FINAL REPORT

# Coastal Climatology Products for Recreation and Tourism End Users in Southeastern North Carolina


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LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

## EXECUTIVE SUMMARY

The objective of this project was to develop a test coastal climatology product for recreation and tourism end users in southeastern North Carolina. The product was designed so that it can offer guidance and serve as a model to the Coastal Services Center and National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA) for further development of climatology products useful to coastal managers across the southeastern U.S.

Such products are important because tourism is a major sector of the global economy with 693 million international tourist arrivals worldwide generating receipts of $178 billion (WTO 2002). The U.S. currently ranks third in the world for international tourist arrivals and first in international tourism receipts ($112 billion) (WTO 2002). Domestic tourism within the U.S. is estimated to be greater than the international arrivals, with travelers spending $490 billion in 2003 (TIAA 2004). Since most coastal recreation and tourism occurs outdoors, information about weather and climate can be very important to managers and participants in determining when to offer or participate in an activity, the duration of that activity, and the activity's success or enjoyment (Smith 1993, Boniface and Cooper 1994, de Freitas 2001). Further, weather and climate information can aid in planning, scheduling, promoting, and participating in alternative activities during periods of adverse weather (Perry 1997).

Specific efforts in this project focused on two main tasks: 1) a needs assessment of coastal climatology information required by both tourism and recreation participants and managers for decision making, and 2) development of a test coastal climatology product for tourism and recreation participants and managers that provides this required information.

The needs assessment interviews included four general areas of inquiry: short-term marine or weather knowledge and information requirements, long-term marine or weather knowledge and information requirements, desired product format and delivery, and basic demographic data. The interviews were administered to 125 recreation and tourism managers and 330 recreation and tourism participants in 15 coastal communities between Atlantic Beach and Sunset Beach in southeastern North Carolina. Managers interviewed for the study were identified through review of business listings and field reconnaissance of business districts within the coastal communities. The participants interviewed in the study were identified through systematic random sampling (every fifth group of people) along transects across public beaches in the study area.

The recreation and tourism manager and participant interviews revealed a need for coastal climatology information, since almost all the interviewees responded that marine and weather information are important in their decision-making processes. However, it should be noted that few, if any, of the interviewees use marine or weather information on the climatological time scale (month or longer). Thus, a coastal climatology product, in order to be effective, must serve as an educational resource, teaching managers and participants the utility of the long-term temporal perspective of climatology. Perhaps the best way to achieve such an educational effort is to present short-term weather and

marine information, the type of data currently used most frequently by managers, within a climatological context. The interviews also indicated that recreation and tourism managers use information in all seasons, particularly spring through fall, and there is little demand for interactive forecasting tools, since few interviewees create their own forecasts. The climate variables most frequently required by interviewees were hurricane information, air temperature, and rain probability. Water temperature and wave height represent the marine variables most frequently used by interviewees that can be incorporated into a test coastal climatology product. Further, interview results indicate managers and participants rely heavily upon television, websites, and radio for marine or weather information. As technology advances, future coastal climatology products should have the capability to be delivered via text messaging, fax, and e-mail.

In addition to the needs assessment interviews completed for this project, feedback concerning the effectiveness of existing coastal climatology websites was collected through a "focus group." The most common comment from members of the focus group indicated that a simple site is the most effective site. Simple can be an elusive concept, but the comments indicate that, in the context of a coastal climatology website, simple refers to 1) a limited amount of information presented on the website, 2) efficient and clear web navigation features, 3) limited use of scientific jargon and graphics, and 4) limited use of colors and "flashy" graphics. Also of note in the focus group were comments regarding the need for more local data and the annoyance with the need to purchase or download software to further assess coastal climatology data.

Using the results of the needs assessment interviews and the website focus group, several guiding principles were developed to help construct the test coastal climatology product.

1. *The favored test product delivery system was a website*.
2. *The test product website was designed to be simple and elegant, providing information without overwhelming the end user*.
3. *The test product website not only provides coastal climatology information, but also serves as an educational resource that attempts to place real-time observations within a climatological framework*.
4. *The test coastal climatology website focuses upon presenting the marine variables identified by recreation and tourism managers as most frequently used in decision making.*
5. *The test coastal climatology website presents coastal climatology information on a local scale.*

With these five principles as a guide, the test coastal climatology website built for this project (*www.cormp.org/climate/*) consists of one "dynamic" page that displays near-real-time observations from Coastal Ocean Research and Monitoring Program (CORMP) observation stations in a climatological context, and four static pages that provide a description of Onslow Bay climate, climate predictions for the U.S., hurricane information for Onslow Bay, and contact information for the principal investigators (PIs) and CORMP Outreach.

The test coastal climatology website was also constructed to incorporate the five cross-cutting issues outlined by Janis and Gamble (2004) as important to the development of effective and useful products for any coastal manager from Virginia to Florida. The test coastal climatology website incorporates the first cross-cutting issue, user-defined coastal climatology, which is based upon interviews and a focus group of tourism and recreation managers and participants from southeastern North Carolina. By collecting this information and using it in Web design, a scientific definition of a coastal climatology is not imposed by the PIs onto the end user, allowing for a more organic, bottom-up design that involves local communities. Thus, a more flexible and user-friendly definition of coastal climatology is achieved.

The second cross-cutting issue, coarse-observation systems, was incorporated into the test coastal climatology website by using CORMP observations stations. Ultimately, six CORMP observation stations will be available in Onslow Bay. These six stations offer a much greater spatial resolution than do the two existing NDBC buoys at Frying Pan Shoals and Diamond Shoals. In addition, the six observation stations offer a better spatial coverage within Onslow Bay, while Frying Pan Shoals and Diamond Shoals are located on the fringes of the region.

The most difficult cross-cutting issue to incorporate into the test coastal climatology website was the third, integrating weather, marine, and climate forecast results across consistent (and statistically practical) spatial and temporal resolutions. Currently, CORMP and the University of North Carolina at Wilmington (UNCW) do not have the capability to create such forecasts. Accordingly, the website utilizes forecasts made from the NOAA Climate Prediction Center and attempts to place these within a coastal climatology framework with an introductory statement on how the end user should interpret the forecasts for Onslow Bay. The issue of integrated weather, marine, and climate forecasts is the most challenging aspect of creating effective coastal climatology products.

A collective design of coastal climatology products by end users and scientists, the fourth cross-cutting issue, was incorporated into the test coastal climatology website by choosing appropriate CORMP resources for the product identified by the needs assessment interviewers. Through such a selection process, both parties have a stake in product development and the end user satisfaction is increased.

The final cross-cutting issue of follow-up was integrated into the product through handing out information pamphlets during interviews, constructing a contact page on the website, and performing ongoing CORMP outreach activities, such as presenting weather and climatology information to secondary educators at the CORMP workshops and working with the National Weather Service Office–Wilmington to create a one-stop shop for weather data that encompass the North Carolina and South Carolina coastlines. Through such efforts, CORMP has created a presence in the coastal communities of southeastern North Carolina. This presence allows for more efficient interaction with the public and end users, allowing for effective follow-up to the creation of the test coastal climatology website.

## GOALS AND OBJECTIVES

The objective of this project is to develop a test coastal climatology product for recreation and tourism end users in southeastern North Carolina. This product will be designed so that it can offer guidance and serve as a model to the Coastal Services Center and National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA) for further development of climatology products useful to coastal managers across the southeastern U.S. The report and climatology product generated for this project include a listing of real-time marine, weather, and climate data and information characterized as important by tourism and recreation participants and managers in southeastern North Carolina coastal communities in needs assessment interviews across the region. Although the results will come from one specific region in the southeastern U.S., the product and final report are structured to incorporate the five cross-cutting issues outlined by Janis and Gamble (2004) as important to the development of effective and useful coastal climatology products for any coastal manager from Virginia to Florida.

## BACKGROUND

Economic activities in coastal locations have a large impact on the overall U.S. economy. In 2000, coastal U.S. states were responsible for 75 percent of the nation's gross national product (Colgan 2003). It has become evident, as knowledge of the link between economic and environmental systems grows, that continued growth of these coastal economies will require protection of coastal natural resources and adaptation to coastal environmental change.

One specific challenge in adapting to coastal environmental change is managing activities to compensate for climatic variability and change. In 1997 and 1998, seasonal and inter-annual variations in climate, such as the El Nino-Southern Oscillation, caused $25 billion in economic impacts, including property losses of $2 billion (NOAA 2003). In response to this challenge of integrating knowledge of climatic variability into commerce, NOAA is focusing upon fostering an understanding of climate variability and change as a component of decision-making skills that allow resource managers to plan for and respond to related changes and problems. Given NOAA's additional goal of providing coastal managers with the knowledge and tools needed to incorporate climate variability into the management of living marine and coastal resources, the Coastal Services Center and NCDC are developing a series of coastal climatologies that assist coastal managers in the decision-making process (Janis and Gamble 2004).

To facilitate the development of these coastal climatology products, a coastal climatology workshop (CCW) was hosted by the Coastal Services Center, NCDC, and the Southeastern Regional Climate Center (SERCC) in October 2003 to assess coastal managers' knowledge of climate information and how to use this information in decision-making across the southeastern U.S. Approximately 30 coastal managers participated in the workshop and discussed the current or potential use of climate information in eight general areas of coastal management: agriculture, energy conservation and planning,

environmental quality, fishery management, natural hazard mitigation, recreation and tourism, transportation, and water quality and consumption. Discussions allowed for a general assessment of the use of climate information in management decisions across the region but did not detail specific applications (Janis and Gamble 2004). As a result, for the Coastal Services Center, NCDC, and NOAA to continue further development of coastal climatology products, examples must be constructed that apply the CCW findings to a specific location, yet are flexible enough to allow for future refinement of similar products across the southeastern U.S. This project represents one of these examples of test coastal climatology products.

## INTRODUCTION

Tourism is a major sector of the global economy with 693 million international tourist arrivals worldwide generating receipts of $178 billion (WTO 2002). The U.S. currently ranks third in the world for international tourist arrivals and first in international tourism receipts ($112 billion) (WTO 2002). Domestic tourism within the U.S. is estimated to be greater than the international arrivals, with travelers spending $490 billion in 2003 (TIAA 2004). Accordingly, recreation and tourism is a significant portion of coastal communities' economic activities across the southeastern U.S. (Pearce 1981). Hotels, restaurants, bars, rental agencies, state parks, charter fishing, boat rentals, and ecotourism companies are just a small sample of the diverse economic activities that can be linked to tourism and recreation along the coast.

Since most coastal recreation and tourism occurs outdoors, information about weather and climate can be very important to managers and participants in determining when to offer or participate in an activity, the duration of that activity, and the activity's success or enjoyment (Smith 1993, Boniface and Cooper 1994, de Freitas 2001). Further, weather and climate information can aid in planning, scheduling, promoting, and participating in alternative activities during periods of adverse weather (Perry 1997). Weather conditions unaccounted for by managers or participants can have a significant negative impact upon coastal economic activities. For example, a particularly rainy summer can cause a decrease in the amount of vacation units rented and in the number of tourists that visit local restaurants and stores.

In addition, climate advisories can help to prepare and protect participants from heat and cold stress, sunburn, effects of air pollution, and heat stroke (de Freitas 1990). Thus, through incorporation of weather and climate data into management decisions, coastal communities can diminish economic loss created by adverse weather and increase efforts to protect public safety from climate-related hazards. Despite this documented relation between weather/climate and tourism, the climate-change-impacts research community has given far less attention to tourism, compared to other sectors, and more research on the subject is required (Scott et al. 2004).

Southeastern North Carolina represents a typical coastal region in the southeastern U.S., possessing strong economic ties to recreation and tourism. New Hanover County, North Carolina, which includes Wilmington and Wrightsville Beach, is located in the center of

the region and represents an example of a recreation and tourism-focused community typical to the region. Many of the barrier islands in the county originally served as a summer retreat, with access by train and boat only. These retreats have evolved into year-round tourist destinations and an integral part of New Hanover County's economy. The economic importance of recreation and tourism to New Hanover County's economy is underscored by the 5,630 jobs in the county related to travel and tourism and by tourism-related income estimated at $931 million in 2000 (Star News 2001).

The focus of most recreation and tourism activities in the community are the local beaches and coastal environment. This coastline is strongly influenced by alongshore currents and waves that drive beach erosion and accretion patterns, causing a need for beach replenishment to support recreation and tourism. Wrightsville Beach has one of the oldest ongoing federally funded beach renourishment projects in the U.S., with over $1,000,000 funding in a given year. Due to such links between coastal tourism and environmental management across southeastern North Carolina, the PIs believe that community residents will enthusiastically embrace efforts to incorporate knowledge of climatic variability into coastal management decisions.

Some use of climate and weather information by tourism management already exists in the form of National Weather Service (NWS) warnings regarding rip currents, small-craft advisories, and tropical storms. However, a comprehensive assessment of recreation and tourism managers' needs for weather and climate information has not been completed to date. Since UNCW has a strong regional presence in southeastern North Carolina and many links with the area's coastal communities (including a high number of alumni employed in the area), a high probability of success in developing end-user-derived climatology products exists for this location.

## METHODOLOGY

Results from the October 2003 CCW hosted by the Coastal Services Center, NCDC, and SERCC indicate that managers of coastal recreation businesses require a wide array of data and information (sea level trends, wave climatology, real-time surf conditions, seasonal and monthly climate forecasts, tropical storm forecasts, and tides) to make effective management decisions. However, these managers noted that some of the obstacles to the effective use of such information include scientific websites not easily understood by recreation managers, the inability to personalize available data, few visualization tools, and a paucity of inshore data (Janis and Gamble 2004). Accordingly, efforts in this project focus on two main tasks: 1) a needs assessment of coastal climatology information required by both tourism and recreation participants and managers for decision making, and 2) development of a test coastal climatology product for tourism and recreation participants and managers that provides this required information.

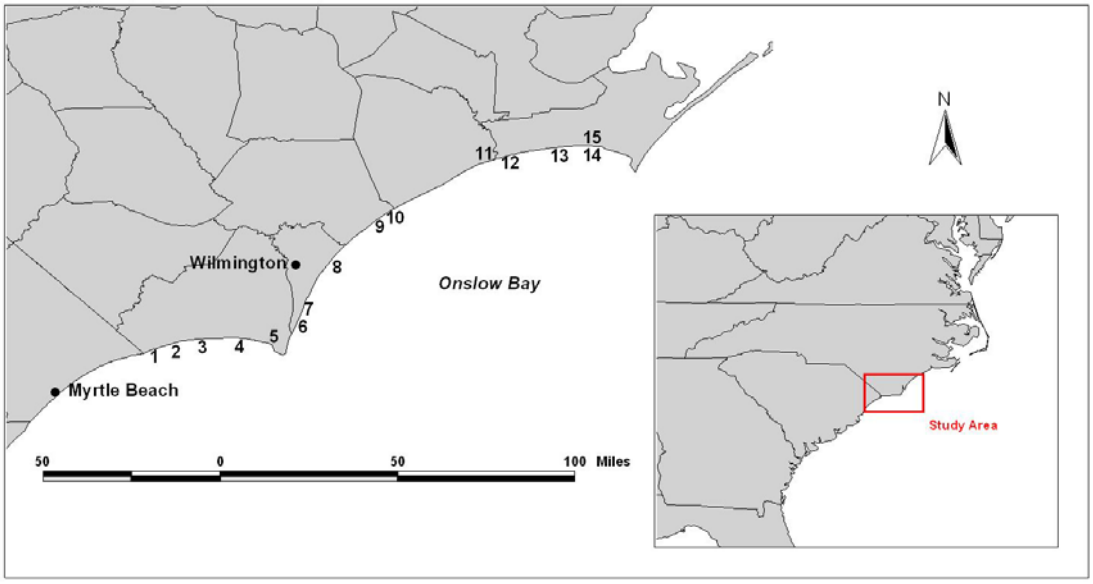
**Needs Assessment Interviews**

*Interview Design*

The purpose of the needs assessment interviews was to further assess and refine the data and information needs of recreation and tourism managers and also develop examples and guidelines for "user friendly" format and delivery of potential coastal climatology products. This expansion and refinement of previous Coastal Services Center efforts was achieved through the administration of needs assessment interviews to 125 recreation and tourism managers and 330 recreation and tourism participants in 15 coastal communities between Atlantic Beach and Sunset Beach in southeastern North Carolina (Figure 1). Both managers and participants are included in this needs assessment because both entities make decisions using marine, weather, and climate information that impact recreation and tourism activities in coastal areas. The managers usually make their decisions that preserve greatest economic return and ensure safety, while participants usually make decisions that maximize both enjoyment and return on economic investment in an activity (Goeldner and Ritchie 2002). If either of the two entities were not included, or were assessed separately, an incomplete and inaccurate assessment of weather and climate information needed for decisions in coastal recreation and tourism activities would result.

The needs assessment interviews included four general areas of inquiry: short-term marine or weather knowledge and information requirements, long-term marine or weather knowledge and information requirements, desired product format and delivery, and basic demographic data. The rationale for separating knowledge and information requirements into two sections was based on the need for interviewees to separate information requirements into short-term and long-term time scales, an issue that was identified in the October 2003 CCW as necessary in developing effective coastal climatology products. This separation ensures the creation of a product that places real-time data in the proper climate context for meaningful interpretation, a requirement stated in the CSC Scope of Work statement. The rationale of inclusion of the product format and delivery section in the needs assessment was to ensure the construction of a climatology product for coastal managers that removes obstacles concerning product accessibility and applicability as outlined in the October 2003 CCW report. The demographic data section was included in the needs assessment interview to allow for collection of ancillary information that can assist in interpretation of interview results.

Figure 1. Coastal communities in southeastern North Carolina where needs assessment interviews were completed.




| Location | Number of Management Interviews | Number of Participant Interviews |
|---|---|---|
| 1. Sunset Beach | 7 | 5 |
| 2. Ocean Isle Beach | 6 | 0 |
| 3. Holden Beach | 2 | 5 |
| 4. Oak Island | 7 | 3 |
| 5. Southport | 8 | 0 |
| 6. Kure Beach | 2 | 10 |
| 7. Carolina Beach | 23 | 49 |
| 8. Wrightsville Beach | 20 | 121 |
| 9. Topsail Island | 6 | 33 |
| 10. Surf City | 3 | 0 |
| 11. Swansboro | 0 | 2 |
| 12. Emerald Isle | 8 | 5 |
| 13. Pine Knoll Shores | 0 | 12 |
| 14. Atlantic Beach | 16 | 43 |
| 15. Morehead City | 8 | 0 |

The questions to be included in the needs assessment interview were developed by modifying a draft list of questions derived from the October 2003 CCW (Appendix A) through consultation with four of the external reviewers (Dorton, Herstine, Meinhold, and Thigpen). After initial modification, the draft list of questions was then handed to students in two of Doug Gamble's courses at UNCW for review and comments. The students' comments were incorporated along with additional reviewers' comments to

form a final draft of the interview questions. During these initial review efforts, it was determined that two separate interview protocols and questions were required for managers and participants, and the two were subsequently developed. The final draft of the two interview protocols and questions was forwarded to each of the external reviewers and the Coastal Services Center for final comments on January 21, 2005. The final comments were incorporated into a final draft of questions for the needs assessment interview, and a test of this final draft was conducted on March 24, 2005, in Myrtle Beach, South Carolina, where eighteen test interviews were completed. The PIs, project manager, and student workers reviewed the effectiveness of these test interview sessions and decided that, overall, the test was successful, and only one minor clarification, the deletion of confusing language, was made to the needs assessment interview questions before administration across the entire study area began on April 15, 2005.

To facilitate comparison and analysis of interview results, each needs assessment interview session consisted of the same introductory language and questions. However, the questions for managers and participants were different, since each group has its own motivation for using climate information in decision-making processes, and one common set of questions may lead to an inaccurate needs assessment. For the manager needs assessment interview, 20 closed-ended questions were included in the interview (Appendix B), and the participant needs assessment interview included 23 closed-ended questions (Appendix C). The needs assessment interviews also included a cover sheet that the interviewer completed, indicating the name of the interviewer, date of interview, time of interview, weather, interview location, sex of interviewee, type of business or organization (manager interview), and designation of interviewee as manager or person with oversight (manager interview).

*Interview Administration*

The interviews were completed by undergraduate student research assistants from the University of North Carolina Wilmington. Each research assistant received training in the administration of needs assessment interviews at interview workshops on January 13 and March 17, 2005. The workshop included a review of the CORMP program, review of the interview questions, including rationale of design and inclusion, and mock needs assessment interviews. The mock needs assessment sessions were videotaped and external reviewers Jim Herstine and Stephen Meinhold provided comments for improvement of student interview techniques.

A written protocol, which each interviewer was required to follow, was laminated (Appendix D) and carried by each interviewer during days of interview work. Through the establishment of a protocol, interview consistency and research assistant safety was ensured. The protocol entailed student workers to travel to field sites in pairs but conduct interviews separately. Through traveling in pairs, travel costs were minimized, troubleshooting of interview administration could be completed more efficiently through discussion between interviewers, and field safety was ensured. Managers interviewed for the study were identified through review of community business listings and field reconnaissance of business districts within the coastal communities. The participants interviewed in the study were identified through systematic random sampling (every fifth group of people) along transects across public beaches in the study area. Upon returning

from a field site, the two student workers reported to the project manager, logged in any completed interview sheets, and discussed the general effectiveness of the interview sessions with the project manager. Such interaction created a channel of communication between the project manager and the student workers, ensuring the quality and effectiveness of the interview process. During the interview sessions, interviewees, if they desired, were given a CORMP magnet and a brochure that included a definition of coastal climatology, a description of CORMP, and contact information for any inquiry or comments that the interviewee had regarding the survey.

*Needs Assessment Survey Analysis*

The needs assessment interviews were constructed using closed-ended response survey design. Such a design limits the number of different responses and can also provide a response rating scale, or a choice of answers that rates responses between two end values (Weisberg et al. 1996). The advantage of this survey design is that responses can be assigned numerical values to facilitate statistical analysis. Given the total of 455 interviews completed for the project, statistical analysis allows for an efficient and effective summary of results. Specifically, statistical analysis included the calculation of percent frequency of each response or calculation of a mean rating value for a question. An example of a question for which a mean rating value of a response can be calculated is Question 7 of the management and Question 9 of the participant needs assessment, which asks for the interviewee's general knowledge level of normal short-term marine or weather conditions of the area. Five responses are provided, ranging from Excellent to Poor. Each potential response can be assigned a value between 1 and 5, and a mean value of all interviewee responses represents a summary of the rating of the entire group's response.

*Website Focus Groups*

In addition to the needs assessment interviews completed by the research assistants, the PI and project manager decided to elicit feedback on the effectiveness of existing coastal climatology websites identified as sources for decision making in the October 2003 CCW. These "focus groups" allowed the PIs to investigate, in more depth, October 2003 CCW participant claims that obstacles to the effective use of coastal climatology information include scientific websites not easily understood by recreation managers, the inability to personalize available data, few visualization tools, and a paucity of inshore data (Janis and Gamble 2004). The website focus group session entailed providing a group of 24 recreation and tourism participants at UNCW with a list of websites from which they chose one website for which they answered a series of open-ended questions on the strengths and weakness of the climate products (Appendix E). The websites used in this "focus group" assessment are the coastal climatology websites listed in Janis and Gamble 2004. Written responses to the open-ended questions were summarized to help guide test product development.

**Coastal Climatology Test Product**

The analysis and summary of interview and focus group responses were used to construct a coastal climatology test product specific to southeastern North Carolina, yet still can be used by the Coastal Services Center to develop other coastal climatology products for the entire southeastern U.S. Beyond the specific information requested by participants, the product attempts to incorporate the five specific cross-cutting issues included in the October CCW report: 1) definition of coastal climatology, 2) observing systems, 3) forecasts, 4) product creation and delivery, and 5) follow-up (Janis and Gamble 2004). Accordingly, the product represents a synthesis of environmental information pertinent to manager and participant needs rather than a statistical summary of climatic variables for southeast North Carolina. Where relevant, efforts will be made to incorporate information and data available from CORMP, an observation system that can be combined with the existing National Weather Service (NWS) network of C-MAN stations, buoys, and land-based weather stations to create a more spatially dense network of observation points in coastal climatology products (addressing the October 2003 CCW call for utilization of better observation networks). CORMP, funded by NOAA, has been in operation at UNCW since mid-2000 and is currently upgrading and enhancing its offshore and shore-based oceanographic and meteorological instrumentation. These efforts include the instrumentation of two fishing piers with wave/current meters and meteorological stations in southeastern North Carolina. The wave/current meters will provide data just beyond the surf zone in near real time and available from an on-site display at the pier and on the Web. Together, the pier instruments and emerging offshore system, which has been upgraded to operate in a real-time mode, will provide quality-assured data on the Web, thereby serving a growing constituency of public service and local users who are "direct consumers" of the data products.

The PIs and the project manager completed a "design concept" for the Web-based test product in May 2005. Specifically, the design concept was for a website that consisted of one dynamic page that displays near-real-time observations from CORMP observation stations in a climatological context, four static pages that provide a description of the Onslow Bay climate, climate predictions for the U.S., hurricane climatology information for Onslow Bay, and contact information for the PIs, project managers, and CORMP Outreach. The Web design was then shared with Michel Fougeres, the UNCW webmaster, and the CORMP data manager, Xiaoyan Qi, for comments on the design and construction of the website. After the review by the Web designers and programmers at UNCW, a Web programmer, Zoey Zahorodny, and the CORMP data manager created the coastal climatology website.

## QUALITY CONTROL AND ASSURANCE PLAN

To ensure the quality of the needs assessment and test coastal climatology product, a quality control plan that relied upon comments from expert external reviewers was instituted throughout the project. Specific tasks completed by the external reviewers under this quality control plan were the development of an appropriate and rigorous list of interview questions, training of research assistants to conduct high-quality interviews, development of a protocol for administering interviews, review of interview data

analysis, and review of the test coastal climatology product. Where appropriate, specifics of external reviewer activities are described in the methodology section of this report. A list of the expert external reviewers, their qualifications, and their activities completed for this project are listed in Appendix F.

## RESULTS AND DISCUSSION

### Needs Assessment Interviews

The original methodology for the needs assessment interviews called for the collection of 500 recreation and tourism manager interviews and 500 recreation and tourism participant interviews. However, once research assistants started interviews in April and May, it became clear quickly that 500 manager interviews was an unattainable goal for the region. Several reasons can be identified as the cause of this unattainable goal. First, the PIs overestimated the total number of recreation and tourism businesses in southeastern North Carolina. The estimate of 500 was based upon the PIs' knowledge of the Wilmington and Myrtle Beach areas. As research assistants completed field reconnaissance and interviews in areas outside these two cities, it was obvious the number and density of recreation and tourism businesses was much lower, and fewer managers were available for interviews. The PIs believe a better estimate of the total number of recreation and tourism businesses available for interviews is 250 to 300.

A second reason for the inability to complete 500 manager interviews was a cool and wet spring in southeastern North Carolina. The National Weather Service Wilmington Office (*www.erh.noaa.gov/er/ilm/climate/*) reported that the average monthly temperatures for March, April, and May 2005 were below normal, 2.3, 1.7, and 3.4 degrees respectively. Further, April 2005 had 19 days of rainfall totaling 4.06 inches, 1.12 inches more than normal, and May 2005 had 24 days of rainfall totaling 5.91 inches, 1.51 inches higher than normal. The result of this cool and wet spring was that fewer recreation and tourism businesses were open and available for interviews, and rain restricted the interviewers' ability to visit and interview managers, since much of their time is spent walking between businesses.

A third reason for the inability to complete 500 manager interviews was a higher than expected refusal rate of manager interviews. This was created in large part by corporate policies of refusing all solicitations and requests for interviews. Estimates of the refusal rate are 10 to 15 percent, which in comparison to other studies is quite low, but it did lower the number of completed management interviews.

The final reason for the inability to complete 500 manager interviews was the time constraints of the contract. Given the July 31, 2005, deadline for completion of a draft report, the PIs and project managers decided in early June that research assistants needed to focus more upon participant interviews of which few had been collected at that time. The rationale for this decision was the PIs believed that the 125 manager interviews completed at that time offered a representative sample of manager needs in the area and any more time spent on the manager interviews would have diminishing returns for adding new information to the project. In the time remaining for participant interviews,

about one month, 330 participant interviews were completed, short of the goal of 500, but as with the manager interviews, the PIs and project manager believed the collected sample was an accurate representation of coastal climatology needs in the area. Any other time used to reach 500 interviews would have taken away from data analysis and not allowed for development of a high-quality coastal climatology product within the time frame of the contract.

*Recreation and Tourism Manager Interviews*

A total of 125 manager needs assessment interviews were completed in 13 communities across the study area (Figure 1). After a quality control review of the data, 116 interviews were chosen for analysis. The reasons for omitting some of the interviews included missing data, unclear responses, and duplicate interview efforts. A total of 19 different types of business establishments were included in the interviews with retail/surf shops (20 percent), hotels/motels (14 percent), realtors/rental agencies (12 percent), and fishing charter boats (11 percent) the most frequent (Table 1). The managers of these establishments indicated overwhelmingly (87 percent) that the knowledge of marine or weather conditions is important to making informed management decisions. In ranking the importance of the knowledge of marine or weather conditions in making informed management decisions, 68 percent of the respondents ranked such knowledge as very important and 20 percent ranked such knowledge as fairly important. When asked what time frame marine or weather information was needed to make informed management plans, 24 percent of the respondents indicated hourly, 68 percent indicated daily, 29 percent indicated weekly, and 7 percent indicated monthly. An additional five of the respondents indicated they required marine or weather information on other time frames. In terms of the season for which the managers needed marine or weather information, 59 percent required information in winter, 79 percent required information in spring, 84 percent required information in summer, and 81 percent required information in the fall.

Managers characterized their general knowledge of short-term marine or weather conditions of the interview area as good to very good (2.5 average, with 1 = excellent, 2 = very good, 3 = good, 4 = fair, and 5 = poor) (Table 2) and their general knowledge of long-term marine or weather conditions of the interview area as good to very good (2.8 average, same scale) (Table 3). Regarding accuracy of forecasts of marine or weather conditions in the area, responding managers on average characterized short-term forecasts as good to fair (3.4 average, same scale) (Table 4) and long-term forecasts as good to fair (3.2, same scale) (Table 5).

Table 1. The different business types included in tourism and recreation manager needs assessment interviews.

| Business Type | Frequency |
|---|---|
| Retail/Surf Shop | 23 |
| Hotel/Motel | 16 |
| Real Estate and Rentals | 14 |
| Fishing Charter | 13 |
| Seafood Market/Grocery | 9 |
| Outdoor Rentals | 8 |
| Bait/Tackle Shop | 7 |
| Food Service/Restaurant | 5 |
| Pier | 4 |
| Dive Shop | 3 |
| Marina | 3 |
| Boat Supply | 3 |
| Golf Club | 2 |
| Ferry Terminal | 1 |
| Photography | 1 |
| Boat Tow | 1 |
| Fun Park | 1 |
| Vacation Center | 1 |
| Travel Agency | 1 |

Table 2. Recreation and tourism managers' responses to the question, *Would you rate your general knowledge of short-term marine or weather conditions for the area at which this interview is being conducted as excellent, very good, good, fair, or poor?* (n = 116)

| Response | Raw Frequency | Percent Frequency |
|---|---|---|
| Excellent | 13 | 11.2 |
| Very Good | 12 | 36.2 |
| Good | 44 | 37.9 |
| Fair | 13 | 11.2 |
| Poor | 1 | 0.9 |

Table 3. Recreation and tourism managers' responses to the question, *Would you rate your general knowledge of long-term marine or weather patterns for the area at which this interview is being conducted as excellent, very good, good, fair, or poor?* (n = 116)

| Response | Raw Frequency | Percent Frequency |
|---|---|---|
| Excellent | 10 | 8.6 |
| Very Good | 27 | 23.3 |
| Good | 47 | 40.5 |
| Fair | 23 | 19.8 |
| Poor | 6 | 5.2 |

Table 4. Recreation and tourism managers' responses to the question, *Would you rate the accuracy of the short-term forecasts of marine or weather conditions for the area at which this interview is being conducted as excellent, very good, good, fair, or poor?* (n = 116)

| Response | Raw Frequency | Percent Frequency |
|---|---|---|
| Excellent | 5 | 4.3 |
| Very Good | 17 | 14.7 |
| Good | 34 | 29.3 |
| Fair | 38 | 32.8 |
| Poor | 20 | 17.2 |

Table 5. Recreation and tourism managers' responses to the question, *Would you rate the accuracy of the long-term forecasts of marine or weather patterns for the area at which this interview is being conducted as excellent, very good, good, fair or poor?* (n = 116)

| Response | Raw Frequency | Percent Frequency |
|---|---|---|
| Excellent | 2 | 1.7 |
| Very Good | 14 | 12.1 |
| Good | 31 | 26.7 |
| Fair | 33 | 28.4 |
| Poor | 24 | 20.7 |

Managers indicated they consider a wide variety of marine and weather factors when making decisions for recreation and tourism organizations (Table 6). The five most frequent responses were hurricane information (94 percent of managers interviewed), wind speed (82 percent), air temperature (70 percent), rain probability (67 percent), and water temperature (62 percent). Only a small portion of the managers interviewed make their own marine or weather condition predictions (17 percent), and those who do make their own forecasts are evenly split between statistical analysis (40 percent) and graphs and charts (45 percent). The exact nature of how these managers use this information to create forecasts is not clear. Some comments were provided indicating intuitive assessment, such as "review forecast" and use "personal observations," but further research of how these forecasts are made has great potential in refining coastal climatology products. The majority of the managers interviewed believe they receive all the types of marine or weather information they need to make successful decisions (87 percent). Of the minority of managers that believe they do not receive all the types of marine or weather information they need to make successful decisions, the most frequent additional types of marine or weather information desired include wave height, rip current, and water quality (23 percent each).

Regarding the format and delivery system of marine or weather information, the managers interviewed currently use television (86 percent), websites (77 percent), radio (65 percent), and newspaper (40 percent) most often (Table 7). In response to a separate question regarding the type of delivery system they do not currently have access to but would like to use in the future, managers indicated that they would like to receive marine

or weather information if it were available by e-mail (12 percent), fax (9 percent), and text messaging (8 percent).

General demographic information collected in the interviews indicates that these managers were predominantly white (93 percent), evenly distributed between male (54 percent) and female (41 percent) (gender totals are below 100 percent due to incomplete recording of gender on interview forms), and on average 38 years old. Almost all managers possessed a level of education between high school graduate and a college degree.

Table 6. Recreation and tourism managers' responses to the question, *Individuals often consider a variety of marine and weather factors when making management decisions for recreation and tourism organizations. Which of the following factors do you consider when making management decisions for your organization?* (n = 116, multiple responses allowed)

| Factor | Raw Frequency | Percent Frequency |
|---|---|---|
| Hurricane information | 109 | 94.0 |
| Wind speed | 95 | 81.9 |
| Air temperature | 81 | 69.8 |
| Likelihood of rainfall | 78 | 67.2 |
| Water temperature | 72 | 62.1 |
| Wind direction | 68 | 58.6 |
| Wave height | 67 | 57.8 |
| Tide level | 57 | 49.1 |
| Water quality | 56 | 48.3 |
| Potential for rip currents | 45 | 38.8 |
| Other (please specify) | 8 | 6.9 |

Table 7. Recreation and tourism managers' responses to the question, *How do you currently get marine or weather information?* (n = 116, multiple responses allowed)

| Factor | Raw Frequency | Percent Frequency |
|---|---|---|
| Television | 100 | 86.2 |
| Website | 89 | 76.7 |
| Radio | 76 | 65.5 |
| Newspaper | 47 | 40.5 |
| Government publication | 21 | 18.1 |
| E-mail | 20 | 17.2 |
| Cell Phone Text message | 4 | 3.4 |
| Fax message | 4 | 3.4 |
| CD-ROM | 3 | 2.6 |
| Other (please specify) | 0 | 0 |

The recreation and tourism manager needs assessment interviews revealed a clear need for coastal climatology information, since almost all the interviewees responded that marine and weather information are important in their decision-making processes.

However, it should be noted that few if any of the interviewees use marine or weather information on the climatological time scale (month or longer). Thus, a coastal climatology product, in order to be effective, must serve as an educational resource, teaching managers the utility of the long-term perspective of climatology. Perhaps the best way to achieve such an educational effort is to present short-term weather and marine information, the type of data currently used most frequently by managers, within a climatological context. Further, recreation and tourism managers use information in all seasons, particularly spring through fall, and there is little demand for interactive forecasting tools, since few managers create their own forecasts—despite responses indicating existing forecasts are only good to fair. The emphasis of the need for hurricane information is understandable, since a hurricane represents potential loss of capital and profit to the managers from a disrupted tourist season and potential damage to business resources. The frequent use of air temperature and rain probability is of no surprise given the extensive research that indicates thermal regimes and rainfall have a large impact on comfort and satisfaction during recreation and tourism activities (de Freitas 2003). Water temperature and wave height represent the most frequently used marine variables that can be incorporated into a test coastal climatology product. Finally, based upon interview results, managers rely heavily upon television, websites, and radio for marine or weather information, but as technology advances, future coastal climatology products should have the capability to be delivered via text messaging, fax, and e-mail.

*Recreation and Tourism Participant Interviews*

A total of 330 participant needs assessment interviews were completed in 11 communities across the study area (Figure 1). After a quality control review of the data, 293 interviews were chosen for analysis. The reasons for omitting some of the interviews included missing data, interviewees under 18 years old, unclear responses, and duplicate interview efforts. The majority of participants were at the beach to either sunbathe (49 percent) or vacation (37 percent), while a smaller portion were at the beach to walk (13 percent), swim (12 percent), or fish (12 percent) (Table 8). The participants indicated overwhelmingly (95 percent) that the knowledge of marine or weather conditions is important to making informed activity and planning decisions. In ranking the importance of the knowledge of marine or weather conditions in making informed participant decisions, 52 percent of the respondents ranked such knowledge as very important and 44 percent ranked such knowledge as fairly important. When asked what time frame marine or weather information was needed to make informed participant plans, 11 percent of the respondents indicated hourly, 73 percent indicated daily, 47 percent indicated weekly, and 5 percent indicated monthly. Two percent of the participant respondents indicated they required marine or weather information on any other time frame. Regarding the season for which the participants needed marine or weather information, 45 percent required information in winter, 77 percent required information in spring, 92 percent required information in summer, and 55 percent required information in the fall.

The participants characterized their general knowledge of short-term marine or weather conditions of the interview area as good (3.1 average, with 1 = excellent, 2 = very good, 3 = good, 4 = fair, and 5 = poor) (Table 9) and their general knowledge of long-term

marine or weather conditions of the interview area as good to fair (3.2 average, same scale) (Table 10). Regarding accuracy of forecasts of marine or weather conditions in the area, responding participants, on average, characterized short-term forecasts as good to fair (3.3 average, same scale) (Table 11) and long-term forecasts as good to fair (3.3, same scale) (Table 12).

Participants indicated they consider a wide variety of marine and weather factors when making decisions for recreation and tourism plans (Table 13). The five most frequent responses were hurricane information (93 percent of participants interviewed), air temperature (92 percent), rain probability (87 percent), water temperature (66 percent) and wind speed (63 percent). Only a small portion of the participants interviewed make

Table 8. The different reasons for visiting the beach provided in tourism and recreation participant needs assessment interviews (n = 293, multiple responses allowed).

| Activity | Raw Frequency | Percent Frequency |
|---|---|---|
| Sun Bathe | 144 | 49.1 |
| Vacation | 108 | 36.9 |
| Swim | 36 | 12.3 |
| Fish | 34 | 11.6 |
| Walk | 28 | 9.6 |
| Other | 25 | 8.5 |
| Surf | 19 | 6.5 |
| Boat/Kayak | 1 | 0.3 |
| SCUBA | 1 | 0.3 |

Table 9. Recreation and tourism participant's responses to the question, *Would you rate your general knowledge of short term marine or weather conditions for the area at which this interview is being conducted as excellent, very good, good, fair or poor?* (n = 293)

| Response | Raw Frequency | Percent Frequency |
|---|---|---|
| Excellent | 8 | 2.7 |
| Very Good | 70 | 23.9 |
| Good | 109 | 37.2 |
| Fair | 88 | 30.0 |
| Poor | 18 | 6.1 |

Table 10. Recreation and tourism participant's responses to the question, *Would you rate your general knowledge of long term marine or weather patterns for the area at which this interview is being conducted as excellent, very good, good, fair or poor?* (n = 293)

| Response | Raw Frequency | Percent Frequency |
|---|---|---|
| Excellent | 16 | 1.0 |
| Very Good | 64 | 12.3 |
| Good | 92 | 51.5 |
| Fair | 80 | 30.0 |
| Poor | 15 | 5.1 |

their own marine or weather condition predictions (11 percent), and of those participants that do make their own forecasts, 26 percent use statistical analysis, 23 percent use graphs and charts, and 38 percent use other methods. The exact nature of how these participants use this information to create forecasts is not clear. Some comments were provided indicating intuitive assessment of weather conditions such as "personal knowledge," "look outside," and "watch weather channel and compare with weather outside" to construct forecasts, but further research of how these forecasts are made has great potential in further determining coastal climatology needs and products. The majority of the participants interviewed believe they receive all the types of marine or weather information they need to make successful decisions (95 percent). Of the minority of participants who believe they do not receive all the types of marine or weather information they need to make successful decisions, the most frequent additional types of marine or weather information desired are wave height (38 percent) and air temperature, wind direction, wind speed, and water quality (23 percent each).

Regarding the format and delivery system of marine or weather information, the participants interviewed currently use television (90 percent), websites (68 percent), radio (46 percent), and newspapers (38 percent) most often (Table 14). In response to a separate question regarding the type of delivery system they do not currently have access to but would like to use in the future, participants indicated they would like to receive marine or weather information if it were available by cell phone or text messaging (12 percent), website (8 percent), and e-mail (3 percent).

Table 11. Recreation and tourism participants' responses to the question, *Would you rate the accuracy of the short-term forecasts of marine or weather conditions for the area at which this interview is being conducted as excellent, very good, good, fair, or poor?* (n = 293)

| Response | Raw Frequency | Percent Frequency |
|---|---|---|
| Excellent | 3 | 1.0 |
| Very Good | 36 | 12.3 |
| Good | 151 | 51.5 |
| Fair | 88 | 30.0 |
| Poor | 15 | 3.1 |

Table 12. Recreation and tourism participants' responses to the question, *Would you rate the accuracy of the long-term forecasts of marine or weather patterns for the area at which this interview is being conducted as excellent, very good, good, fair, or poor?* (n = 293)

| Response | Raw Frequency | Percent Frequency |
|---|---|---|
| Excellent | 2 | 0.7 |
| Very Good | 28 | 9.6 |
| Good | 150 | 51.2 |
| Fair | 72 | 24.6 |
| Poor | 35 | 11.9 |

Table 13. Recreation and tourism participants' responses to the question, *Individuals often consider a variety of marine and weather factors when making decisions about recreation and tourism plans. Which of the following factors do you consider when making recreation and tourism plans?* (n = 293, multiple responses allowed)

| Factor | Raw Frequency | Percent Frequency |
|---|---|---|
| Hurricane information | 274 | 93.5 |
| Air temperature | 270 | 92.2 |
| Likelihood of rainfall | 255 | 87.0 |
| Water temperature | 193 | 65.9 |
| Wind speed | 185 | 63.1 |
| Water quality | 139 | 47.4 |
| Wave height | 135 | 46.1 |
| Potential for rip currents | 130 | 44.4 |
| Tide level | 117 | 39.9 |
| Wind direction | 111 | 37.9 |
| Other (please specify) | 13 | 4.4 |

General demographic information collected in the interviews indicates that the participants interviewed were predominantly white (99 percent), evenly distributed between male (51 percent) and female (46 percent) (gender totals are below 100 percent due to incomplete recording of gender on interview forms), and on average 35 years old. Almost all participants possessed a level of education between high school graduate and a college degree (93 percent), while a small percentage (7 percent) had master's degrees or higher.

Table 14. Recreation and tourism participants' responses to the question, *How do you currently get marine or weather information?* (n = 293, multiple responses allowed)

| Factor | Raw Frequency | Percent Frequency |
|---|---|---|
| Television | 264 | 90.1 |
| Website | 200 | 68.3 |
| Radio | 135 | 46.1 |
| Newspaper | 113 | 38.6 |
| Government publication | 20 | 6.8 |
| E-mail | 18 | 6.1 |
| Cell Phone Text message | 15 | 5.1 |
| CD-ROM | 1 | 0.3 |
| Fax message | 1 | 0.3 |
| Other (Please specify) | 0 | 0 |

The recreation and tourism participant needs assessment interviews revealed a clear need for coastal climatology information, since almost all the interviewees responded that marine and weather information are important in their decision-making processes. However, it should be noted, as with the managers, that few if any of the interviewees use marine or weather information on a climatological time scale (month or longer). This underscores the need for a coastal climatology product to serve as an educational resource, teaching participants the utility of the long-term perspective of climatology, as well as providing basic observations and information.

Another participant interview result of note is the use of information for all seasons. However, as compared to managers, participants' needs are more focused on summer and spring. As with the managers, the participants interviewed indicated little demand for interactive forecasting tools. The type of information needed is also similar to managers' needs in that participants most frequently use hurricane information, air temperature, and rain probability. As with the manager interviews, it should be noted that water temperature and wave height represent the most frequently used marine variables that can be incorporated into a test coastal climatology product. Finally, based upon interview results, participants rely heavily upon television, websites, and radio for marine or weather information, but as technology advances, future coastal climatology products should have the capability to be delivered via cell phone, text messaging, and e-mail.

*Website Focus Group*

A total of 24 people were included in a website "focus group" that reviewed websites identified in the October 2003 CCW as significant sources of coastal climatology information. A total of six open-ended questions were included in the "focus group" session that gathered the perceived strengths and weaknesses of the listed websites. Many of the comments provided by this group were specific to the websites reviewed (Appendix H), but several themes developed regarding effective coastal climatology Web pages.

The most common comment from members of the focus group was that a simple site is the most effective site. Simple can be an elusive concept, but the comments indicate that, in the context of the coastal climatology website, simple refers to 1) a limited amount of information presented on the website, 2) efficient and clear web navigation features, 3) a limited use of scientific jargon and graphics, and 4) limited use of colors and "flashy" graphics. Such comments are similar to guidelines in Thurlow et al. (2004) for the development of coastal climatology Web products. Also of note in the focus group were comments about the need for more local data and the annoyance with the need to purchase or download software to further assess coastal climatology data.

## TEST COASTAL CLIMATOLOGY PRODUCT DEVELOPMENT

*Test-Product Guiding Principles*

Using the results of the needs assessment interviews and the website focus group, several guiding principles were developed to help construct the test coastal climatology product.

1. *The test product will be a website* – According to the interview results, the three most popular delivery systems for marine or weather data are television, websites, and radio. Given the capabilities of CORMP, the website is the most cost-effective, efficient, and sustainable way to deliver coastal climatology information. A website test product builds upon CORMP's existing webpage, and with additional resources and technology CORMP may be able to couple the website with e-mail and text messaging of information in the future.
2. *The test product website will be designed to be simple and elegant, providing the most information without overwhelming the end user* – The most important finding of the website focus group, keeping the website simple, will be incorporated into the test product; the simpler the product the greater the sustainability of the resource in terms of technical, financial, and logistical support.
3. *The test product website will not only provide coastal climatology information, but it will also serve as an educational resource that attempts to place real-time observations within a climatological framework* – As identified by the October 2003 CCW and the needs assessment interviews, recreation and tourism managers and participants use marine or weather information on a short-term as opposed to a long-term, or climatological, time frame. Thus, in order for the test coastal climatology website to be effective, it will present real-time marine or weather information and label the data as above or below the climatic average and also display observations for the previous month. By presenting the real-time data in such a fashion, the end user will appreciate the importance of the climatology of coastal conditions.
4. *The test coastal climatology website will focus on presenting the marine variables identified by recreation and tourism managers as most frequently used in decision making* – By focusing on the variables used most by end users, a greater degree of success is expected for the test product by avoiding the inclusion of extraneous information on the website. In addition, a description of the region's hurricane climatology will be included to address the end users' most sought-after variable.

5. *The test coastal climatology website will present coastal climatology information on a local scale* – As indicated by the October 2003 CCW report and the website focus group of this project, recreation and tourism end users desire coastal climatology on a local scale. To meet this need, the test coastal climatology Web page will provide information for Onslow Bay in southeastern North Carolina, collected by CORMP and NWS, thereby taking advantage of the high density spatial coverage of oceanographic and meteorological observations in the region.

*The Test Coastal Climatology Website* (*www.cormp.org/climate/*)
The test coastal climatology Web page consists of one dynamic page that displays near-real-time observations from CORMP observation stations in a climatological context, two static pages that provide descriptions of the Onslow Bay climate, climate predictions for the U.S., hurricane information for Onslow Bay, and contact information for the PIs and project managers and CORMP Outreach. All the pages were designed to be simple and consistent. Each page has the CORMP banner at the top of the page and the same navigation menu on the left-hand side. At the bottom of each page is a listing of Web pages (through icons) of the organizations participating in this project.

The dynamic Web page, entitled "Today's Onslow Bay Coastal Climate Information," initially loads as a map of Onslow Bay that displays all CORMP observation stations (Figure 2). The end user is instructed to click on the map location for which they desire information. The locations are also listed in a table below the map. Once the location map or table is clicked, a display of a current marine or weather variable is loaded (Figure 3). The display includes text and graphics that indicate where the observation stands in the climatological range for the location. The average of the chosen variable for the forthcoming week is also displayed, as well as a pull-down menu that allows the end user to change variables. Below the listing of the current observation and the climatological range, a running graph of observations for the past month is provided. At the bottom of the page, a clickable map is provided that allows the end user to change locations and load observations for another CORMP observation station. Currently this test product displays meteorological variables for nine different locations, and the data displayed are taken from CORMP, National Data Buoy Center (NDBC), and National Weather Service (NWS) archives (Table 15). More variables and locations will be added to the page as CORMP expands and resources become available to support data management and Web programming.

Figure 2. The test product dynamic Web page, "Today's Onslow Bay Coastal Climate Information."

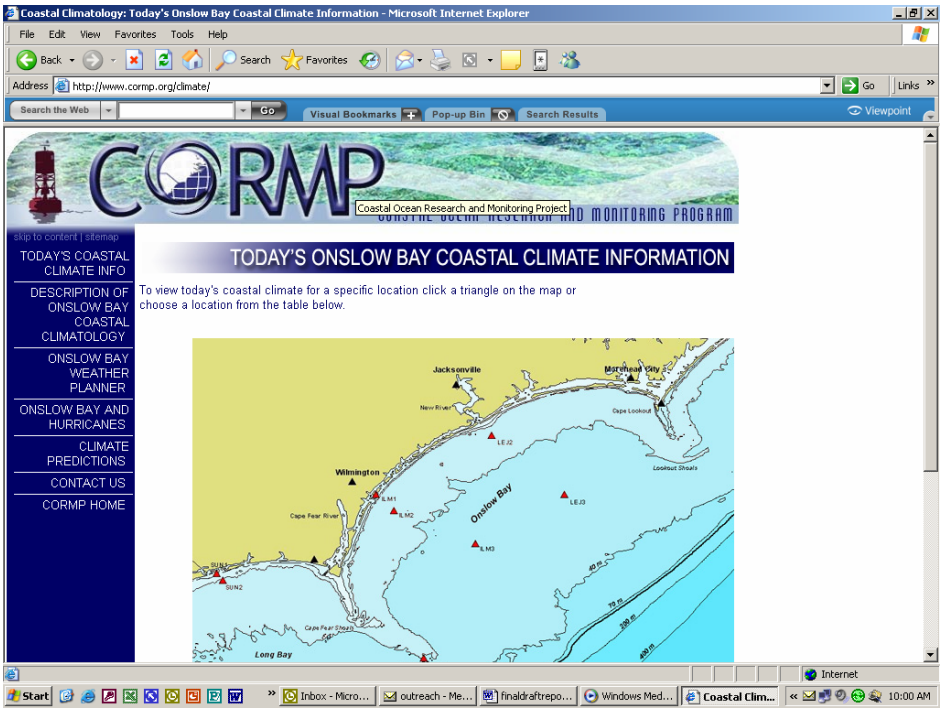



Figure 3. The test product dynamic Web page that displays current marine or weather variables and places them within a climatological context.

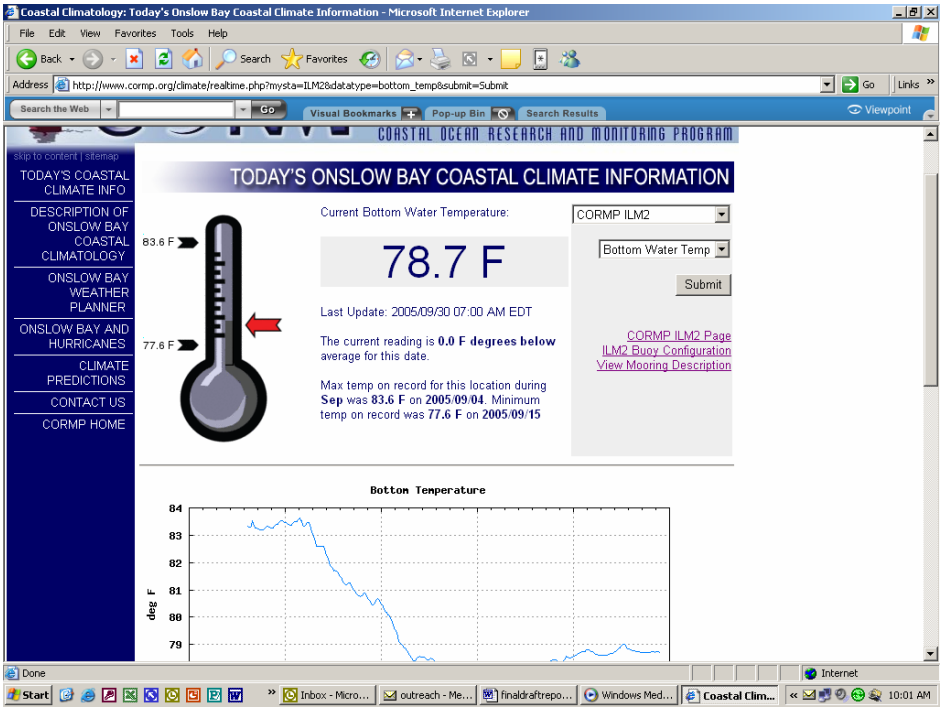


Table 15. The types of data included in the test coastal climatology website listed by location.

| Location | Air Pressure | Air Temperature | Surface Water Temperature | Bottom Water Temperature | Wave Height |
|---|---|---|---|---|---|
| CORMP ILM 2 | XX | XX | | XX | |
| CORMP ILM 3 | XX | XX | XX | XX | |
| CORMP LEJ 2 | XX | XX | XX | | XX |
| Frying Pan Tower (NDBC) | XX | XX | | | XX |
| Cape Lookout (NDBC) | XX | XX | | | |
| Oak Island (NWS) | | XX | | | |
| Wilmington (NWS) | | XX | | | |
| Jacksonville (NWS) | | XX | | | |
| Beaufort (NWS) | | XX | | | |

The first static page of the test coastal climatology website, entitled "Onslow Bay Coastal Climatology – Description," provides a text description of the general climatology of Onslow Bay (Figure 4). The text is as user-friendly as possible, using text boxes to summarize the main points and avoiding technical jargon. Linked to this textual description are numerical descriptors of climatic variables collected at the National Weather Service Wilmington Office and Frying Pan Shoals (Figure 5). These data are listed and displayed by month and provide data for end users to compare to current observations.

The second static page, entitled "Description of Hurricanes in Onslow Bay," attempts to cover the main points of the region's hurricane climatology (return interval, impact of global teleconnections, and hurricane hazards) without overwhelming the reader with too much text. Sources are provided for the end user to investigate more about the hurricane climatology of the region (Figure 6). The third static page is a link to the National Weather Service's Climate Prediction Center, allowing the end user to find climate predictions for the region. Text is provided on this page, indicating to the end user the limitation of the climate predictions (Figure 7). The fourth static page, entitled "Contact Us," provides contact information for the PIs and project manager. Through inclusion of

Figure 4. The test coastal climatology Web page that provides a textual description of Onslow Bay's coastal climatology.

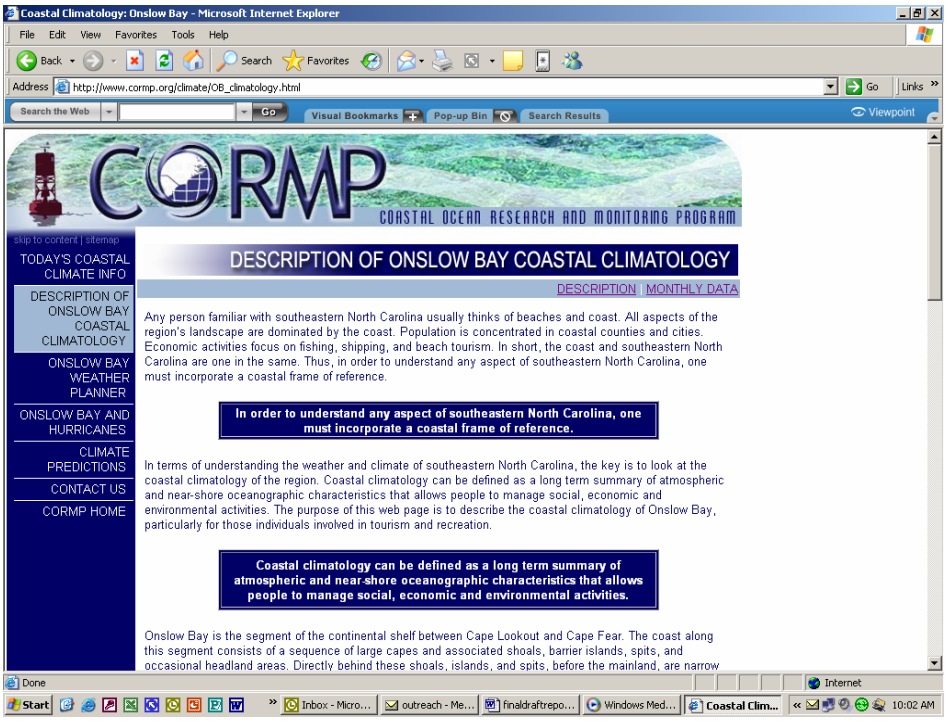



Figure 5. The test coastal climatology Web page that provides monthly numerical descriptors of Onslow Bay's coastal climatology.

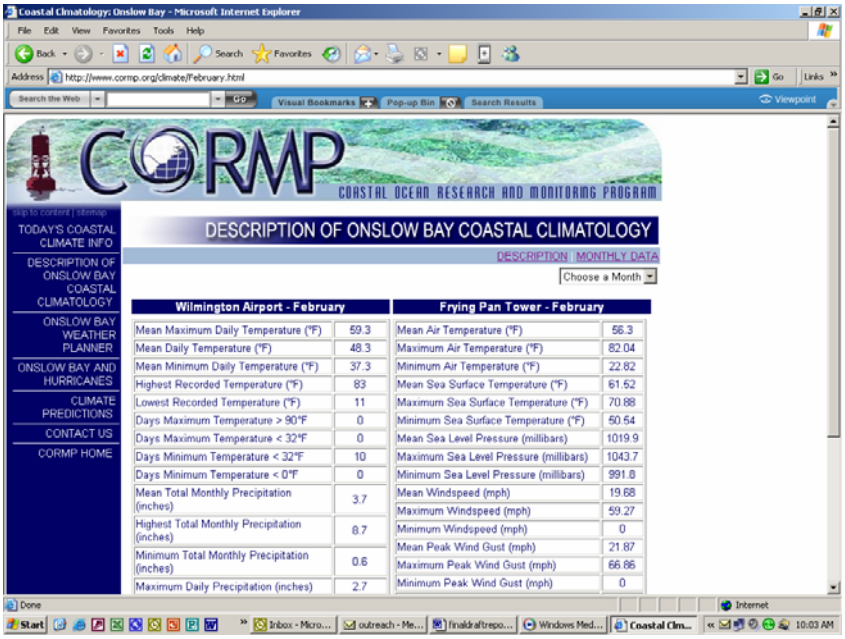


Figure 6. The test coastal climatology Web page that provides a description of Onslow Bay's hurricane climatology.

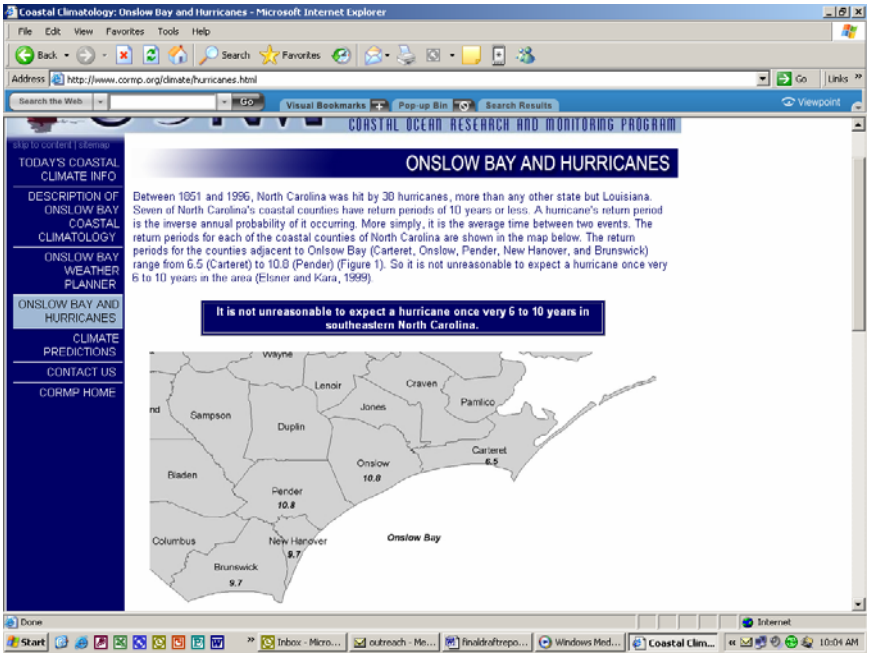
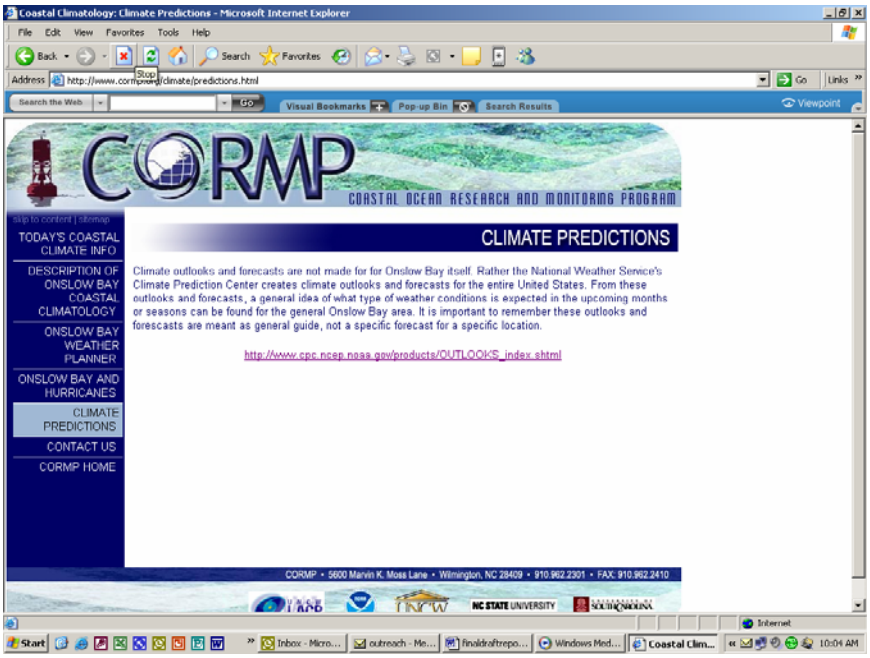



Figure 7. The test coastal climatology Web page that provides a link to the National Weather Service's Climate Prediction Center.



such a page, end users can interact with CORMP and UNCW faculty and staff members to ask questions and discuss issues concerning the website.

The final component of the website, the "Onslow Bay Weather Planner," is planned for development through a cooperative effort between CORMP and the University of South Carolina. The goal for this Web page is to have an interactive interface through which end users can enter the weather conditions they desire for a specific activity. Upon entering these conditions, the Web page will provide an estimate of the time of year in which these conditions are most likely to exist in Onslow Bay. Support for the further development of this Web page is being sought by CORMP, and if the page can be developed it will offer a future expansion of this test coastal climatology website.

## SUMMARY AND CONCLUSION

An assessment of recreation and tourism managers' and participants' needs for coastal climatology information in southeastern North Carolina indicates that marine or weather information is important to their decision-making processes. Using the results of the needs assessment interviews and the focus group, a test coastal climatology Web page (*www.cormp.org/climate/*) was constructed that consists of one dynamic page that displays near-real-time observations collected at CORMP observation stations in a climatological context, and four static pages that provide descriptions of the Onslow Bay climate and contact information for the PIs, project managers, and CORMP Outreach. Not only was this test coastal climatology Web site based on the results of the needs assessment interviews and the focus group, it was also constructed to incorporate the five cross-cutting issues outlined by Janis and Gamble (2004) as important to the development of effective and useful products for any coastal manager from Virginia to Florida.

The test coastal climatology website incorporates the first cross-cutting issue, user-defined coastal climatology, by utilizing results from interviews and a focus group involving tourism and recreation managers and participants from southeastern North Carolina. Such an approach has been termed an "end-to-end" process and ensures identification of weaknesses of forecasts and products and allows for improvement of the overall process in terms of a product's scientific rigor and dissemination and use (Johnston et al. 2004). Without such a process, a product is not serving to advance its usefulness (Rosenzweig 2001). In this coastal climatology product, a scientific definition of a coastal climatology is not imposed by the PIs onto the end user, allowing for a more organic, bottom-up design that involves local communities, and a more flexible, user-friendly definition of coastal climatology is achieved.

The second cross-cutting issue, coarse-observation systems, is incorporated into the test coastal climatology website through using CORMP observation stations. Ultimately, six CORMP observation stations will be available in Onslow Bay. These six stations offer a much greater spatial resolution of observations as compared to the two existing NDBC buoys at Frying Pan Shoals and Diamond Shoals. In addition, the six observation stations offer a better spatial coverage within Onslow Bay, while Frying Pan Shoals and Diamond Shoals are located on the fringes of the region.

The most difficult cross-cutting issue to incorporate into the test coastal climatology website is the third, integrating weather, marine, and climate forecast results across consistent (and statistically practical) spatial and temporal resolutions. Currently CORMP and UNCW do not have the capability to create such forecasts. Accordingly, the website utilizes forecasts made from the NOAA Climate Prediction Center and attempts to place these within a coastal climatology framework with an introductory statement on how the end user should interpret the forecasts for Onslow Bay. The issue of integrated weather, marine, and climate forecasts is the most challenging aspect of creating effective coastal climatology products.

A collective design of coastal climatology products by end users and scientists, the fourth cross-cutting issue, was incorporated into the test coastal climatology website by choosing appropriate CORMP resources for the product using the needs assessment interviews. Through such a selection process, both parties have a stake in product development and the end-user satisfaction is increased.

The final cross-cutting issue of follow-up was integrated into the product through handing out information pamphlets during interviews, construction of a contact page on the website, and conducting ongoing CORMP outreach activities—such as presenting weather and climatology information to secondary educators at the CORMP workshops and working with the National Weather Service Office – Wilmington to create a one-stop shop for weather data that encompasses the North Carolina and South Carolina coastlines. Through such efforts, CORMP has created a presence in the coastal communities of southeastern North Carolina. This presence allows for more efficient interaction with the public and end users, allowing for effective follow-up to the creation of the test coastal climatology website.

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# Appendix A:
# Draft List of Needs Assessment Interview Questions Derived from the October 2003 Coastal Climatology Workshop (CCW)

**Section I: Long-Term or Climatic Information Needs**

1. What long-term decisions regarding recreation and tourism do you make that utilize marine or weather data?
2. What type of data is currently used in these long term decisions?
3. Do you manipulate or analyze data in order to make long-term decisions?
4. If you do manipulate or analyze data for long-term decisions, what tools do you use in your manipulation or analysis?
5. What marine or weather data are currently unavailable for you long-term decisions regarding recreation and tourism that you would like to incorporate into your decision process?
6. What tools for manipulation and analysis of marine or weather data are currently unavailable for your long-term decisions regarding recreation and tourism that you would like to incorporate into your decision process?
7. What type of training regarding the incorporation of marine and weather data into long-term decision making processes would you like to receive?

**Section II: Near-Real-time or Meteorological Information Needs**

8. What short-term decisions regarding recreation and tourism do you make that utilize marine or weather data?
9. What type of data is currently used in these short-term decisions?
10. Do you manipulate or analyze data in order to make short-term decisions?
11. If you do manipulate or analyze data for short-term decisions, what tools do you use in your manipulation or analysis?
12. What marine or weather data are currently unavailable for your short-term decisions regarding recreation and tourism that you would like to incorporate into your decision process?
13. What tools for manipulation and analysis of marine or weather data are currently unavailable for your short-term decisions regarding recreation and tourism that you would like to incorporate into your decision process?
14. What type of training regarding the incorporation of marine and weather data into short-term decision-making processes would you like to receive?

**Section III: Product Format and Delivery**

15. Which of the following delivery systems would you prefer to receive climate or weather data?
    a. Web page b. CD-ROM c. paper copy d. e-mail
16. Do you prefer text products or graphical representation of data?
17. Would you prefer a static data product or an interface that allows manipulation of data and products?
18. What is an acceptable cost for data?

# Appendix B:
# Final Recreation and Tourism Manager Needs Assessment Interview Questions

**Recreation and Tourism Management Climate Needs Assessment**
UNCW and CORMP

Hello, my name is _____. I am a student researcher at UNCW. I am conducting a survey that will assess the types of climate data that individuals need in order to make decisions regarding their recreation and tourism plans. Your participation in this study is entirely voluntary and all of your responses will be anonymous. You may refuse to participate or you may stop participating at any time without adverse affects. The survey will only take less than 10 minutes to complete. Will you answer a few questions? (If they respond YES, go to Question #1. If they respond NO, thank them for their time and terminate the interview)

Name of Interviewer: _____

Date of Interview: _____ Time of Interview: _____

Weather: Sunny Cloudy Rainy Approx Temp:
Other:

Interview Location: _____

Type of business or organization: _____

Male or Female Manager or Person with Oversight

Q1. Are you 18 years of age or older? (**Not necessary to ask if the answer is obvious**)
_____ Yes→ go to Q2
_____ No (**TERMINATE INTERVIEW and thank the individual**)

Q2. In what year were you born? 19____

Q3. Is the knowledge of marine and/or weather conditions important to your ability to make informed management decisions regarding your organization?
_____ Yes→ go to Q4
_____ No→ go to Q7

Q4. How important is the knowledge of marine and/or weather conditions in making informed management decisions regarding this organization? Is it:
_____ Very Important
_____ Fairly Important
_____ Not Very Important
_____ Not Important At All

Q5. Is the marine and/or weather information you need to make informed decisions regarding your management plans required on an hourly, daily, weekly, monthly or other time-frame basis? (**Ask all and mark all responses that apply**)
_____ Hourly
_____ Daily
_____ Weekly
_____ Monthly
___ Other (Please specify)_____

Q6. Is the marine and/or weather information you need required during the winter, spring, summer or fall seasons? (**Ask all and mark all responses that apply**)
_____ Winter (Dec, Jan and Feb) _____ Summer (June, July and Aug)
_____ Spring (March, Apr and May) _____ Fall (Sept, Oct and Nov)

Q7. Would you rate your general knowledge of the marine and/or weather conditions for the area at which this interview is being conducted as excellent, very good, good, fair or poor?

| **Excellent** | **Very Good** | **Good** | **Fair** | **Poor** |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

Q8. Would you rate your general knowledge of the long term marine and/or weather patterns for the area at which this interview is being conducted as excellent, very good, good, fair or poor?

| **Excellent** | **Very Good** | **Good** | **Fair** | **Poor** |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

Q9. Would you rate the accuracy of the current forecasts of marine and/or weather conditions for the area at which this interview is being conducted as excellent, very good, good, fair or poor?

| **Excellent** | **Very Good** | **Good** | **Fair** | **Poor** |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

Q10. Would you rate the accuracy of long term forecasts of marine and/or weather patterns for the area at which this interview is being conducted as excellent, very good, good, fair or poor?

| **Excellent** | **Very Good** | **Good** | **Fair** | **Poor** |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

Q11. Individuals often consider a variety of marine and weather factors when making management decisions for recreation and tourism organizations. Which of the following factors do you consider when making management decisions for your organization? (**Ask all and mark all responses that apply and give laminated copy of responses to the interviewee.**)

| | | | |
|---|---|---|---|
| a. | Air temperature? | _____Yes | _____No |
| b. | Wind speed? | _____Yes | _____No |
| c. | Wind direction? | _____Yes | _____No |
| d. | Likelihood of rainfall? | _____Yes | _____No |
| e. | Wave height? | _____Yes | _____No |
| f. | Potential for rip currents? | _____Yes | _____No |
| g. | Water temperature? | _____Yes | _____No |
| h. | Water quality? | _____Yes | _____No |
| i. | Hurricane information? | _____Yes | _____No |
| j. | Tide level? | _____Yes | _____No |
| k. | Other (please specify) | _____Yes | _____No |

Q12. Do you make your own marine and/or weather condition predictions?

_____ Yes→ go to Q13
_____ No→ go to Q14

Q13. Do you use statistical analysis, create graphs or charts, or use another method for making your own marine and/or weather condition predictions?

_____ Statistical analysis
_____ Graphs or charts
_____ Other (Please specify)_____

Q14. Do you currently have access to all the types of marine and/or weather information and factors that you need in order to make successful management decisions regarding your organization?

_____ Yes→ go to Q16
_____ No→ go to Q15

Q15. What additional types of marine and/or weather information and factors would you like to have access to in order to make successful management decisions regarding your organization? (**Ask all and mark all responses that apply give laminated copy of responses to the interviewee.**)

| | | | |
|---|---|---|---|
| a. | Air temperature? | _____Yes | _____No |
| b. | Wind speed? | _____Yes | _____No |
| c. | Wind direction? | _____Yes | _____No |
| d. | Likelihood of rainfall? | _____Yes | _____No |
| e. | Wave height? | _____Yes | _____No |
| f. | Potential for rip currents? | _____Yes | _____No |
| g. | Water temperature? | _____Yes | _____No |
| h. | Water quality? | _____Yes | _____No |
| i. | Hurricane information? | _____Yes | _____No |
| j. | Tide level? | _____Yes | _____No |
| k. | Other (please specify) | _____Yes | _____No |

Q16. How do you currently get marine and/or weather information? (**Ask all and mark all responses that apply give laminated copy of responses to the interviewee.**)

| | | | |
|---|---|---|---|
| a. | Website? | _____Yes | _____No |
| b. | CD-ROM? | _____Yes | _____No |
| c. | Government publication? | _____Yes | _____No |
| d. | E-mail? | _____Yes | _____No |
| e. | Television? | _____Yes | _____No |
| f. | Radio? | _____Yes | _____No |
| g. | Newspaper? | _____Yes | _____No |
| h. | Cell Phone Text message? | _____Yes | _____No |
| i. | Fax message? | _____Yes | _____No |
| j. | Other? (Please specify) | _____Yes | _____No |

Q17. Which of the following ways would you prefer to receive additional marine and/or weather information if it were available? (**Ask all and mark all responses that apply give laminated copy of responses to the interviewee.**)

| | | | |
|---|---|---|---|
| a. | Website? | _____Yes | _____No |
| b. | CD-ROM? | _____Yes | _____No |
| c. | Government Publication? | _____Yes | _____No |
| d. | E-mail? | _____Yes | _____No |
| e. | Television? | _____Yes | _____No |
| f. | Radio? | _____Yes | _____No |
| g. | Newspaper? | _____Yes | _____No |
| h. | Cell Phone Text message? | _____Yes | _____No |
| i. | Fax message? | _____Yes | _____No |
| j. | Other? (Please specify) | _____Yes | _____No |

Next I will ask for some general demographic information that will help with analysis of interview data.

Q18. What is your highest level of education completed?

_____Less than high school graduate
_____High school graduate/GED
_____Some college/not a college graduate
_____Associate degree/community college graduate
_____Bachelors degree/college graduate
_____Masters degree
_____Graduate degree beyond Masters degree

Q19. Are you White (Non-Hispanic), Black (Non-Hispanic), Hispanic, Asian/Pacific Island, American Indian/Alaskan Native or some other race?

_____White (Non-Hispanic) _____Black (Non-Hispanic)
_____Hispanic _____Asian/Pacific Island
_____American Indian/Alaskan Native
_____Other (Please specify)_____

Q20. Do you have any additional comments you would like to make about this survey in general or about marine and weather information for recreation and tourism planning purposes in specific?

**This concludes our interview. Thank you very much for participating! Would you like an informational pamphlet that describes this project and CORMP? Would you like to receive e-mail messages about new CORMP efforts?**

**If yes provide e-mail sign-up sheet.**

# Appendix C:
# Final Recreation and Tourism Participant Needs Assessment Interview Question List

**Recreation and Tourism Participant Climate Needs Assessment**
UNCW and CORMP

Hello, my name is _____. I am a student researcher at UNCW. I am conducting a survey that will assess the types of climate data that individuals need in order to make decisions regarding their recreation and tourism plans. Your participation in this study is entirely voluntary and all of your responses will be anonymous. You may refuse to participate or you may stop participating at any time without adverse affects. The survey will only take less than 10 minutes to complete. Will you answer a few questions? (**If they respond YES, go to Question #1. If they respond NO, thank them for their time and terminate the interview.**)

Name of Interviewer: _____

Date of Interview: _____ Time of Interview: _____

Interview Location: _____

Weather: Sunny Cloudy Rainy Approx Temp:
Other:

Male or Female

Q1. Are you 18 years of age or older? (**Not necessary to ask if the answer if obvious**)
_____ Yes→ go to Q2
_____ No (**TERMINATE INTERVIEW and thank the individual**)

Q2. Why did you visit the coast today? **(Ask and circle all responses that apply.)**
Vacation Sun Bathe Surf Fish Walk
Boat/Kayak
SCUBA Dive Swim
Other (Please specify)_____

Q3. What is the zip code at your permanent home address?
_____ Zip code

Q4. In what year were you born? 19____

Q5. Is the knowledge of marine and/or weather conditions important to your ability to make informed recreation and tourism plans?
_____ Yes→ go to Q6
_____ No→ go to Q9

Q6. How important is the knowledge of marine and/or weather conditions in making informed recreation and tourism plans? Is it:
_____ Very Important
_____ Fairly Important
_____ Not Very Important
_____ Not Important At All

Q7. Is the marine and/or weather information you need to make informed recreation and tourism plans required on an hourly, daily, weekly, monthly or other time-frame basis? (**Ask all and mark all responses that apply**)
_____ Hourly
_____ Daily
_____ Weekly
_____ Monthly
_____ Other (Please specify)_____

Q8. Is the marine and/or weather information you need required during the winter, spring, summer or fall seasons? (**Ask all and mark all responses that apply**)
_____ Winter (Dec, Jan and Feb) _____ Summer (June, July and Aug)
_____ Spring (March, Apr and May) _____ Fall (Sept, Oct and Nov)

Q9. Would you rate your general knowledge of the marine and/or weather conditions for the area at which this interview is being conducted as excellent, very good, good, fair or poor?

| **Excellent** | **Very Good** | **Good** | **Fair** | **Poor** |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

Q10. Would you rate your general knowledge of the long term marine and/or weather patterns for the area at which this interview is being conducted as excellent, very good, good, fair or poor?

| **Excellent** | **Very Good** | **Good** | **Fair** | **Poor** |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

Q11. Would you rate the accuracy of the current forecasts of marine and/or weather conditions for the area at which this interview is being conducted as excellent, very good, good, fair or poor?

| **Excellent** | **Very Good** | **Good** | **Fair** | **Poor** |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

Q12. Would you rate the accuracy of long term forecasts of marine and/or weather patterns for the area at which this interview is being conducted as excellent, very good, good, fair or poor?

| **Excellent** | **Very Good** | **Good** | **Fair** | **Poor** |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

Q13. Individuals often consider a variety of marine and/or weather factors when making decisions about recreation and tourism plans. Which of the following factors do you consider when making recreation and tourism plans? (**Ask all and mark all responses that apply give laminated copy of responses to the interviewee.**)

| | | | |
|---|---|---|---|
| l. | Air temperature? | _____Yes | _____No |
| m. | Wind speed? | _____Yes | _____No |
| n. | Wind direction? | _____Yes | _____No |
| o. | Likelihood of rainfall? | _____Yes | _____No |
| p. | Wave height? | _____Yes | _____No |
| q. | Potential for rip currents? | _____Yes | _____No |
| r. | Water temperature? | _____Yes | _____No |
| s. | Water quality? | _____Yes | _____No |
| t. | Hurricane track? | _____Yes | _____No |
| u. | Tide level? | _____Yes | _____No |
| v. | Other (please specify) | _____Yes | _____No |

Q14. Do you make your own marine and/or weather condition predictions?

_____ Yes→ go to Q15
_____ No→ go to Q16

Q15. Do you use statistical analysis, create graphs or charts, or use another method for making your own marine and/or weather condition predictions?

_____ Statistical analysis
_____ Graphs or charts
_____ Other (Please specify)_____

Q16. Do you currently have access to all the types of marine and/or weather information and factors that you need in order to make successful recreation and tourism plans?

_____ Yes→ go to Q18
_____ No→ go to Q17

Q17. What additional types of marine and/or weather information and factors would you like to have access to in order to make successful recreation and tourism plans? (**Ask all and mark all responses that apply give laminated copy of responses to the interviewee.**)

| | | | |
|---|---|---|---|
| l. | Air temperature? | _____Yes | _____No |
| m. | Wind speed? | _____Yes | _____No |
| n. | Wind direction? | _____Yes | _____No |
| o. | Likelihood of rainfall? | _____Yes | _____No |
| p. | Wave height? | _____Yes | _____No |
| q. | Potential for rip currents? | _____Yes | _____No |
| r. | Water temperature? | _____Yes | _____No |
| s. | Water quality? | _____Yes | _____No |
| t. | Hurricane track? | _____Yes | _____No |
| u. | Tide level? | _____Yes | _____No |
| v. | Other (please specify) | _____Yes | _____No |

Q18. How do you currently get marine and/or weather information? (**Ask all and mark all responses that apply give laminated copy of responses to the interviewee.**)

| | | | |
|---|---|---|---|
| a. | Website? | _____Yes | _____No |
| b. | CD-ROM? | _____Yes | _____No |
| c. | Government Publication? | _____Yes | _____No |
| d. | E-mail? | _____Yes | _____No |
| e. | Television? | _____Yes | _____No |
| f. | Radio? | _____Yes | _____No |
| g. | Newspaper? | _____Yes | _____No |
| h. | Cell Phone Text message? | _____Yes | _____No |
| i. | Fax message? | _____Yes | _____No |
| j. | Other? (Please specify) | _____Yes | _____No |

Q19. Which of the following ways would you prefer to receive additional marine/or and weather information if it were available? (**Ask all and mark all responses that apply give laminated copy of responses to the interviewee.**)

| | | | |
|---|---|---|---|
| k. | CD-ROM? | _____Yes | _____No |
| l. | Government Publication? | _____Yes | _____No |
| m. | E-mail? | _____Yes | _____No |
| n. | Television? | _____Yes | _____No |
| o. | Radio? | _____Yes | _____No |
| p. | Newspaper? | _____Yes | _____No |
| q. | Cell Phone Text message? | _____Yes | _____No |
| r. | Fax message? | _____Yes | _____No |
| s. | Other? (Please specify) | _____Yes | _____No |

Next I will ask for some general demographic information that will help with analysis of interview data.

Q20. What is your highest level of education completed?

_____Less than high school graduate
_____High school graduate/GED
_____Some college/not a college graduate
_____Associate degree/community college graduate
_____Bachelors degree/college graduate
_____Masters degree
_____Graduate degree beyond Masters degree

Q21. Are you White (Non-Hispanic), Black (Non-Hispanic), Hispanic, Asian/Pacific Island, American Indian/Alaskan Native or some other race? (**Not necessary to ask if the answer is obvious**)

_____White (Non-Hispanic) _____Black (Non-Hispanic)
_____Hispanic _____Asian/Pacific Island
_____American Indian/Alaskan Native
_____Other (Please specify)_____

Q22. Next I will read some income categories. As I read the list please stop me when I get to the category that includes your household's total annual income before taxes.

_____Less than $20,000
_____Between $20,000 and $39,999
_____Between $40,000 and $59,999
_____Between $60,000 and $79,999
_____Between $80,000 and $99,999
_____$100,000 or more
_____Refused
_____Don't know

Q23. Do you have any additional comments you would like to make about this survey in general or about marine and weather information for recreation and tourism planning purposes in specific?

**This concludes our interview. Thank you very much for participating! Would you like an informational pamphlet that describes this project and CORMP? Would you like to receive e-mail messages about new CORMP efforts?**

**If yes provide e-mail sign-up sheet.**

## Appendix D

# Tourism and Recreation Coastal Climatology Interview Protocol

For all interview sessions:

- Be presentable – dress neatly, wear CORMP shirt (LACR visor optional), no torn pants/shorts, no bathing suits or surf shorts, sandals or flip flops are acceptable.
- All workers are to travel in pairs or be accompanied by Jeff Marshall or Doug Gamble to and from a study site. Once at the site, the workers should work independently to complete the interviews.
- Always be positive and helpful. If a person refuses to participate, say "Thank you for your time" and walk away. Write in large letters NR on the first page of the interview packet and return the packet to Jeff Marshall with all other completed interviews.
- Read the interview to the person and record the answers and confirm they are over 18 years old.
- Hand the laminated response sheet to interviewee for questions 13/17 and 18/19 on the participant survey and questions 13/17 and 18/19 on the manager survey.
- Make note of any questions that participants consistently request to be clarified or explained.
- At the end of interview session, thank the participant, ask him/her if he/she would like a pamphlet, and whether he/she would like to provide an e-mail to receive announcements of product development or potential training sessions.
- At the end of the day or trip, log in all interview sheets with Jeff Marshall.
- If inclement weather (rain or strong wind) starts during the proposed survey time, interferes with interview efforts, and persists for longer than 20 minutes, abandon survey efforts.
- Provide any interviewee with Dr, Gamble's business card if they wish to contact the principal investigator for the project.
- ***Do not characterize this project as NOAA research. The project is to be described as a UNCW research project.***
- ***Each student must have a cell phone available during interview sessions for use in emergency situations.***

For manager interview sessions:

- Begin at the designated starting point, usually a street intersection, and walk along the designated transect, usually a series of streets, stop at each tourism/recreation establishment and request to interview the manager or person with oversight for the location. Start at the designated times of 9AM or 1PM and continue for three hours or until no establishments on the designated transect are available.
- Acceptable tourism/recreation establishments include, but are not limited to surf shops, beach item rental stores, kayak and jet-ski rentals, rental properties offices, tackle shops, state park offices, charter services, fishing piers, amusement parks, dive shops , and marinas. If in doubt, complete the interview but make note that it should be reviewed to determine inclusion in the study. When you return to UNCW, make sure Marshall or Gamble review questionable interviews.

For participant interview sessions:

- Begin at the designated starting point, usually a beach access, and walk along the beach, stopping every five people, or groups of people (a group of people who have traveled to the beach together or are interacting on the beach), and request an interview. In group situations request the person with the next closest birth date in the calendar year. Start at the designated times of 9AM or 1PM and continue for three hours or until you run out of potential participants. If enough people are available, walk back and forth between the designated starting and end points within the three hours. Do not repeat individuals or groups. Start your interview transect at the back of the beach, and any repeated transects should be started moving 10 paces closer to the water.

# Appendix E:
# Question List for Coastal Climatology Website Focus Group

## Coastal Climatology Website Questionnaire

**Directions**: View *one* of the following websites and answer the questions below. Check the one viewed.

| | | |
|---|---|---|
| | National Data Buoy Center | www.ndbc.noaa.gov/Maps/Southeast.shtml |
| | National Oceanographic Data Center | www.nodc.noaa.gov/ |
| | National Hurricane Center | www.nhc.noaa.gov |
| | National Climatic Data Center | www.ncdc.noaa.gov/oa/ncdc.html |
| | National Ocean Service (NOS) Water Level Observation Network (*Tide Data*) | www.tidesonline.nos.noaa.gov/geographic.html |
| | NCEP Marine Modeling and Analysis Branch (*Wave Model Data*) | http://polar.ncep.noaa.gov/ |
| | Oceanweather Incorporated (*Wave/SST Data*) | www.oceanweather.com/data/ |
| | Buoyweather.com (*Marine Weather Data*) | www.buoyweather.com |
| | Weather Underground Marine Weather | www.wunderground.com/MAR/ |
| | Southeast Atlantic Coastal Ocean Observing System (SEACOOS) | http://seacoos.org/Data%20Access%20and%20Mapping/ |
| | Coastal Ocean Research Monitoring Program (CORMP) | www.cormp.org |

1. What type of coastal recreation/tourism activities are you involved in?

2. What did you like about this website?

3. What did you not like about this website?

4. Was the overall design of the website suitable to your data observing needs? How would you improve the “usability” of this site?

5. What kind of coastal data would you like to see added to this website? (E.g. more observations, nowcasts, forecasts, long term trends, increased spatial/temporal resolution)

6. What is your favorite website for coastal climate data?

**Selected Responses from the Coastal Climatology Website Focus Group**

Buoyweather.com

Likes:

- Very clear and readable
- Attractive layout, explains graphs thoroughly, current graph of precipitable water

Dislikes:

- It cost money
- Click on map as opposed to icon to lower left
- Need direction of swell
- Wording on charts too small to read
- Only one link to current information chart when several charts are provided
- Not free
- Pure garbage
- Wanted me to download its products
- All the site did was link me to other sites

CORMP

Likes:

- Present conditions, river plume stations (3)
- Good inventory of past data
- Frame constantly on the left while navigating
- Basic and user friendly
- Nice colors and balance of object placement
- Easy to read

Dislikes:

- More data for a larger area
- Not visually attractive, does not have appealing graphics and links that make it easier to navigate
- If I wasn't a geography major, I wouldn't know how to relate the information
- Add 24 hr wave map, animated stuff, current satellite and radar images
- It would be more user friendly if the frames could be presented when you follow the link way from the page
- Add wave height and coastal warnings
- Too much white space on right side of screen
- Needs more maps

NCEP Marine Modeling and Analysis Branch

Likes:

- Some info and graphics were pretty cool

Dislikes

- Not appealing to the eye
- Too many links off the main page – unless you are an expert you probably won't know where to look

National Climatic Data Center

Likes:

- Vast data
- Usable for many aspects of earth and environmental science

Dislikes:

- Overwhelming
- Provide a link to usable data for students/educators

National Data Buoy Center

Likes:

- I liked the detailed maps
- Simplistic layout, easy to navigate

Dislikes:

- Needs more colors to be pleasing to the eye
- Need more observations

National Hurricane Center:

Likes:

- Simple, easy to navigate
- History of hurricanes
- Jammed pack if information
- Stat about storms

Dislikes:

- Needs more pictures to capture interest
- Make it more colorful and appealing
- Add marine and wave forecast and offshore radar
- Maybe too much information
- As with most NOAA sites . . . the layout is confusing

National Oceanographic Data Center

Likes:

- Links to other types of information about the ocean, broad topics

Dislikes:

- Just a clearing house, didn't have much to offer on its own
- Add more graphics to make more attractive
- Hard to find forecasting and interactive models

Oceanweather

Likes:

- Clarity of swell direction and size
- All options are easy to find
- Gives you wave height, sea temp, winds
- Good for offshore but not on or near-shore
- Current marine data including wave graphics, marine observations, and SST
- Perfect for boaters
- Provides world info

Dislike:

- Need Inverted surface chart
- Need more atmospheric data to compare with marine (2)
- The buoy stations are color coded but there is no indication of what colors represent, same with contour lines
- Data and forecast on too broad of scale
- No current satellite or radar images
- Good data requires software
- Navigation bar should be on left side not bottom of page
- Do not split states in two for data presentation

Weather Underground

Likes:

- Gives sea surface temperature for all of east coast (2)
- Has current weather photos for different areas
- The point and click data for your coastal region (2)
- Ease of finding regional info when you type in the zip code
- Listed wind direction, speed and wave heights
- Includes Great Lakes and West Coast

Dislikes:

- Lots of useless information like the astronomy section
- Paid members can only access the loops
- Add swell charts and wind direction
- Pop-up ads
- Did not provide detailed info about the SE coasts of NC
- Add search box for specific beach or marine area

# Appendix F:
# Participating External Reviewers

Jennifer Dorton, CORMP Outreach Services, University of North Carolina at Wilmington. *Interview design and administration, interview data analysis.*

Michel Fougeres, Information Technology Systems Division, Department of Client Services, University of North Carolina at Wilmington. *Website design.*

Dr. Jim Herstine, Assistant Professor of Parks and Recreation Management, Department of Health and Applied Human Sciences, University of North Carolina at Wilmington. *Interview design and administration, interview data analysis, test coastal climatology Web product*

Dr. Stephen Meinhold, Associate Professor, Department of Political Science, University of North Carolina at Wilmington. *Interview design and administration, interview data analysis, test coastal climatology Web product.*

Steven Pfaff, National Weather Service Wilmington Office. *Test coastal climatology Web product.*

John Quagliariello, National Weather Service Wilmington Office. *Test coastal climatology Web product.*

Dr. Jack Thigpen, North Carolina Sea Grant. *Interview design and administration, interview data analysis, test coastal climatology Web product.*