Report to the North Carolina Sea Grant Program

"Assessing the Public's Awareness and Understanding of Rip Currents at Wrightsville Beach, Carolina Beach and Kure Beach in New Hanover County, North Carolina, USA"

Sea Grant
North Carolina

Rip Currents

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Introduction

This study was conducted at the request of the North Carolina Sea Grant Program. The purpose of the study was to assess the public's awareness and understanding of Rip Currents at Wrightsville Beach, Carolina Beach and Kure Beach in New Hanover County, North Carolina, USA thereby allowing the North Carolina Sea Grant Program to evaluate the effectiveness of its active campaign to educate New Hanover County beach-goers about Rip Currents.

Background

New Hanover County

New Hanover County is located in southeastern North Carolina. Its northern border is Pender County and its southern border is Brunswick County. East of New Hanover County is the Atlantic Ocean and to the west is the Cape Fear River and Brunswick County. According to the United States Census Bureau, New Hanover County has a total area of 328 square miles with 199 square miles of land and 129 square miles of water. New Hanover County is the second smallest county in North Carolina in terms of area. The population of New Hanover County was 160,307 in 2000 and 179,553 in 2005. The population density in 2005 was 903 people per square mile. The 2006 estimated population of New Hanover County was 182,591. Approximately 95% of the population of New Hanover County is urban and 5% rural. New Hanover County is divided into

five (5) townships: Cape Fear, Federal Point, Harnett, Masonboro and Wilmington. The county contains four (4) incorporated municipalities: Wilmington, Wrightsville Beach, Carolina Beach and Kure Beach. Wilmington is the only municipality in New Hanover County that does not border the Atlantic Ocean. Wrightsville Beach, Carolina Beach and Kure Beach all have oceanfront beaches.

Rip Currents

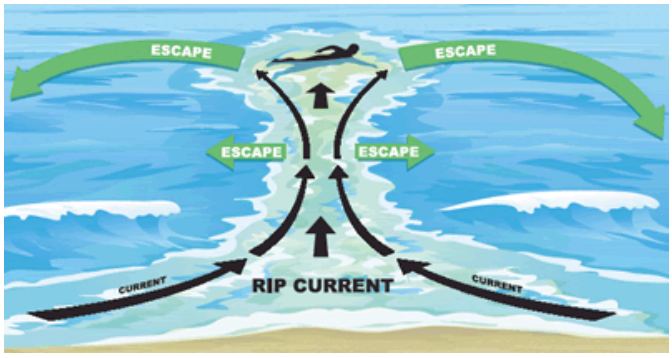
Rip Currents are powerful, channeled currents of water flowing away from shore (perpendicular to the beach) and out into the sea. Rip Currents typically extend from the shoreline, through the surf zone, and past the line of breaking waves. These currents may extend 200 to 2,500 feet (61 to 762 meters) lengthwise, but they are typically less than 30 feet (9 meters) wide. Typical flow of water in a Rip Current is at 0.5 meters per second (1 – 2 feet per second), and can be as fast as 2.5 meters per second (8 feet per second). Rip Currents can occur at any beach with breaking waves. Rip Currents do not pull people under the water—Rip Currents pull people away from the shoreline. Rip Currents are responsible for approximately 100 deaths every year in the United States. They are the number-one concern for beach lifeguards: about 80 percent of all beach rescues are related to Rip Currents totaling 25,000 lifeguard rescues a year on

average (**Table 1**). Despite these startling statistics, many swimmers do not know anything about Rip Currents, and they have no idea how to survive when caught in a Rip Current. Rip Currents are not "undertow" or "riptides."

Table 1—2003 – 2007 National Lifesaving Statistics (USLA 2007)

		Rescues			
Year	Beach Attendance	Beach Rip Currents	Beach Other Surf	Beach Total	Percent Rip Current-Related
2002	223,543,899	21,874	3,770	25,644	85%
2003	246,889,194	20,383	4,323	24,706	83%
2004	249,176,470	27,753	6,383	34,136	81%
2005	255,701,463	23,972	6,127	30,099	80%
2006	216,149,436	27,359	6,712	34,071	80%

While the precise conditions leading to a Rip Current are not know, the general picture is as follows—when wind and waves push water towards the shoreline, the previous backwash is often pushed sideways by the oncoming waves. This water streams along the shoreline until it finds an exit back to the sea. The resulting Rip Current is usually narrow and located in a trench between sandbars, under piers or along jetties.



There are some tangible, observable clues to look for in the water to see if a Rip Current is present. These clues include: unusually calm waters, caused by the channel of water flowing out; a channel of churning, choppy water; a difference in the color of the water; a line of seaweed, debris or foam moving seaward from the shoreline; a break in the incoming wave pattern; and, a lower waterline on the shoreline.

NOAA; Nick Steers— http://www/ripcurrents.noaa.gov/images/ripfromabove.jpg

NOAA— http://www.ripcurrents.noaa.gov/images/big_sur/DE%20SG%20Monterey%20rip%206.jpg

If an individual is caught in a Rip Current, there are some measures that an individual can take to assist him/her in surviving the Rip Current. The individual caught in a Rip Current should—stay calm to conserve energy and think clearly and not fight the Rip Current; escape the Rip Current by swimming parallel to the shoreline if possible; once the Rip Current weakens, the individual should swim at an angle away from the Rip Current toward the shoreline; the individual can also float or calmly tread water until the Rip Current disperses into deeper waters and then swim at an angle away from the Rip Current toward the shoreline.

Rip Current Awareness Strategies Team

In August 2004, the **Rip Current Awareness Strategies Team** (RCAST) was formed. The RCAST brought together a diverse group of individuals and

organizations with a shared vision of eliminating Rip Current fatalities at New Hanover County area beaches. The RCAST mission was to develop and deliver a multi-agency educational outreach program targeting elementary and secondary students, local residents, and tourists. Notable accomplishments of the RCAST include:

1. development of an educators' resource page which went live in March 2005
2. distribution of 26,000 "***Break the Grip of the Rip***" brochures to students in public and private schools in New Hanover County
3. distribution of 1,600 "***Break the Grip of the Rip***" posters for display in public and private school classrooms in New Hanover County
4. distribution of 3,000 "***Break the Grip of the Rip***" refrigeration magnets for placement in beach rental units and hotels in New Hanover County
5. a movie-size **"Break the Grip of the Rip"** poster was displayed from May through November 2005 at Consolidated Theatres Mayfaire Cinema in Wilmington
6. RCAST members appeared in a piece about Rip Currents and beach safety that was aired on NBC's *Today Show* on July 1, 2005
7. RCAST members provided information on RCAST and Rip Current safety for articles published throughout North Carolina, including the Charlotte Observer, Wilmington Star, and North Carolina Exchange Club magazine
8. distributed 1,500 Rip Current safety brochures to incoming UNC Wilmington students in August 2005

General Methodology

The study research team consisted of Dr. Jim Herstine, Dr. Doug Gamble, Dr. Chris Dumas and Dr. Stephen Meinhold from the University of North Carolina Wilmington (UNCW). The survey instrument (**Appendix 1**) was constructed by the research team with the cooperation and assistance of Spencer Rogers, North Carolina Sea Grant Extension Specialist. Survey instrument pre-tests were conducted by the research team on August 9, 12, and 17 2006. The study was actively conducted at designated oceanfront beach locations in Wrightsville Beach, Carolina Beach and Kure Beach, New Hanover County, North Carolina from August 19 – September 20, 2006. The surveys were administered randomly during these dates between 10:00 am and 5:00 pm.

In order to systematize and formalize the survey administration each of the beaches to be surveyed was divided into zones. Wrightsville Beach was divided into four (4) zones; Carolina Beach was divided into four (4) zones; and, Kure Beach was divided into three (3) zones. Volunteer survey administrators were recruited and trained and a "*Beach Safety and Awareness Survey Administration Protocol (BSASAP)*" (**Appendix 2**) was developed by the research team. The BSASAP provided the volunteer survey administrators with specific and detailed instruments on the methodology for administering the survey instrument. The survey administrators were instructed to only work with the "zone" he/she was assigned for each day of interviewing and to ask each question exactly as it appeared on the survey instrument. A systematic random sampling technique was utilized to select survey respondents. This technique required the survey administrators to work within his/her designated zone and walk across the oceanfront beach stopping every fifth (5^{th}) individual or group of individuals and requesting an interview.

The survey administrators were instructed to begin their initial interviewing by walking the beach within the designated zone along a line closest to the dune/vegetation line and farthest from the water. The survey administrator was instructed to start the interview transect at the back of the beach at either end of the designated zone and walk in a parallel line to the water's edge toward the

opposite end of the assigned zone. Any repeated transects for that day were to be started by moving ten (10) normal paces (approximately 25 feet) closer to the water. This pattern was to be repeated stopping every fifth (5^{th}) individual or group of individuals and requesting an interview until the designated zone had been completely transected. The survey administrators were instructed on subsequent interviewing days to alternate the start of the repeated transects among the dune/vegetation line, the middle of the dry sand area and the water's edge and then follow the established protocol. The survey administrators were also instructed to make an accurate estimate of the number of potential individuals he/she could have interviewed if he/she were interviewing every individual in the zone on the beach during the time he/she administered the survey instrument.

Results

General Results

Significant facts and frequencies gleaned from the Rip Current data analysis include:

- 359 valid surveys were obtained
  - 204 surveys were obtained from Wrightsville Beach—57%
  - 116 surveys were obtained from Kure Beach—32%
  - 39 surveys were obtained from Carolina Beach—11%
- 43% of the respondents were male and 57% were female
- 82% of the respondents were White and 5% were African-American
- 89% of the respondents answered *yes* to the question ***Do you know what Rip Currents are?***
- When asked ***Please tell me what are Rip Currents?***, the responses were:
  - Channeled currents of water—64%
  - Typically form at breaks in sandbars and near structures such as jetties and piers—11%
  - Quite common—4%
  - Other responses—44%

        - "undertow"; "pulls you out to sea"

- 98% of the respondents answered "*Agreed"* to the question ***Rip Currents exist along the New Hanover County coast***.
- When asked ***From which of the following sources of information did you become aware that Rip Currents exist along the New Hanover County coast?***, the responses were:
    - Signs—44%
    - Brochures—8%
    - Radio—10%
    - TV—46%
    - Newspaper—22%
    - Refrigerator magnet—2%
    - Friend—14%
    - Family member (not children)—19%
    - Child/children—4%
    - Other sources—35%
        - "lifeguard"; "lifeguard training"; "experienced/witnessed"
- When asked ***From which of the following sources of information did your child/children become aware that Rip Currents exist along the New Hanover County coast?***, the responses were:
    - Signs—6%
    - Brochures—8%
    - Radio—2%
    - TV—5%
    - Newspaper—3%
    - Refrigerator magnet—0%
    - Friend—5%
    - Family member—15%
    - Other sources—9%
        - "lifeguard"; "lifeguard flags"; "school"; "grew up here"

- When asked ***What would you do if you were caught in a Rip Current?***, the responses were:
  - Stay calm—16%
  - Don't fight the current—30%
  - Escape by swimming parallel to the shoreline—68%
  - If unable to escape, float or tread water—25%
  - Draw attention to yourself—5%
  - Do nothing at all—2%
  - Other—11%
    - "float"; "swim with it"; "don't know"
- When asked the question ***Why are Rip Currents dangerous?***, the responses were:
  - Rip Currents pull people away from shore—44%
  - Rip Currents vary in speed—4%
  - Rip Currents can sweep even the strongest swimmer out to sea—19%
  - People become tired and can drown—62%
  - I don't know why Rip Currents are dangerous—3%
  - Other reasons—24%
    - "people panic"; "suck you under"; "unpredictable"
- When asked ***What are some clues that a Rip Current may be present?***, the responses were:
  - A channel of churning, choppy water—18%
  - A difference in water color—18%
  - A line of foal, seaweed or debris moving seaward—12%
  - A variation in wave patterns—25%
  - I don't know any clues that a Rip Current may be present—30%
  - Other clues—32%
    - "sand disturbances"; "changes in current"; "lifeguards/flags"
- 60% of the respondents who traveled to the beach with an individual under the age of 18 had discussed Rip Currents with him/her

- 52% of the respondents have been coming to the beach where he/she was interviewed for 7 years or less
- 34% of the respondents typically visited the beach where he/she was interviewed during the week
- 73% of the respondents typically visited the beach where he/she was interviewed on weekends
- 49% of the respondents typically visited the beach where he/she was interviewed during vacations and days off
- 53% of the respondents planned to take 6 or fewer trips to the beach where he/she was interviewed during the 2007 season (Easter weekend through Labor Day weekend)
- 54% of the respondents were overnight visitors
- 62% of the respondents who were overnight visitors were staying for 3 or fewer nights
- 60% of the respondents who were overnight visitors were staying on a beach island
- 37% of the respondents who were overnight visitors were staying in a hotel/motel and 32% were staying in a non-rental cottage or house
- 59% of the respondents were married
- 40% of the respondents had a college degree
- 18% of the respondents had a household total annual income of $60,001 to $75,000 and 26% had a household total annual income of more than $100,000

Willingness to Pay (WTP) Results

As scientific understanding of Rip Currents advances and the ability to forecast Rip Current events improves, coastal managers have begun to develop Rip Current education and safety programs such as the “Rip Current Awareness and Safety Program” (RCASP). However, such programs must compete for scarce public funds, and to date no information has been available on the public’s willingness to pay for rip current education. This study finds that the

willingness of beachgoers to pay for Rip Current awareness and safety information is substantial.

A detailed description of the willingness to pay (WTP) analysis methodology is provided in **Appendix 3**. The point estimate of mean (average) willingness to pay for RCASP is $44 per year per household for day visitors, $66 per year per household or overnight visitors, or $53 per year per household on average across all beach visitors. Confidence intervals for these point estimates are given in **Appendix 3 Table A3 1 – 5**. Given a sample mean of 21.9 beach trips per visitor per year across all beach visitors, mean willingness to pay for RCASP per beach trip is $2.42.

To develop an estimate of the aggregate value of RCASP to day trip visitors, we consider those North Carolina residents living within 120 miles of the NC coast. In 2004, approximately 1.6 million households lived within 120 miles of the NC coast. Based on a recent random sample telephone survey conducted in 2004 (Herstine et al. 2005), 63 percent of these households visited a NC beach in 2003. To develop a conservative estimate of NC resident day trip visitors' willingness to pay for RCASP in 2007, we assume that 63 percent of 1.6 million households each value the RCASP program at the lower bound of the 95% confidence interval around the average willingness to pay value (WTP_{mean}) for day visitors, or $27.57 annually per day visitor household, for an aggregate estimate of $27.8 million annually in 2007. This aggregate benefit estimate is conservative for several reasons: First, it assumes no increase in beach-going households due to population growth between 2004 and 2007. Second, the estimate assumes no increase in beach trips per beach-going household due to RCASP (i.e., if some households take additional beach trips due to an increased feeling of safety resulting from RCASP educational efforts, the value of these additional trips is not included in the benefit estimate). Third, the estimate uses the lower bound estimate of willingness to pay per household per trip rather than the (larger) point estimate. Although the benefit estimate is conservative, several caveats should be mentioned. The estimate assumes that beachgoers who do not know the definition of Rip Currents would value Rip Current information to the

same extent as those who know the definition of Rip Currents. The estimate also assumes that day trip beach goers at all NC beaches are similar to the beachgoers surveyed in the study area with respect to their willingness to pay for RCASP. The estimate does not include the WTP of overnight visitors.

To develop an estimate of the aggregate value of RCASP to overnight visitors, an estimate of the annual number of overnight beach trips could be multiplied by the lower bound of the 95% confidence interval for WTP_{mean} for overnight visitors, or $44.14 per visitor per year. Multiplying the sample proportion of overnight visitors to day visitors (0.745 = 0.427/0.573) by the estimated number of day visitors (1 million = 0.63*1.6million) produces an estimate of 745,000 overnight visitors per year. Multiplying 745,000 overnight visitors by $44.14 per visitor produces an estimate of $32.9 million for the aggregate WTP of overnight visitors for the RCASP program. This benefit estimate is conservative for reasons similar to those mentioned above for day trip visitors.

Spatial Differences in Responses Results

Spatial analysis of the survey data collected in the Rip Current Beach Awareness and Safety study attempted to answer two (2) questions:

1. Do survey participants' responses differ significantly by location within the study area?
2. Where do survey participants come from based upon zip code of permanent residence?

A two or more sample X^2 test, or contingency table, was conducted to determine if responses are significantly different for questions 7, 9, 11, 12 and 13 (**Appendix 1**). These questions were chosen due to their focus upon Rip Current knowledge as opposed to the remaining survey questions which collected demographic data. The contingency tables were completed to test a null hypothesis that survey participants' responses do not differ significantly between Wrightsville Beach, Carolina Beach and Kure Beach at the 95% confidence level.

For Survey Question #7—***Please tell me what are Rip Currents?***, the null hypothesis was rejected (X^2 = 59.5, d.f. = 6). Examination of the survey

frequencies for question #7 indicates that the significant difference was caused by a greater percentage of participants at Carolina Beach choosing response "d) Other", or their own definition of a Rip Current, as a response as compared to Wrightsville Beach and Kure Beach (**Table 2**).

Table 2—Response Percentages for Survey Question #7

What are Rip Currents?	7a Channelized Currents	7b Breaks in Sandbars	7c Quite Common	7d Other
Wrightsville Beach	52.7%	10.3%	5.9%	37.1%
Carolina Beach	35.5%	3.2%	0%	61.3%
Kure Beach	62%	9%	0%	28%

The contingency table analysis for Survey Question #9—***From which of the following sources of information did you become aware that Rip Currents exist along the New Hanover coast?***, indicated rejection of the null hypothesis ($X^2 = 41.4$, d.f. = 18), or a statistically significant difference in frequency of survey participants' responses between Wrightsville Beach, Carolina Beach and Kure Beach. However, this difference should be viewed with caution due to violation of test assumption that 80% of the expected frequencies are greater than or equal to 5. Only 67% of this sample are greater than or equal to 5. It appears that the difference is created again by a high frequency of responses in the "Other" response (**Table 3**).

Table 3—Response Percentages for Survey Question #9

Sources of Information	9a Signs	9b Brochures	9c Radio	9d TV	9e Newspaper	9f Magnet	9g Friend	9h Family	9i Child	9j Other
Wrightsville Beach	20.8%	2.9%	3.8%	23.7%	11.8%	0.6%	8.4%	10.1%	1.2%	16.8%
Carolina Beach	8.3%	0%	5.6%	19.4%	2.8%	0%	11%	5.6%	2.8%	44.4%
Kure Beach	24.8%	5.7%	6.7%	21.4%	11.4%	1.9%	4.3%	8.1%	2.9%	12.9%

The contingency table analysis for Survey Question #11—***What would you do if you were caught in a Rip Current?***, resulted in a rejection of the null hypothesis (X^2 = 52.6, d.f. = 12) indicating a statistically significant difference in frequency of survey participants' responses between Wrightsville Beach, Carolina Beach and Kure Beach. However, this difference should be viewed with caution due to violation of test assumption that 80% of the expected frequencies are greater than or equal to 5. Only 67% of this sample are greater than or equal to 5. A greater percentage of "Other" response in Carolina Beach appears to be the cause of the difference for Question #11 also (**Table 4**).

Table 4—Response Percentages for Survey Question #11

What would you do if caught in a Rip Current?	11a Stay Calm	11b Don't Fight	11c Swim Parallel	11d Float or Tread	11e Call for Help	11f Do Nothing	11g Other
Wrightsville Beach	10.7%	22.4%	43.7%	14.7%	2.6%	0.7%	5.1%
Carolina Beach	4.9%	17.1%	39%	7.3%	4.9%	0%	26.8%
Kure Beach	10.7%	13.6%	44.3%	21.4%	2.9%	2.1%	5%

For Survey Question #12—***Why are Rip Currents dangerous?***, the null hypothesis was not rejected (X^2 = 8.0, d.f. = 10) indicating no statistically significant difference in frequency of participants' responses between Wrightsville Beach, Carolina Beach and Kure Beach. In regard to Survey Question #13 ***What are some clues that a Rip Current may be present?***, the contingency table analysis resulted in rejection of the null hypothesis (X2 = 24.2, d.f. = 10) indicating a statistically significant difference in frequency of survey participants' responses between Wrightsville Beach, Carolina Beach and Kure Beach. The differences in response frequency indicate that at Kure Beach, responded with "a)" and "c)" more frequently and "f)" less frequency as compared to Wrightsville and Carolina Beach (**Table 5**). Such responses indicate that participants in Kure Beach identify "A channel of churning, choppy water" and "A line of foam, seaweed or debris moving seaward" as compared to "Other" or a participant defined clue.

Table 5—Response Percentages for Survey Question #13

Clues that a Rip Current is present?	13a Channel of Water	13b Water Color	13c Line of Foam	13d Wave Pattern	13e Don't Know	13f Other
Wrightsville Beach	14.5%	10.1%	5.3%	18.9%	23.2%	28.1%
Carolina Beach	11.9%	19%	4.8%	11.9%	19%	33.3%
Kure Beach	21%	10.5%	16.1%	14.7%	18.2%	19.5%

The spatial distribution of survey participant's place of residence was examined by mapping the frequency of zip codes provided by participants in Survey Question #5. The majority of responses to the survey instrument came from individuals from the New Hanover County area and the greater Raleigh area (**Figure 1**). Thirty-nine (39) of the respondents were from out-of state with the greatest number of out-of-state respondents from Virginia, followed by Pennsylvania, South Carolina, Maryland and Virginia (**Table 6)**.

Figure 1—Distribution of Responses by Zip Code

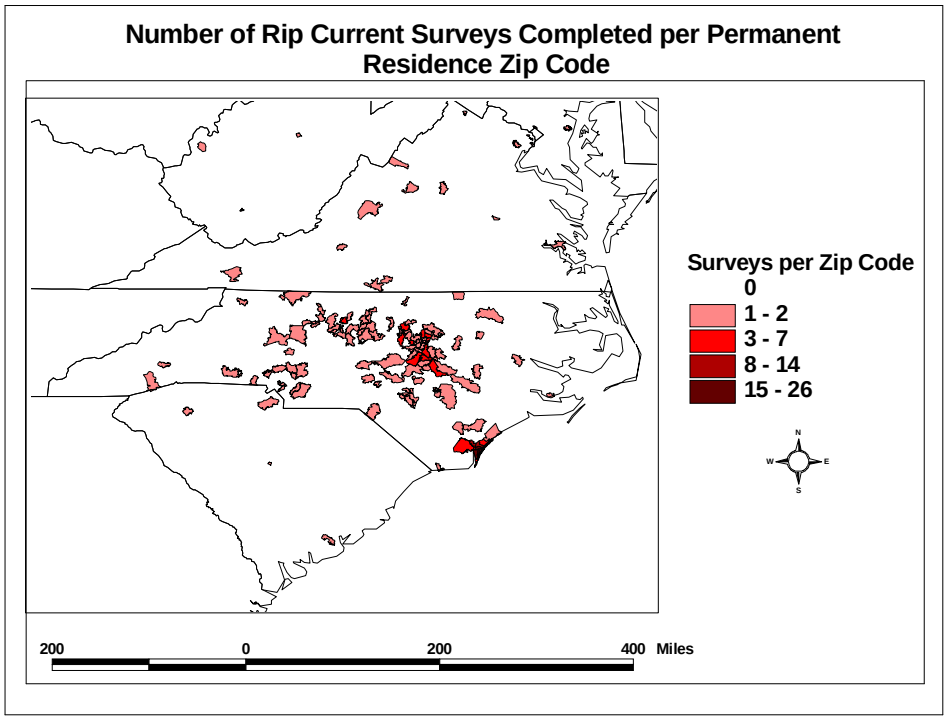


Table 6—Frequency of Respondents Residing Outside North Carolina

State	Frequency
MA, NH, NJ, OH, TN, WA	1
AL, IL	2
MD, WV	3
NY, PA, SC	4
VA	11

Conclusions

General Information

The majority of the survey respondents were aware of Rip Currents (89%) and ninety-eight percent (98%) of the respondents were aware that Rip Currents exist along the New Hanover County coast. This information would seem to indicate that Rip Current awareness is not a problem in New Hanover County. However, one gets a different perspective when the responses to survey questions 11 and 12 are analyzed. When asked ***What would you do if you were caught in a Rip Current?***, only sixty-eight percent (68%) of the respondents stated "Escape by swimming parallel to the shoreline" and only thirty percent (30%) responded "Don't fight the current." This would seem to indicate that the respondents believe they are knowledgeable about Rip Currents and know what to do if caught in a Rip Current; however, one might be justified in challenging this knowledge based upon the fact that the respondents did not give the "best or preferred" response to the question. When the respondents were asked ***Why are Rip Current dangerous?***, only nineteen percent (19%) stated that "Rip Currents can sweep even the strongest swimmer out to sea" and only forty-four percent (44%) responded that "Rip Currents pull people away from shore." Twenty-four percent (24%) responded "Other." Again, based upon these responses, one might question the respondents' knowledge of Rip Currents. Even though the respondents know that Rip Currents exist, a substantial proportion of beachgoers does not know how to determine whether a Rip Current

is occurring, and a substantial proportion does not know what to do if caught in a Rip Current in order to safely escape it. These conclusions suggest that additional educational efforts such as "Break the Grip of the Rip" are warranted and necessary.

The most effective media for educating the respondents about Rip Currents along the New Hanover County coast are use of television, signs and other sources such as lifeguards, notification systems (lifeguard flags), and school based education programs. The least effective methods for educating the respondents about Rip Currents are refrigerator magnets, brochures and the use of radio. The most effective means for educating children about Rip Currents would be family members and friends. The respondents were familiar with the accepted methods for escaping a Rip Current and aware of the clues indicating the presence of a Rip Current. The results of the study support the notion that Rip Current awareness and safety in New Hanover County is not an issue. However, the fact that Rip Current awareness and safety is not an issue in New Hanover County is probably due to the public's exposure to television, signage and beach specific information (e.g., lifeguards and lifeguard station flags) regarding Rip Currents.

Willingness to Pay (WTP)

As scientific understanding of Rip Currents advances and the ability to forecast Rip Current events improves, coastal managers have begun to develop rip current education and safety programs such as the "Rip Current Awareness and Safety Program" (RCASP). However, such programs must compete for scarce public funds, and to date no information has been available on the public's willingness to pay for Rip Current education. This study finds that the willingness of beachgoers to pay for Rip Current awareness and safety information is substantial. The point estimate of mean (average) willingness to pay for RCASP is $44 per year per household for day visitors, $66 per year per household or overnight visitors, or $53 per year per household on average across all beach visitors. (Confidence intervals for these point estimates are given in **Appendix 3 Table A3-5**.) When aggregated across all visitors to North

Carolina beaches, the estimated willingness to pay of all day visitors is $27.8 million annually, with overnight visitors willing to pay an additional $32.9 million annually.

Public expenditures on water safety and awareness programs such as RCASP may be justified by legal risk management arguments in addition to beachgoer willingness to pay. Coastal municipalities may wish to reduce the risk of legal liability arising from Rip Current-related injuries and drowning. In a recent legal case involving a drowning due to rip currents at Miami Beach, USA, the Supreme Court of Florida (2005) found: "We hold that based on the undisputed facts, the City controls the beach area and was operating a public swimming area at the 29th Street location at the time of the accident. Thus, the City had a duty of care to warn of dangers that were known or should have been known, and is not shielded from liability as a matter of law based on sovereign immunity." By preventing injuries and death, water safety and awareness programs reduce the legal liability of coastal municipalities.

On a global basis, the World Health Organization (WHO) (2003) reports that in 2002 an estimated 376,000 people drowned worldwide, making it the 3rd leading cause of unintentional injury death globally after road traffic injuries and falls. These figures exclude drowning due to floods (cataclysms), boating and water transport. The vast majority (approximately 97%) of all drowning deaths occurred in low- and middle-income countries, and over half of the global mortality due to drowning occurs among children aged between 0 and 14 years. Better water safety awareness and education programs, such as RCASP, could reduce these grim statistics. The WHO report calls for increased awareness and instruction for children to avoid drowning hazards, and increased research to further identify vulnerable populations, risk factors, protective factors, and economic impacts of drowning and drowning prevention. The RCASP addresses the leading cause of drowning along the coasts of the United States.

Spatial Differences in Responses

A spatial difference in responses was observed among Wrightsville Beach, Carolina Beach and Kure Beach respondents for some key survey

questions. This spatial difference in responses can be interpreted as an absence of a uniform definition of a Rip Current and/or the absence of a uniformly identified method for dealing with a Rip Current in the event one finds himself/herself in a Rip Current. Assuming the message and language used in the survey is the common message and language used in the educational media distributed regarding Rip Currents, the results also indicate that Carolina Beach respondents were not getting this message or language as clearly as Wrightsville Beach and Kure Beach respondents and were choosing other options for defining a Rip Current and how to escape it.

It must also be noted that the vast majority of survey respondents were from New Hanover County and the greater Raleigh area. Such spatial distribution indicates that Rip Current educational efforts targeted at New Hanover County and the greater Raleigh area residents may be the most effective means for disseminating Rip Current awareness materials.

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APPENDIX 1

Beach Awareness and Safety Survey

Name of Interviewer: _____
Date of Interview: _____ Time of Interview: _____
Interview Location:
W-B1 (Shell Island Resort to Johnnie Mercer's Pier)_____
W-B2 (Johnnie Mercer's Pier to Station 1)_____
W-B3 (Station 1 to Oceanic Pier)_____
W-B4 (Oceanic Pier to Masonboro Inlet Jetty)_____
C-B1 (North End of Freeman Park to Entrance to Freeman Park)_____
C-B2 (Entrance to Freeman Park to Beginning of Boardwalk at Carolina Beach Avenue)_____
C-B3 (Beginning of Boardwalk at Carolina Beach Avenue to Pier at Ocean Grill & Tiki Bar)_____
C-B4 (Pier at Ocean Grill & Tiki Bar to Atlantic Towers High-Rise at Alabama Avenue)_____
Kure Beach1 (Atlantic Towers High-Rise at Alabama Avenue to Kure Beach Pier)_____
Kure Beach2 (Kure Beach Pier to North End of Fort Fisher Rocks)_____
Kure Beach3 (South End of Fort Fisher Rocks to Fort Fisher State Recreation Area)_____

Hello, I'm_____ from the University of North Carolina Wilmington and the North Carolina Sea Grant Program and we are conducting a study regarding individual's knowledge and awareness of beach safety issues. Your participation in this survey is entirely voluntary and will take less than 5 minutes. You may terminate this interview at any time. All answers will be kept confidential.

Q1 Would you be willing to answer a few questions? **Q1a** _____Yes **Q1b**_____ No
(If YES, go to **Q2**. If NO, thank them for their time and terminate the interview)

Q2 Is the individual being interviewed: **Q2a** _____Male **Q2b** _____Female

Q3 Is the individual being interviewed:
- **Q3a**_____White (Non-Hispanic)
- **Q3b**_____Black (Non-Hispanic)
- **Q3c**_____Hispanic
- **Q3d**_____Asian/Pacific Islander
- **Q3e**_____American Indian/Alaskan Native
- **Q3f**_____Other (Please specify_____)

Q4 In what year were you born? _____Year (If under the age of 18, born 1988 or later , thank the individual, tell them you are only allowed to interview individuals 18 or older, and terminate the interview.)

Q5 What is the zip code of your permanent residence? _____

Q6 Do you know what Rip Currents are?
Q6a _____Yes **Q6b** _____No → skip to **Q21**

Q7 Please tell me what are Rip Currents? (**Listen to the individual's response and mark all of the following responses that you hear**)
Q7a____Rip Currents are channelized currents of water flowing away from shore at surf beaches
Q7b____Rip Currents typically form at breaks in sandbars and also near structures such as jetties and piers
Q7c____Rip Currents are quite common and can be found on many surf beaches every day
Q7d ___Other (Please specify)_____

Q8 Rip Currents exist along the New Hanover County coast.
Q8a _____Agree **Q8b**_____Disagree → skip to **Q11**

Q9 From which of the following sources of information did you become aware that Rip Currents exist along the New Hanover coast? (**Ask all and mark all responses that apply**)

Q9a___Signs in and around the New Hanover County beaches → go to **Q11**
Q9b___Brochures distributed in the school system and other locations → go to **Q11**
Q9c___Radio → go to **Q11**
Q9d___Television → go to **Q11**
Q9e___Newspaper → go to **Q11**
Q9f___Refrigerator magnet → go to **Q11**
Q9g___Friend → go to **Q11**
Q9h___Family member not my child/children → go to **Q11**
Q9i___My child/children (Please specify age/ages)_____ → go to **Q10**
Q9j ___Other (Please specify)_____ → go to **Q11**

Q10 From which of the following sources of information did your child/children become aware that Rip Currents exist along the New Hanover coast? (**Ask all and mark all responses that apply**)

Q10a___Signs in and around the New Hanover County beaches
Q10b___Brochures distributed in the school system and other locations
Q10c___Radio
Q10d___Television
Q10e___Newspaper
Q10f___Refrigerator magnet
Q10g___Friend
Q10h___Family member
Q10j ___Other (Please specify)_____

Q11 What would you do if you were caught in a Rip Current? (**Listen to the individual's response and mark all of the following responses that you hear)**

Q11a___Stay calm
Q11b___Don't fight the current
Q11c___Escape the current by swimming in a direction following the shoreline (parallel to the shoreline). When free of the current, swim at an angle—away from the current—toward shore
Q11d___If you are unable to escape by swimming, float or tread water. When the current weakens, swim at an angle away from the current toward shore
Q11e___If at any time you feel you will be unable to reach shore, draw attention to yourself: face the shore, call or wave for help
Q11f___I would do nothing at all
Q11g ___Other (Please specify)_____

Q12 Why are Rip Currents dangerous? (**Listen to the individual's response and mark all of the following responses that you hear)**

Q12a___Rip Currents pull people away from shore
Q12b___Rip Current speeds can vary from moment to moment and can quickly increase to become dangerous to anyone entering the surf
Q12c___Rip Currents can sweep even the strongest swimmer out to sea
Q12d___People become tired and can drown
Q12e___I don't know why Rip Currents are dangerous
Q12f ___Other (Please specify)_____

Q13 What are some clues that a Rip Current may be present?

Q13a ___A channel of churning, choppy water
Q13b ___A difference in water color
Q13c___A line of foam, seaweed or debris moving seaward
Q13d___A variation in the incoming wave pattern
Q13e___I don't know any clues that a Rip Current may be present
Q13f ___Other (Please specify)_____

Q14 Would your household be willing to pay _____ per year in local or state taxes to support Rip Current Awareness and Safety Programs? (**Rotate the dollar amount for each survey and write the amount selected for this particular respondent in the space provided—$1, $5, $10, $25, $50, $100)**

Q14a_____Yes **Q14b**_____No

Q15 Why would you not be willing to pay the $_____? (**Write the amount selected for the above question in the space**)

Q15a_____The amount is too high
Q15b_____I believe beach goers should educate themselves
Q15c_____I don't trust government
Q15d_____I don't think it is fair to make beach goers pay
Q15e_____I don't think it is fair to make non-residents pay
Q15f_____I don't trust the NC Sea Grant Program
Q15g_____Other (please explain)_____

Q16 How many individuals, including yourself, normally live in your household?

_____People

Q17 How many adults (18 or older) traveled with you to the beach today?

_____People

Q18 How many individuals under the age of 18 traveled with you to the beach today?

_____People

Q19 Have you had a discussion with these individuals under the age of 18 about Rip Currents?

Q19a_____Yes **Q19b**_____No → skip to **Q21**

Q20 What have you told these individuals under the age of 18 about Rip Currents?_____

_____

Q21 How many years have you been coming to this beach?

_____Years

Q22 When do you typically come to this beach?

Q22a___During the week
Q22b___On weekends
Q22c___Vacations and days off

Q23 Including today, how many trips to this beach have you taken since Easter weekend (April 16th)?

_____Trips

Q24 At this point, knowing what you do about your other commitments, how many more trips to this beach do you think you will take through Labor Day weekend (September 4th)?

_____Trips

Q25 How many trips do you expect to take ***next summer*** (Easter weekend through Labor Day weekend)?

_____Trips

Q26 What is the primary purpose of your trip to the beach today?

Q26a___Sun/tan
Q26b___Relax/read
Q26c___Walk/jog
Q26d___Swim
Q26e___Surf/board
Q26f___Fish
Q26g___Socialize/date/meet people
Q26h___Entertain kids
Q26i___Other (Please specify_____)

Q27 Are you an overnight visitor?
Q27a_____Yes **Q27b**_____No → skip to **Q31**

Q28 How many nights are you staying?

_____Nights

Q29 Are you staying at night on a beach island or on the mainland?
Q29a_____On a beach island **Q29b**_____On the mainland

Q30 Which type of lodging are you using at night?
Q30a___Hotel/motel
Q30b___Rental cottage/house
Q30c___Rental condo/apartment
Q30d___Non-rental cottage/house
Q30e___Non-rental condo/apartment
Q30f___Other (Please specify_____)

Q31 What is your marital status?
Q31a_____Single
Q31b_____Married
Q31c_____Separated
Q31d_____Divorced
Q31e_____Other (Please specify_____)

Q32 What is your highest level of education completed?
Q32a_____Less than high school graduate
Q32b_____High school graduate
Q32c_____Some college / not a college graduate
Q32d_____Associate degree / community college graduate
Q32e_____Bachelors degree / college graduate
Q32f_____Masters degree
Q32g_____PhD degree
Q32h_____Law school graduate
Q32i_____Medical school graduate

Q33 What is your occupation?

_____

If retired, please ask what their occupation was_____

Q34 As close as you can recall, what is your household's total annual income before taxes? Is it 15 thousand dollars or less, between 15,001 and 25,000, between 25001, and 30,000, between 30,001 and 35,000, between 35,001 and 40,000, between 40,001 and 45,000, between 45,001 and 50,000, between 50,001 and 60,000, between 60,001 and 75,000, between 75,001 and 100,000 or more than 100,000?

Q34a___$15,000 or less
Q34b___Between $15,001 and $25,000
Q34c___Between $25,001 and $30,000
Q34d___Between $30,001 and $35,000
Q34e___Between $35,001 and $40,000
Q34f___Between $40,001 and $45,000
Q34g___Between $45,001 and $50,000
Q34h___Between $50,001 and $60,000
Q34i___Between $60,001 and $75,000
Q34j___Between $75,001 and $100,000
Q34k___More than $100,000

This concludes our interview. Thank you very much for participating!

APPENDIX 2

Beach Safety and Awareness Survey Administration Protocol

Thank you for agreeing to volunteer as a survey administrator for the Beach Safety and Awareness Study (Rip Currents). Your time and efforts are greatly appreciated.
Here are some specific things to remember while administering the survey instrument:

1. Only work within the "zone" you have been assigned for each day of interviewing.
2. Ask each question as it appears on the survey instrument.
3. Be presentable while administering the survey—wear the t-shirt supplied to you and any other respectable UNCW clothing (shorts, baseball cap, visor, etc).
4. We will be using a systematic random sampling technique to select survey respondents. Work within your designated survey zone and walk across the beach stopping to interview **every fifth individual or group of individuals** (a group of individuals who have traveled to the beach together and/or are interacting on the beach together), and request an interview. The first time that you interview, begin walking the beach along a line closest to the dune/vegetation line and farthest from the water. Start your interview transect at the back of the beach at either end of the designated zone you are working and walk in a parallel line to the water's edge toward the opposite end of the zone you are working. Any repeated transects for that day should be started moving 10 paces (approximately 25 feet) closer to the water. The second time you go out to interview, start in the middle of the dry sand area of either end of the zone you are working and walk in a parallel line to the water's edge toward the opposite end of the zone. Any repeated transects for that day should be started moving 10 paces (approximately 25 feet) closer to the water. The third time you go out to interview, start at the water's edge at either end of the zone you are working and walk in a parallel line to the water's edge toward the opposite end of the zone. Any repeated transects for that day should be started moving 10 paces (approximately 25 feet) to the dune/vegetation line (away from the water). The fourth time that you interview, you will begin back at the dune/vegetation line of the zone and repeat the above. Do not repeat groups or individuals.
5. Always be position, respectful and helpful. If someone refuses to respond to the survey, say "Thank you for your time", smile and walk away. Be certain to mark **Q1b**____ _____*No* on the survey sheet.
6. At the end of each completed interview session, thank the respondent, smile and walk away to your next interview following the guidelines in item #4 above.
7. If inclement weather (rain or strong winds) starts during the time you are administering the survey, interferes with your interviewing efforts, and persists for longer than 30 minutes, abandon your survey efforts for the day. Do not stay out of the beach during thunder and lightning!
8. Bring water, a snack and sunscreen with you to the beach.
9. Make a note of any question that respondents consistently request to be clarified or explained and notify Jim Herstine at herstinej@uncw.edu.
10. You must make an accurate estimate of the number of potential individuals you could have interviewed if you were interviewing every single individual on the beach during the time you administered the survey instrument. In other words, please count the number of individuals on the beach in the zone you were interviewing in during the time frame you interviewed, including those you interviewed and those who declined to be interviewed. Keep track of these estimates and submit this information to either Spencer Rogers or Jim Herstine as you submit your completed survey sheets. Record this information on the **Beach Safety and Awareness Tracking Sheet**.
11. Submit all completed survey instruments to Spencer Rogers at the Center for Marine Science or to Jim Herstine at 119-C Hanover Hall on the UNCW campus.

APPENDIX 3

Willingness To Pay (WTP) Analysis Methodology

The willingness to pay analysis considers beachgoers (both local residents and non-residents) who visited beaches in New Hanover County, North Carolina, USA, in the summer of 2006. Of the 364 beachgoers approached by surveyors, only 32 (9%) refused to answer survey questions. Of those answering the survey questions, eleven percent (11%) answered "No" to the question: ***"Do you know what Rip Currents are?"*** If a respondent answered "No," the questions concerning willingness to pay for a Rip Current Awareness and Safety Program were skipped. As a result, the analysis considers only those NC beachgoers (both residents and non-residents) who agreed to answer survey questions and who answered "Yes" to the question "Do you know what Rip Currents are?"

We use the contingent valuation (CV) method (Mitchell and Carson 1989, Haab and McConnell 2003) to estimate beachgoers' willingness to pay (WTP) for the Rip Current Awareness and Safety Program (RCASP). CV is a method of recovering information about survey respondents' WTP for changes in the quantity or quality of goods or services. In this study, CV is applied to estimate beachgoers' willingness to pay for additional information services, namely, the RCASP.

This study uses the dichotomous choice CV method. (The method is "dichotomous" because the survey respondent must choose between two possible responses, "Yes," or "No," on a key survey question.) The dichotomous choice method is used because it is incentive-compatible, meaning that respondents have the best chance of influencing the outcome of the survey when they answer survey questions truthfully, that is, respondents have incentive to tell the truth rather than to lie when answering survey questions. In the dichotomous choice method, each survey respondent is asked whether or not he would be willing to pay a specified dollar amount for a specified good or services. In this study, the following dichotomous choice question is asked:

Would your household be willing to pay amount X per year in local or state taxes to support Rip Current Awareness and Safety Programs?

where X is replaced by one of the values $1, $5, $10, $25, $50, and $100, chosen at random for each survey respondent. Although each respondent is asked whether he would be willing to pay only one of the values, any particular value is considered by many different survey respondents. By analyzing the statistical relationships between the payment amounts and the respondents' yes/no answers to the willingness to pay question, an estimate can be made of the dollar value of the specified good or service to the average survey respondent. This estimate is then multiplied by the number of potential consumers of the good or service in the market, in this case the number of beachgoers, to estimate the aggregate value of the good or service, in this case the RCASP.

The payment vehicle (form of payment) described in the CV question above is an annual payment of local or state taxes. A tax payment vehicle is used to avoid "free-rider" problems in which a respondent who truly values the good or service may not want to admit that he is willing to pay simply because he feels that others would not pay and attempt to "free-ride" on his payment. In the event that the program were implemented, then if it were to be funded by a tax that all would be required to pay, then the "free-riding" problem is avoided.

A basic economic modeling framework used to analyze dichotomous CV data is the random willingness to pay model (RWTP). Hanemann (1984) and Cameron and James (1987) show how estimates of WTP can be derived by statistically analyzing dichotomous CV data within a RWTP modeling framework. Two modeling decisions must be made by the analyst: the type of functional form to be used for the WTP function and the type of error term distribution. A WTP function measures the amount of money a consumer is willing to pay for a good or service depending on characteristics of the consumer (income, gender, age, etc.), characteristics of the good or service, and characteristics of the choice situation. It is assumed that if a consumer's WTP for a good or service in

question is larger than its cost, then she would answer "Yes" to the CV question rather than "No." (In the present study, the good in question is the Rip Current Awareness and Safety Program, and the cost of the good is the annual tax payment stated in the CV question.) For this study, we consider two commonly-used WTP functional forms, linear and exponential, and two commonly-used error distributions, normal and logistic. Selecting the normal error distribution results in the "PROBIT" discrete choice statistical regression model. Selecting the logistic error distribution results in the "LOGIT" discrete choice statistical regression model (see Greene 2003, chapter 21, and Haab and McConnell 2002, chapter 2). Either model attempts to predict the probability that an individual says "Yes" to the CV question, based on the WTP function, the cost of the good (the annual tax payment), and the Yes/No responses to the CV question collected from the surveyed individuals. If the model results are statistically significant, point estimates of WTP can be derived from the results, and statistical confidence intervals for WTP can be calculated.

In the present study, a PROBIT model is used to estimate the probability that a consumer answers "Yes" to the CV question. The dependent variable in the PROBIT model is a dichotomous (binary) variable WP, where $WP_i = 1$ if individual i answers "Yes" to the CV question, and $WP_i = 0$ if the individual answers "No." (Note that although WP is the dependent variable in the PROBIT model, the model is used to estimate the probability that WP = 1). We follow the typical, conservative practice and assume that WP = 0 for each survey respondent who does not report WP. WP is assumed to be determined by he following independent variables: the tax payment amount required to fund the RCASP (PAYAMT), whether the individual is an experienced beachgoer, as indexed by the number of years that the individual has visited the beach (YRSBEACH), whether or not the individual will enter the water to swim or surf during this beach trip (WATER), whether the respondent was unfamiliar with water characteristics indicating rip currents (NOCLUE), and standard demographic variables: the individual's gender (GENDER), age (AGE), marital status (MARRIED), number of children (NUMKIDS), level of education, as

proxied by college graduation status (COLLEGE), and ethnicity (MINORITY). In addition, we include an independent variable that helps us determine whether results for local residents are different from those for out-of-town visitors, often an important policy question in beach recreation studies. The survey provides information on state of residence (NCSTATE), whether the current beach trip is a day trip or an overnight trip (OVERNGT), and number of beach trips per year for each surveyed individual (TRIPS07). Because many overnight beach visitors are out of state residents, many overnight beach visitors make few beach trips per year, and many out of state residents make few beach trips per year, these three factors are correlated. After deleting observations with missing data, there were only 27 observations on out of state residents (NCSTATE=0), too few for meaningful analysis, and so NCSTATE was dropped from the model. Of the two variables OVERNGT and TRIPS07, OVERNGT had the strongest statistical influence on WP. In order to avoid statistical multi-collinearity problems, TRIPS07 was dropped from the analysis and OVERNGT is used as a proxy for out-of-town visitor status in the final models.

Data for WTP Analysis

The survey produced observations on 293 respondents who were willing to answer survey questions and who stated that they knew what Rip Currents were. After deleting observations with missing data, 206 observations were available for analysis. Descriptive statistics for the model variables are presented in **Table A3 – 1**. Of the 206 survey respondents analyzed, just over 65 percent answered "Yes" to the willingness to pay question (WP). The annual tax payment amount PAYAMT variable ranged from $1/yr to $100/yr, with an average value of $27/yr across respondents. Household incomes (INC) ranged from $7,500 to $100,000+ per year, with an average value of $67,000. Forty-five percent of survey respondents were male (GENDER), and fifty-five percent were female. Respondents ranged in AGE from 19 to 72 years, with an average age of 41.8 years. Respondents reported having from zero to six children under 18 years of age with them at the beach (NUMKIDS), with an average number of children of 0.82. A bit less than 45 percent of survey respondents indicated that

they planned to contact the water (WATER) through swimming or surfing while at the beach. Just under 60 percent of respondents are college graduates (COLLEGE), 86 percent are North Carolina residents (NCSTATE), and 7 percent

Table A3 – 1—Descriptive Statistics for Variables Used in Willingness to Pay (WTP) Regression Models (n = 206)

Variable	Mean	Std.Dev.	Minimum	Maximum
WTP	0.65534	0.476415	0	1
PAYAMT ($'s)	27.2233	32	1	100
INC ($1,000s)	67.233	29.0813	7.5	100
GENDER (1=male)	0.451456	0.49885	0	1
AGE (years)	41.8058	13.1754	19	72
NUMKIDS	0.820388	1.23832	0	6
WATER (1=swim or surf)	0.446602	0.498352	0	1
COLLGRAD (1=yes)	0.597087	0.491678	0	1
NCSTATE (1=NC resident)	.864077670	.343540921	0	1
TRIPS07	21.8834951	36.6171494	1	365
OVERNGT (1=overnight trip)	0.427184	0.495875	0	1
MINORITY (1=minority)	0.072816	0.260466	0	1
YRSBEACH	13.716	12.7547	0	61
NOCLUE (1=no clue)	0.296117	0.457655	0	1

are members of a racial minority group (MINORITY). Respondents reported plans to take from 1 to 365 trips to the beach on which they were surveyed during 2007 (TRIPS07), with an average number of trips of 21.9. Almost 43 percent of respondents reported staying overnight at the beach during the surveyed beach trip (OVERNGT). Respondents stated that they had been visiting the beach on which they were surveyed from zero to 61 years (YRSBEACH), with an average length of beach experience of 13.7 years. Nearly 30 percent of survey respondents reported that they were unfamiliar with clues indicating the presence of rip currents in the water (NOCLUE).

WTP Results

A basic check on the consistency of the data provided by a CV survey is finding a negative relationship between the tax payment amount described in the CV question (PAYAMT) and the "Yes/No" willingness to pay question (WP). The results in **Table A3 – 2** indicate that the percentage of survey respondents

answering “Yes” to the willingness to pay question decreases as the tax payment amount increases, indicating a negative relationship between the tax payment and willingness to pay. To investigate the factors influencing WTP and to provide the information needed to develop dollar estimates of mean and median WTP, the results of several regression models are presented in **Table A3 – 3** and **Table A3 – 4**.

Table A3 – 2—Relationship between Hypothetical Annual Tax Amount Necessary to Support RCASP and Willingness to Pay (WTP) of Beachgoers

Annual Tax Amount (PAYAMT)	Yes (WTP=1)	No (WTP=0)	Total Obs.	Percent Yes
$1	34	4	38	0.89
$5	34	7	41	0.83
$10	22	12	34	0.65
$25	21	16	37	0.57
$50	18	12	30	0.60
$100	6	20	26	0.23
Total (Ave. for Percent Yes)	136	71	206	0.66

Table A3 – 3—Regression Model Results for Linear Willingness to Pay (WTP) Function

LINEAR WTP FUNCTION MODEL
(Dependent Variable = WTP)

Model Variable	PROBIT Coef. Est. (t-stat)	PROBIT Marginal Effects	LOGIT Coef. Est. (t-stat)	LOGIT Marginal Effects	Variable Means
Constant	β_0 = 0.966632 (1.901)*	-----	β_0 = 1.612198 (1.804)*	-----	1
PAYAMT	β_1 = -1.73E-02 (-5.452)**	-0.00624	β_1 = -2.85E-02 (-5.212)**	-0.00622	27.2233
INC	β_2 = 6.54E-03 (0.419)	-----	β_2 = 1.16E-02 (0.435)	-----	67.23301
INCSQ	β_3 = -8.50E-05 (-0.682)	-----	β_3 = -1.50E-04 (-0.707)	-----	5361.893
GENDER	β_4 = -2.26E-02 (-0.11)	-----	β_4 = -2.24E-02 (-0.064)	-----	0.451456
AGE	β_5 = -8.51E-03 (-1.021)	-----	β_5 = -1.43E-02 (-1.013)	-----	41.80583
NUMKIDS	β_6 = 0.151878 (1.677)*	0.0548	β_6 = 0.264909 (1.657)*	0.0579	0.820388
WATER	β_7 = -9.30E-02 (-0.442)	-----	β_7 = -172501 (-0.484)	-----	0.446602
COLLGRAD	β_8 = 5.96E-03 (0.028)	-----	β_8 = -4.98E-03 (-0.014)	-----	0.597087
OVERNGT	β_9 = 0.38185 (1.766)*	0.1354	β_9 = 0.635975 (1.71)*	0.1359	0.427184
MINORITY	β_{10} = 0.10529 (0.272)	-----	β_{10} = 0.136713 (0.208)	-----	7.28E-02
YRSBEACH	β_{11} = 2.94E-03 (0.371)	-----	β_{11} = 4.29E-03 (0.319)	-----	13.71602
NOCLUE	β_{12} = 0.120596 (0.533)	-----	β_{12} = 0.203407 (0.529)	-----	0.296117
Model Observations	n = 206		n = 206		
Model log likelihood	-111.8720		-111.9319		
Restricted log likelihood	-132.6801		-132.6801		
Chi squared	41.61616		41.49655		
Degrees of freedom	12		12		
p-value	0.386E-04		0.405E-04		
Percentage of correct predictions	73.30 %.		72.82 %		

*indicates statistical significance at the 10% level
**indicates statistical significance at the 5% level

Table A3 – 4—Regression Model Results for Exponential Willingness to Pay (WTP) Function

EXPONENTIAL WTP FUNCTION MODEL
(Dependent Variable = WTP)

Model Variable	PROBIT Coef. Est. (t-stat)	PROBIT Marginal Effects	LOGIT Coef. Est. (t-stat)	LOGIT Marginal Effects	Variable Means
Constant	β_0 = 1.471625 (2.774)**	-----	β_0 = 2.611671 (2.745)**	-----	1
LNPMNT	β_1 = -0.4002 (-5.492)**	-0.1418	β_1 = -0.6830 (-5.246)**	-0.1442	2.429458
INC	β_2 = 9.39E-03 (0.604)	-----	β_2 = 1.42E-02 (0.539)	-----	67.23301
INCSQ	β_3 = -1.00E-04 (-0.809)	-----	β_3 = -1.58E-04 (-0.755)	-----	5361.893
GENDER	β_4 = -1.14E-02 (-0.055)	-----	β_4 = -1.85E-02 (-0.053)	-----	0.451456
AGE	β_5 = -1.01E-02 (-1.197)	-----	β_5 = -1.70E-02 (-1.192)	-----	41.80583
NUMKIDS	β_6 = 0.15539 (1.69)*	0.0551	β_6 = 0.262583 (1.641)*	0.0554	0.820388
WATER	β_7 = -7.47E-02 (-0.351)	-----	β_7 = -0.170183 (-0.473)	-----	0.446602
COLLGRAD	β_8 = 4.43E-02 (0.208)	-----	β_8 = 3.31E-02 (0.092)	-----	0.597087
OVERNGT	β_9 = 0.26538 (1.245)	0.0929	β_9 = 0.462143 (1.271)	0.0961	0.427184
MINORITY	β_{10} = 0.305699 (0.778)	-----	β_{10} = 0.466964 (0.710)	-----	7.28E-02
YRSBEACH	β_{11} = 2.15E-03 (0.270)	-----	β_{11} = 3.21E-03 (0.235)	-----	13.71602
NOCLUE	β_{12} = 0.116633 (0.518)	-----	β_{12} = 0.194041 (0.512)	-----	0.296117
Model Observations	n = 206		n = 206		
Model log likelihood	-111.1314		-110.9303		
Restricted log likelihood	-132.6801		-132.6801		
Chi squared	43.09751		43.49969		
Degrees of freedom	12		12		
p-value	0.217E-04		0.186E-04		
Percentage of correct predictions	72.33 %.		72.33 %		

*indicates statistical significance at the 10% level
**indicates statistical significance at the 5% level

Linear WTP Function Model

Table A3 – 3 presents regression results for a linear WTP function model using normal (PROBIT) and logistic (LOGIT) error terms**. Table A3 – 4** presents results based on an exponential WTP function model using normal and logistic error terms. Because the dependent variable is discrete in both PROBIT and LOGIT models, the traditional tests used to assess model significance (i.e., F-tests) and fit (e.g., R^2) are inappropriate. Instead, a likelihood ratio test is customarily used to assess model significance, and the percentage of correct predictions of the dependent variable is used to assess model fit.

Likelihood ratio test results for the linear WTP function PROBIT and LOGIT models (**Table A3 – 3**) indicate that both models are highly significant ($p<0.05$). The PROBIT model correctly predicts the dependent variable WP in 73.30 percent of the sample, that is, the model correctly predicts 73.30 percent of the Yes/No choices made by the survey respondents. The LOGIT model correctly predicts WP in 72.82 percent of the sample.

In terms of the statistical significance of the independent variables in the linear WTP function models, for both the PROBIT and LOGIT specifications the t-statistics presented in **Table A3 – 3** indicate that the size of the tax payment (PAYAMT) is significant at the five percent (5%) level. The negative sign on the PAYAMT coefficient indicates that an increase in PAYAMT reduces the probability of answering "Yes" to the CV question. Number of children (NUMKIDS) and overnight stay (OVERNGT) are positive and significant at the ten percent level, indicating that both an increase in the number of children and staying overnight increase the probability of answering "Yes" to the CV question. All other regressors are not significant in determining the probability of answering "Yes" to the CV question.

Because the PROBIT and LOGIT models are non-linear regression models, the coefficients in **Table A3 – 3** do not give directly the incremental effects of changes in model variables on the probability of answering "Yes" to the CV question. However, these incremental, or marginal, effects can be calculated (see LIMDEP 2002, p. E15-22) and are presented in the "Marginal Effects"

columns of **Table A3 – 3** for the statistically significant model variables. Each marginal effect gives the change in the probability of answering "Yes" to the CV question as a result of a marginal increase in the model variable. The marginal effects are calculated at the average (mean) values of the model variables. Hence, for the PROBIT model, a $1 increase in the required annual tax payment (PAYAMT) results in a 0.624 percent decrease in the probability of answering "Yes" to the WTP question, assuming that all other model variables are at their mean values. Similarly, one additional child (NUMKIDS) increases the probability of answering "Yes" by approximately 5.48 percent. Staying overnight (OVERNGT) increases the probability of saying "Yes" by 13.54 percent compared to a day trip. Results are almost identical for the LOGIT model specification.

The linear WTP function model results in **Table A3 – 3** can be used to calculate the average (mean) willingness to pay (WTP_{mean}) for the Rip Current Awareness and Safety Program. For the linear WTP function model, WTP_{mean} is given by:

$$WTP_{mean} = [1/(-\beta_1)]\cdot[\beta_0 + \beta_2\cdot INC + \beta_3\cdot INCSQ + \beta_4\cdot GENDER + \beta_5\cdot AGE + \beta_6\cdot NUMKIDS + \beta_7\cdot WATER + \beta_8\cdot COLLGRAD + \beta_9\cdot OVERNGT + \beta_{10}\cdot MINORITY + \beta_{11}\cdot YRSBEACH + \beta_{12}\cdot NOCLUE],$$

where the coefficient values (e.g. β_1) are those given in **Table A3 – 3**, and each variable is replaced by its mean value from **Table A3 – 3** (for the derivation of WTP_{mean} for both PROBIT and LOGIT model specifications, see Haab and McConnell 2002, chapter 2). The first six rows of **Table A3 – 5** present estimates of WTP_{mean} for the linear WTP function model. Three estimates are provided for each model specification (PROBIT and LOGIT) corresponding to the average beach visitor, day visitor, and overnight visitor. The WTP_{mean} estimate of $53.12 (**row 1 of Table A3 – 5**) gives the annual household willingness to pay for the RCASP program averaged across all beach visitors, including both day and overnight visitors, for the PROBIT model specification. Using a Wald test

(LIMDEP 2002, pp.R10-21 to R10-23, R11-11 to R11-16), the estimate of WTP_{mean} is found to be statistically significant at the 1 percent level. Using the Delta Method (see Greene 2003, pp.70, 913-917; LIMDEP 2002, p. R10-22) the standard error of WTP_{mean} is found to be 7.18, producing a 95 percent confidence

Table A3 – 5—Mean and Median Willingness to Pay (WTP) Estimates (per beach-going household, per year)

WTP Function	Error Distribution	Trip Type (Average, Day, or Overnight)	WTP (mean)	WTP (median)	Std. Error	t-stat	95% Confidence Interval	
Linear	Probit	Average	$53.12	-----	$7.18	7.395	$39.04	$67.20
Linear	Probit	Day	$43.69	-----	$8.22	5.314	$27.57	$59.80
Linear	Probit	Overnight	$65.77	-----	$11.04	5.959	$44.14	$87.40
Linear	Logit	Average	$53.29	-----	$7.37	7.233	$38.85	$67.73
Linear	Logit	Day	$43.75	-----	$8.40	5.207	$27.29	$60.22
Linear	Logit	Overnight	$66.08	-----	$11.45	5.772	$43.64	$88.52
Exponential	Probit	Average	-----	$38.34	$11.38	3.369	$16.03	$60.65
Exponential	Probit	Day	-----	$28.88	$10.10	2.86	$9.09	$48.67
Exponential	Probit	Overnight	-----	$56.06	$25.86	2.168	$5.38	$106.73
Exponential	Logit	Average	-----	$38.47	$10.92	3.522	$17.06	$59.88
Exponential	Logit	Day	-----	$28.81	$9.83	2.93	$9.54	$48.09
Exponential	Logit	Overnight	-----	$56.69	$25.37	2.235	$6.97	$106.40

interval of $39.04 to $67.20, meaning that the true WTP_{mean} would fall within this range in 95 percent of repeated samples. The WTP_{mean} point estimate for day visitors is $43.69 (**row 2 of Table A3 – 5**), and the estimate for overnight visitors is $65.77 (**row 3 of Table A3 – 5**). Estimates of WTP_{mean} under the LOGIT model specification (**rows 4 – 6 of Table A3 – 5**) are very similar to the PROBIT model estimates.

Exponential WTP function model

Table A3 – 4 presents results based on an exponential WTP function model using normal and logistic error terms. Likelihood ratio test results for the exponential WTP function PROBIT and LOGIT models (**Table A3 – 4**) indicate that both models are highly significant ($p<0.05$). The PROBIT and LOGIT

models each correctly predict the dependent variable WP in 72.33 percent of the sample.

In terms of the statistical significance of the independent variables in the exponential WTP function models, for both the PROBIT and LOGIT specifications the t-statistics presented in **Table A3 – 4** indicate that the size of the tax payment (PAYAMT) is significant at the five percent level. The negative sign on the PAYAMT coefficient indicates that an increase in PAYAMT reduces the probability of answering "Yes" to the CV question. The coefficient for number of children (NUMKIDS) is positive and significant at the ten percent level, indicating that both an increase in the number of children increases the probability of answering "Yes" to the CV question. In contrast to the linear WTP model results, OVERNGT is not significant (at the 10 percent level) in the exponential WTP model. All other regressors are not significant in determining the probability of answering "Yes" to the CV question. Marginal effects for the significant variables (and OVERNGT) in the exponential WTP model are presented in **Table A3 – 4**. Hence, for the PROBIT model, a 1 unit increase in the log of required annual tax payment (LNPMNT) (equivalently, an increase from $11.34 to $30.85 in PAYAMT) results in a 14 percent decrease in the probability of answering "Yes" to the WTP question, assuming that all other model variables are at their mean values. Similarly, one additional child (NUMKIDS) increases the probability of answering "Yes" by approximately 5.51 percent. Staying overnight (OVERNGT) increases the probability of saying "Yes" by 9.29 percent compared to a day trip. Results are almost identical for the LOGIT model specification.

The exponential WTP function model results in **Table A3 – 4** can be used to calculate the *median* willingness to pay (WTP_{median}) for the Rip Current Awareness and Safety Program. For the exponential WTP function model, WTP_{median} is given by:

WTP_{median} = EXP{[1/(- β_1)]·[β_0 + β_2·INC + β_3·INCSQ + β_4·GENDER + β_5·AGE + β_6·NUMKIDS + β_7·WATER + β_8·COLLGRAD + β_9·OVERNGT + β_{10}·MINORITY+ β_{11}·YRSBEACH+ β_{12}·NOCLUE]},

where the coefficient values (e.g. β_1) are those given in **Table A3 – 4**, and each variable is replaced by its mean value from **Table A3 – 4** (for the derivation of WTP_{median} for both PROBIT and LOGIT model specifications, see Haab and McConnell 2002, chapter 2). Rows 7-9 of **Table A3 – 5** present estimates of WTP_{median} for the exponential WTP function model. Three (3) estimates are provided for each model specification (PROBIT and LOGIT) corresponding to the average beach visitor, day visitor, and overnight visitor. The WTP_{median} estimate of $38.34 (**row 7 of Table A3 – 5**) indicates that fifty percent (50%) of all beach households are willing to pay less than this amount for the RCASP program, and fifty percent are willing to pay more (under the PROBIT model specification). The fact that WTP_{median} is less than WTP_{mean} in the linear WTP model indicates that the distribution of WTP is not symmetric but rather is skewed toward higher WTP values. Using a Wald test (LIMDEP 2002, pp.R10-21 to R10-23, R11-11 to R11-16), the estimate of WTP_{median} is found to be statistically significant at the 5 percent level. Using the Delta Method (see Greene 2003, pp.70, 913-917; LIMDEP 2002, p. R10-22) the standard error of WTP_{median} is found to be 11.38, producing a 95 percent confidence interval of $16.03 to $60.65, meaning that the true WTP_{median} would fall within this range in 95 percent of repeated samples. The WTP_{median} point estimate for day visitors is $28.88 (**row 8 of Table A3 – 5**), and the estimate for overnight visitors is $56.06 (**row 9 of Table A3 – 5).** Estimates of WTP_{median} under the LOGIT model specifications (**rows 10 – 12 of Table A3 – 5)** are very similar to the PROBIT model estimates.