith 1999). Given this insight, Carolina Clear hopes to gain public involvement and support from media releases with positive water quality news and updates to encourage public involvement.

Through collaborative efforts from Cooperative Extension programming to University-facilitated research, including Clemson University's Center for Watershed Excellence and Department of Sociology and Anthropology, tool development that speaks to the knowledge base identified in this survey and which give watershed issues clarity for the stakeholders are means to encourage watershed-scale public involvement. These tools currently available include the Intelligent River and Watershed Stewardship Map for South Carolina. Future research efforts will utilize sociodemographic information to further determine target audiences and methods of communicating this program's environmental protection messages.

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Gene Eidson has over 25 years of experience in water resources management and community-based environmental stewardship programming. Dr. Eidson is a Professor of Biological Sciences at Clemson University and serves as Director of the Baruch Institute of Coastal Ecology & Forest Science, Centers for Applied Ecology and Watershed Excellence and Restoration Ecology Focus Area within the Clemson University Restoration Institute. He is principal investigator of several of Clemson's largest interdisciplinary research teams, the Intelligent River and Aiken Green Infrastructure. In addition, Dr. Eidson was founder, President & CEO of Southeastern Natural Sciences Academy, a 501(c)(3) organization located in Augusta, Georgia. He can be contacted at the Center for Watershed Excellence, 144 Long Hall, Clemson, SC 29634, geidson@clemson.edu.

References

Alderserio, K., D. Wait, and M. Sobsey. 1996. Detection and characterization of male-specific RNA coliphages in a New York City reservoir to distinguish between human and non-human sources of contamination. *Proceedings of a Symposium on New York City Water Supply Studies*, Ed. McDonnell et al., TPS-96-2. American Water Resources Association. Herndon, VA.

Bamberg, S. and G. Moser. 2007. Twenty years after Hines, Hungerford and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behavior. *Journal of Environmental Psychology* 27: 14-25.

Berk, R. A. and R. G. Fovell. 1999. Public perceptions of climate change: A ''willingness to pay'' assessment. *Climatic Change* 41(3–4):413–446.

Borgida, E. and R. Nisbett. 1977. The differential impact of abstract vs. concrete information on decision. *Journal of Applied Social Psychology* 7: 258-271.

Center for Watershed Protection. 1999. *A Survey of Residential Nutrient Behavior in the Chesapeake Bay. Ellicott City, MD*. Center for Watershed Protection. http://www.cwp.org/UNEP_all.PDF).

Charleston Metro Chamber of Commerce. 2009. 2009/2010 Charleston Regional Economic Profile. Charleston, SC. www.charlestonchamber.net.

Costanzo, M., D. Archer, E. Aronson, and T. Pettigrew. 1986. Energy conservation behavior: The difficult path from information to action. *American Psychologist* 41(5): 521-528.

Eidson, G. 2008. *Proceedings of the 2008 South Carolina Water Resources Conference*: October 14-15, 2008, North Charleston Convention Center. Clemson University Center for Watershed Excellence. Clemson, SC. ISBN: 978-0-615-25592-7.

Hamill, R., T. D. Wilson, and R. Nisbett. 1980. Insensitivity to sample bias: Generalizing from a typical case. *Journal of Personality and Social Psychology* 39(4): 578-589.

Hardwick, N. 1997. *Lake Sammamish watershed water quality survey*. King County Water and Land Resources Division. Seattle, WA.

Hines, J. M., H. R. Hungerford, and A. N. Tomera. 1986/1987. Analysis and synthesis of research on responsible environmental behavior. *The Journal of Environmental Education* 18(2): 1-8.

McClafferty, J. 2002. *A Survey of Chesapeake Bay watershed residents: Knowledge, attitudes and behaviors towards Chesapeake Bay watershed quality issues*. Chesapeake Bay Program: Annapolis, MD.

McKenzie-Mohr, D. and W. Smith. 1999. *Fostering sustainable behavior: An introduction to community-based social marketing*. New Society Publishers. British Columbia.

Mobley, C. and J. Witte. 2005. *Public opinion on water-related issues: Knowledge, attitudes and behaviors*. Saluda-Reedy Watershed Consortium. Greenville, SC.

Sleavin, W. J. and D. L. Civco. 2000. Measuring impervious surfaces for non-point source pollution modeling. *Proceedings of the 2000 American Society of Photogrammetry and Remote Sensins (ASPRS) Annual Convention*. http://74.125.155.132/scholar?q=cache:3FjFnTd0zzoJ:scholar.google.com/measuring+impervious+surfaces%22&hl=en&as_sdt=2000000000000. Accessed May 30, 2010.

South Carolina Department of Health and Environmental Control (SC DHEC). 2003. *Public perceptions and concern about polluted runoff*. Columbia, SC.

Swann, C. 1999. *A survey of residential nutrient behaviors in the Chesapeake Bay*. Widener Burrows, Inc. Chesapeake Research Consortium, Center for Watershed Protection. Ellicot City, MD.

Tarrant, M. A., A. D. Bright, and H. K. Cordell. 1997. Attitudes toward wildlife species protection: Assessing moderating and mediating effects in the value-attitude relationship. *Human Dimensions of Wildlife* 2(2): 1-20.

Thoms, M. C. 2006. Variability in riverine ecosystems. *River Research and Applications* 22: 115-121.

Trial, W. T. Jr., C. Slaughterbeck, J. Goldberg, G. Ma, and M. Samadpour. 1993. Bacterial source tracking: Studies in an urban Seattle watershed. *Puget Sound Notes* 30:1-3.

United States Bureau of the Census. 2000. *United States Census 2000 Demographic Profiles*: Charleston-North Charleston, SC MSA; Columbia, SC MSA; Florence, SC MSA; Myrtle Beach, SC MSA; Sumter, SC MSA.

United States Environmental Protection Agency. 2010. *MS4 Permit Improvement Guide*. EPA 833-R-10-001. Washington, D.C.

Vernberg, F. J. and W. B. Vernberg. 2001. *The coastal zone: Past, present, and future*. University of South Carolina Press. Columbia, SC.

Witte, J., R. Pargas, C. Mobley, and J. Hawdon. 2004. Instrument effects of images in web-based surveys. *Social Science Computer Review* 22(3): 363-369.

Zahran, S., S. Brody, H. Grover, and A. Vedlitz. 2006. Climate change vulnerability and policy support. *Society and Natural Resources* 19(9): 771-789.