

### Introduction

The National Integrated Drought Information System (NIDIS) and Carolinas Integrated Sciences and Assessments (CISA) are partnering to develop and support a Carolinas Drought Early Warning System (DEWS) pilot project. Initial activities have included understanding drought in the region, a stakeholder workshop and development of pilot projects. This poster reports on progress made to date.

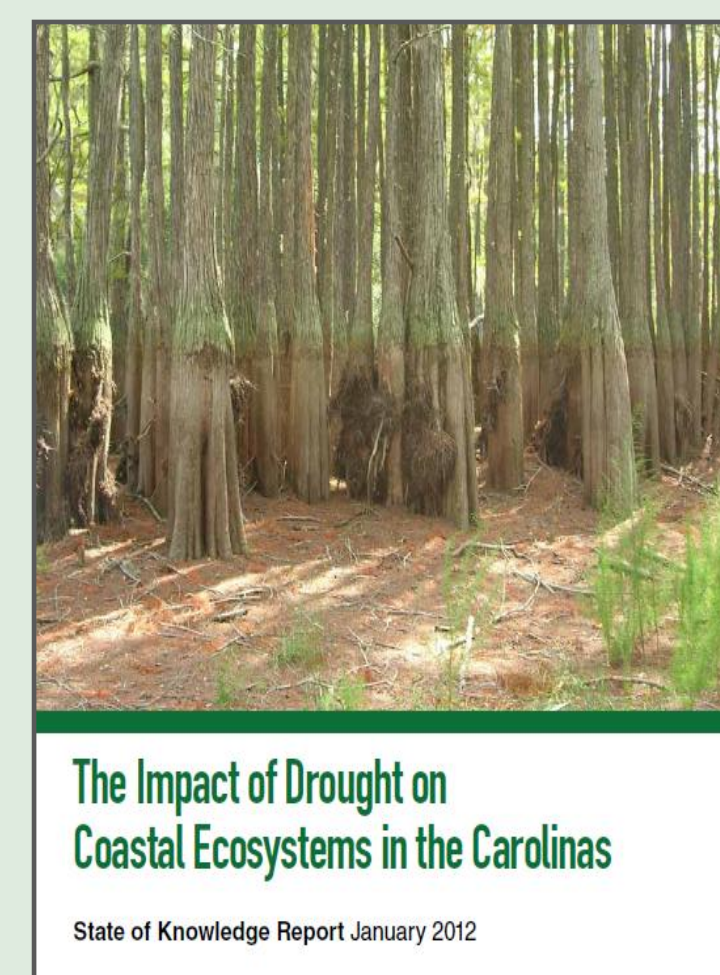
### Focus on Coastal Ecosystems

The project's focus is coastal ecosystems. In the Carolinas, drought effects on environmental resources, particularly in coastal areas, are not as well-understood, or as well-integrated into existing drought planning and response processes, as other impacts and resources (e.g. agriculture, surface water supplies). Key concerns related to drought and coastal ecosystems focus on impacts to water quality and quantity, habitats, species, and estuarine processes. Drought contributes to increased salinity and saltwater intrusion, reduced flushing or assimilation of pollutants, and overall water quality changes. Ecosystem impact concerns center on habitat loss or conversion and consequent effects on recruitment, distribution and migration patterns as well as on primary and secondary production. Saltwater intrusion, low stream flows, and low water levels contribute to impacts and are attributed to both drought and human actions (e.g. changes in dam releases due to drought).

### Carolinas Integrated Sciences & Assessments

CISA is 1 of 11 NOAA Regional Integrated Sciences and Assessments (RISA). We work with a variety of stakeholders to incorporate climate information into decision-making processes. Core focus areas include:

- Drought
- Climate and Watershed Modeling
- Coastal Management
- Health
- Adaptation



CISA's drought work seeks to improve monitoring methods, to develop a more comprehensive understanding of regional impacts, and to assess drought planning and early warning needs. Several projects have been initiated to advance regional and local capacity to cope with drought and to improve understanding of drought-related impacts on social and environmental systems.

- Development of the **Dynamic Drought Index Tool (DDIT)**, a web based drought mapping tool that displays multiple drought indices for different time scales and across user-specified regions
- Development of a web-based **Decision Support System (DSS)** PRISM2 (Pee Dee River and Atlantic Intracoastal Waterway Salinity Intrusion Model) for stakeholder and government agency use in evaluating potential changes in the hydrologic system of the Pee Dee River under different climatic regimes
- Completion of the **Drought and Coastal Ecosystems State of Knowledge Report** to better understand literature gaps and research needs

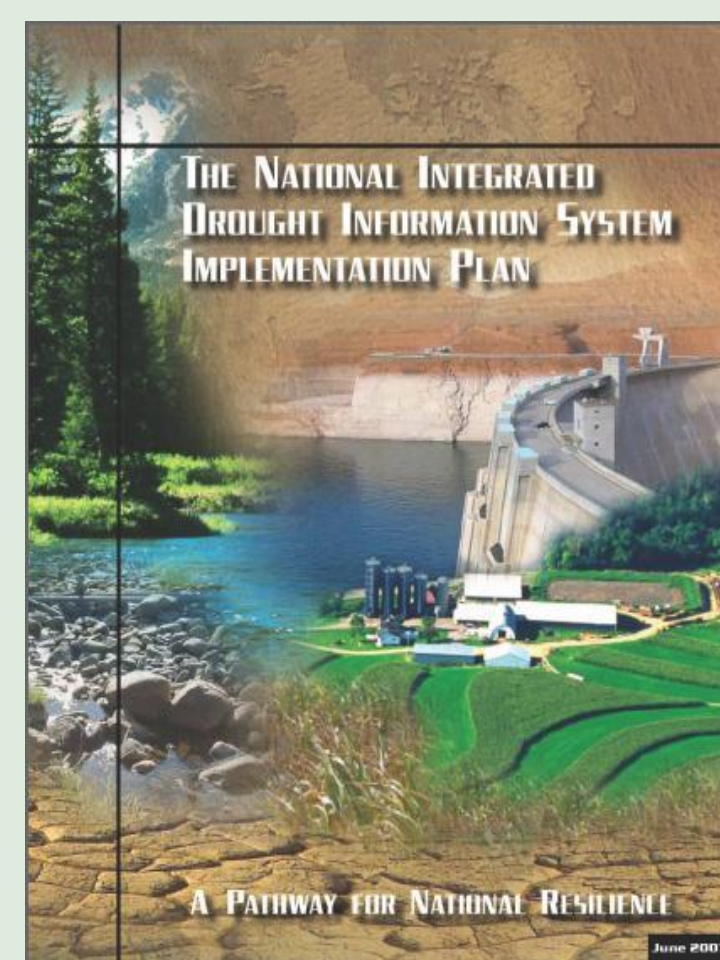
### National Integrated Drought Information System

The National Integrated Drought Information System (NIDIS) Act, signed into law in 2006, calls for an interagency, multi-partner approach to drought monitoring and forecasting. NIDIS consolidates data on drought's physical, hydrological and socio-economic impacts for critical, drought-sensitive areas to enable proactive planning. Regional early warning system pilots or prototype systems are being developed to coordinate and strengthen capacity among states, counties, agencies and tribal communities for developing, managing and using drought early warning information. These systems support the following functions at regional, watershed and local scales:

- 1) communication and education
- 2) integrating monitoring and forecasting products,
- 3) impacts assessments and decision support tool development
- 4) drought portal development
- 5) engaging preparedness communities, i.e., embedding information from (1) through (4) into planning and adaptation

#### Elements of a Drought Early Warning System

- Monitoring – hydrological & meteorological
- Forecasting/Outlook - onset, intensification and recovery
- Management triggers
- Anticipated impacts
- Effective communication to stakeholders



### Development of Drought Early Warning System Pilot Projects

Drought early warning can be used to identify climate and water supply trends leading to the emergence or intensification of drought. This information can reduce impacts if delivered to decision makers in a timely and appropriate format. Drought early warning is more useful if mitigation measures and preparedness plans are in place. Stakeholders who monitor various early warning indicators can help to develop and implement more efficient and effective drought-relief interventions. The process below provides information on the steps taken to date by CISA and NIDIS for development of a **drought early warning system (DEWS)** for coastal ecosystems in the Carolinas.

#### Understanding Drought in the Region

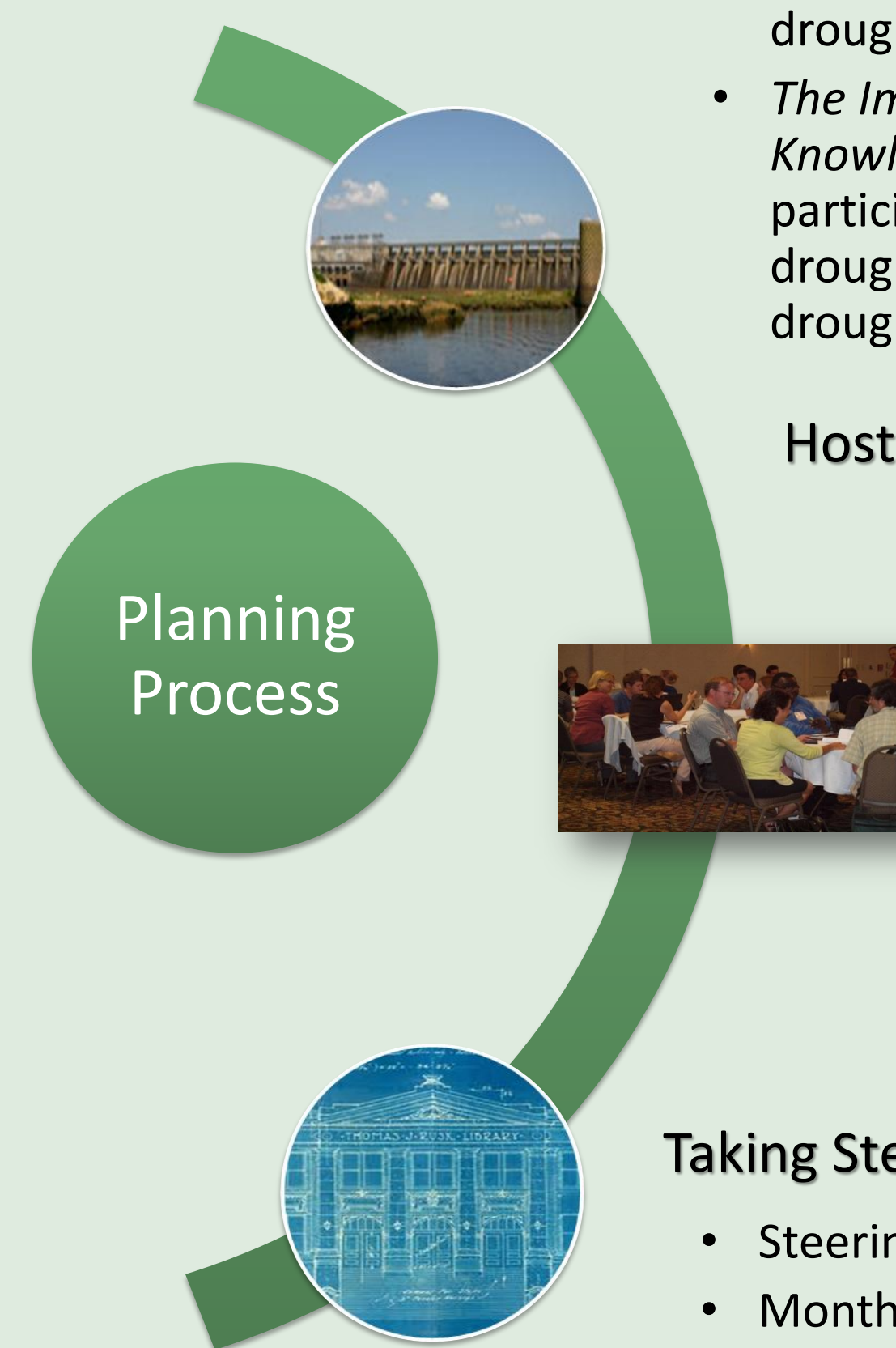
- Spring 2010 - Stakeholder workshop held to identify needs for a drought early warning system
- *The Impact of Drought on Coastal Ecosystems in the Carolinas State of Knowledge Report* (Gilbert et al., 2012) was a result of workshop participants indicating a need for greater availability of appropriate drought data and information to manage coastal resources during drought.

#### Hosting Stakeholder Meetings

- Scoping workshop steering committee meeting held at Fort Johnson, SC May 1, 2012
  - Identified interested organizations, agencies and individuals for the scoping workshop
  - Identified priority topics for generation of pilot project ideas during World Café style breakout sessions
- DEWS Scoping Workshop held in Wilmington, NC July 31 – August 1 2012 to generate pilot project ideas

#### Taking Steps Towards Implementation

- Steering committees established for each pilot project
- Monthly committee calls have begun for each pilot project
- Next steps include identification of key sectors or geographic regions to target, identification of potential project partners, identification of other available resources to build upon
- This information will be used to map out a project action plan for each pilot



### Scoping Workshop Activities: Pilot Project Selection Process

Scoping workshop participants generated pilot project ideas during World Café style breakout sessions on the first day of the workshop. Each World Café table discussion centered on a specific topic related to drought and coastal ecosystems in the Carolinas (see table below). On the second day, moderators reported back to the full group on pilot ideas generated for each topic.

Workshop participants voted on pilot ideas generated for each topic. Workshop participants voted on pilot projects using the Turning Technologies Audience Response System, which provides real-time results integrated into a PowerPoint presentation. Participants discussed pilot project selection criteria and metrics for success in selecting projects. Ultimately, four projects were selected to move forward.

#### Scoping Workshop World Café Table Topics

Improving Understanding of Ecosystem & Species Impacts
Public Health Risks
Impacts & Management Strategies for Coastal Lands
Water & Drought Management
Economic Impacts of Drought
Drought Early Warning Metrics & Tools
Ties to Climate Change Adaptation
Communication and Education

### Pilot Project 1: Evaluation of Drought Indicators and Indices

Many of the commonly used drought indices were not developed with the unique characteristics of coastal ecosystems in mind. Predicting the onset, intensification and recovery of a drought could be improved with more knowledge of drought indicators and indices in coastal ecosystems. The goals developed by workshop participants for this particular pilot project will be to

- Determine which current drought indicators and indices are appropriate for assessing drought in coastal ecosystems
- Investigate the benefits and feasibility of creating a drought index based on real-time salinity data

### Pilot Project 2: Seafood Safety Forecast

During drought, freshwater flows are reduced and water temperatures rise. Impacts of these changes include increases in concentrations of pollutants, increases in salinity, changes in pH, increases in harmful algal blooms (HABs), increases in shellfish predator populations, increases in Vibrio bacteria and Cyanobacteria. All of these changes, and others not listed here, can have harmful effects on seafood. The *Seafood Safety Forecast* pilot project would aim to

- Provide an early warning system for commercial, recreational and subsistence fishermen who harvest drought-sensitive seafood in both fresh and salt waters in the coastal regions of the Carolinas

### Pilot Project 3: Drought Forecasting Communications

Numerous drought, hydrometeorological and climate products are available to stakeholders in the Carolinas. However, stakeholders may not be aware of all products which are available, may not have the products they need to make decisions (i.e. the regional or temporal scale may not be adequate), or may not know the best way to tailor the products to their region or situation. This pilot project idea was designed by workshop participants to

- Introduce stakeholders to current products used for drought forecasting
- Determine what additional drought forecasting products stakeholders need and what time scales are of most interest to them
- Determine the best way to deal with uncertainty resulting from forecast data, including how uncertainty is conveyed to stakeholders
- Determine the best methods to relay information about drought forecasting tools

### Pilot Project 4: Drought Impact Reporting

Participants identified many possible benefits of improving drought impact reporting to include improving drought monitoring, building stakeholder awareness and engagement, building linkages between drought indicators and impacts, and addressing the need to improve understanding of the economic benefits of preparedness activities related to the NIDIS pilot, and mitigation and planning strategies. The overarching goals suggested by participants for this project will be to

- Assess ways in which drought impacts might be monitored through stakeholder engagement and citizen science
- Investigate ways to improve the communication of coastal ecosystem drought impacts

### NIDIS Carolinas Scoping Workshop

#### Steering Committee Member & Participant Organizations

\* Steering Committee Member Organization

Audubon South Carolina	NOAA National Weather Service
Beaufort-Jasper Water & Sewer Authority	NOAA Regional Climate Services, Eastern Region*
DOI Southeast Climate Science Center	NOAA Southeast and Caribbean Regional Team*
East Carolina University	North Inlet - Winyah Bay National Estuarine Research Reserve
Gullah/Geechee Nation	Pocosin Lakes National Wildlife Refuge
Lumbee Tribe of North Carolina	South Atlantic Landscape Conservation Cooperative
National Climatic Data Center	SC Sea Grant Consortium*
National Drought Mitigation Center*	SC State Climate Office*
NC Coastal Reserve & National Estuarine Research Reserve	Southeast Regional Climate Science Center*
NC DENR, Division of Coastal Management	The Nature Conservancy, NC & SC*
NC DENR, Division of Water Resources	US Army Corps of Engineers
NC Department of Health & Human Services, Division of Public Health	US EPA, Region 4*
NC Department of Public Safety, Division of Emergency Management	UNC Wilmington, Center for Marine Science
NC Sea Grant*	USC Public Health Research Center, Dept. of Environmental Health Sciences
NC State Climate Office*	US Fish & Wildlife Service, SC Coastal Program*
NC Water Resources Research Institute	US Fish & Wildlife Services, SC Lowcountry Refuges Complex*
NOAA Center for Coastal Environmental Health & Biomolecular Research*	US Marine Corps, Camp Lejeune
NOAA Fisheries, Southeast Regional Office*	USGS NC Water Science Center
NOAA National Centers for Coastal Ocean Science, Center for Human Health Risk*	USGS SC Water Science Center*

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#### References

Gilbert, S., K. Lackstrom, and D. Tufford. 2012. The Impact of Drought on Coastal Ecosystems in the Carolinas. Research Report: CISA-2012-01. Columbia, SC: Carolinas Integrated Sciences and Assessments.