Drought and Coastal Ecosystems: Identifying Impacts and Opportunities to Inform Management

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NIDIS-Carolinas Pilot Program Update

• Background
• Findings from CISA’s drought impacts project
  ▫ interviews with local decision makers
• Ongoing work and next steps
Why should we care about drought?
Why a pilot program focused on drought and coastal ecosystems?
Why do we need to know more about drought impacts?
Drought since 2000

- Percent area in D1-D4 (contiguous U.S.)
  - 7.74% (low, July 2010) to 65.45% (high, Sept 2012)
  - Average = 32.18%
- Percent area in D0-D4 (contiguous U.S.)
  - 21.35% (low, June 2010) to 80.75% (high, July 2012)
  - Average = 49.74%
  - Source: US Drought Monitor

- Estimated Costs
  - $100 billion
  - Agriculture, forestry, fire
  - State and local assessments (if/when conducted)
  - Source: http://www.ncdc.noaa.gov/billions/summary-stats
National Integrated Drought Information System

- Information and tools to monitor and forecast drought
- Stakeholder engagement, communications, outreach
• SC Drought Conditions, Percent Area, 2000-present
  ▫ Source: US Drought Monitor

To zoom in, click and drag the cursor. To return to the full time series, double-click anywhere in the chart.
Why drought and coastal ecosystems?

- Drought is a significant stressor to coastal ecosystems, but ecological/drought information has not been systematically integrated into drought monitoring and response.

- Available information is diverse, but not comprehensive:
  - By ecosystem
  - How drought is defined and characterized
  - Temporal dimensions (seasonal v. multi-year events)
  - Episodic impacts v. broader, systemic change
NIDIS-Carolinas Pilot Program

• Carolinas Scoping Workshop, Wilmington, NC, Summer 2012
  • Drought indicators & indices
  • Drought impact reporting
  • Drought forecasting
  • Seafood safety
Why focus on “drought impacts”? 

- Need to expand our understanding of drought beyond the four categories typically used:
  - Meteorological
  - Agricultural
  - Hydrological
  - Socioeconomic

- “Ecological drought”
  - Water deficiency causing stress to plants, animals, ecosystems

- Improved understanding of drought impacts and vulnerabilities can:
  - Inform the development of mitigation strategies
  - Improve understanding of how and what to monitor
The Economic Impact Of Travel on South Carolina Counties 2012

30 Billion Reasons Why Life's Better Outdoors

The Economic Impact of South Carolina's Natural Resources

2009
CISA’s drought impacts pilot project

Findings from interviews with local decision makers
Why interviews?

- To learn first-hand about
  - On-the-ground drought impacts in coastal regions of the Carolinas
  - Mechanisms for coping with drought impacts
  - Drought information use and needs

- 2 sets of interviews
  - March-June 2013
    Beaufort County, SC
  - Oct-Nov 2013
    Carteret County, NC
Study area

- Carteret County
- Beaufort County

Map showing the locations of Carteret and Beaufort counties in North Carolina.
Who we interviewed

- Commercial fisheries businesses (n=13)
  - Shrimpers, crabbers, other commercial fishermen
  - Seafood houses

- Recreational fishing businesses (n=6)
  - Fishing guides, charter boats

- Fishing – research and extension (n=6)

- Outdoor recreational businesses (n=6)
  - Kayakers, ecotourism companies

- Land/refuge managers (n=11)
  - National Wildlife Refuges
  - Public and private parks and preserves
  - National Estuarine Research Reserves
Analysis of drought impacts: What are we looking for?

- Direct physical impacts
- Indirect impacts on species, ecosystems
- Interactions with other climate, biological, and human stressors
- Secondary, indirect impacts to individuals, businesses, organizations
- Responses & adaptations by affected groups
Cascading impacts (commercial fishing example)

Direct impacts
- Water quality conditions, salinity
- Freshwater inputs (timing, availability)

Indirect (ecological) impacts
- Habitat suitability; habitat stress or change
- Movement, location, recruitment of species

Interacting stressors
- Human: water quality, resource use, development, regulations, economics
- Weather/climate: local conditions, water and air temperature, storms
- Biological: disease

Socioeconomic impacts
- Unavailable, inaccessible resources
- Decreased quality, quantity; decreased landings
- Additional costs; increased competition

Responses
- Diversify species, locations
- Diversify business activities and strategies
Cascading impacts (refuge management example)

**Direct impacts**
- Water quality conditions, salinity
- Freshwater inputs, water levels
- Soil conditions

**Indirect (ecological) impacts**
- Stressed vegetation
- Species composition changes and shifts
- Increased fire risk

**Interacting stressors**
- Human: water management, land use
- Weather/climate: local conditions, sea level rise
- Biological: invasive species

**Socioeconomic impacts**
- More difficult to manage refuges for optimal conditions
- Fishing and hunting events cancelled; local businesses affected

**Responses**
- Balance competing interests and priorities
- Long-term monitoring and adaptation projects
Information use and needs for a drought early warning system (all groups)

• **Drought matters**
  ▫ But, limited use of existing drought information and tools
  ▫ Concerns about impacts are:
    • Sector-specific
    • Context-dependent: local variability and diversity, micro-climates

• **Salinity matters**
  ▫ Cross-cutting issue

• **Drought is one component of a broader weather-climate continuum**
  ▫ Interest in extremes: timing, duration, seasonality
  ▫ Flooding and “drought busters” are just as significant for many decisions
Decision-Making Continuum for Commercial Fishing Businesses

Factors Influencing Decisions

- Abundance and Location of Target Species
- Weather / Extreme Events
  - Flows/Salinity
- Climate Variability
- Regulations and Policies
  - (Gear, when and where fishing is permitted, catch limits)
- Fuel Prices
- Overall economic conditions
  - Business and operational costs
- Market Conditions
  - Demand, product prices, customer expectations

Decisions

- Fishing Effort
  - How far to travel
  - Hours/days/locations
  - How many people to employ
- Diversify Target Species
- Diversify Business Strategies
- Maintain/Upgrade Gear and Equipment

Operational Seasonal Annual 3+ Years

Short-term Long-term
Decision-Making Continuum for Refuge Managers

Federal Policies and Priorities
- Conservation and management of fish, wildlife and plants and their habitats
- Compatible wildlife-dependent recreational uses
  (e.g., hunting, fishing, wildlife observation and photography, environmental education and interpretation)

Factors Influencing Decisions
- Weather
  - Precipitation patterns
  - Extreme events
- Climate Variability
  - Saltwater intrusion
- Sea level rise

Refuge-specific Factors
- Ownership and management of neighboring (e.g., private) lands
- Coordination with state (or other) agencies
- Existing water control structures, pumping equipment
- Topography
- Invasive species
- Available resources to implement monitoring and long-term projects (staff, funding)

Decisions
- Use Management
  - Hunting and fishing events
  - General public access and use
- Habitat Management
  - Prescribed burning
  - Pond water levels and maintenance
  - Adaptive management
  - Development and implementation of projects to adapt to climate change

Operational
- Seasonal
- Annual
- Long Term

Short-term

Long-term
Ongoing projects and next steps
weekly condition monitoring citizen science project
connecting weather and climate to the environment

• CISA is working with CoCoRaHS volunteers to collect weekly condition monitoring reports in addition to their daily precipitation measurements
  ▫ Uses existing tools developed by the Community Collaborative Rain, Hail & Snow network (CoCoRaHS)

• Regular observations help to:
  ▫ Identify the early signs of drought
  ▫ Identify when conditions begin to improve
  ▫ Identify any lingering impacts
Participating Groups

- Current CoCoRaHS Observers
- Master Naturalists
- Master Gardeners
- Chowan Edenton Environmental Group (NC)

43 observers submitting regular condition monitoring reports

551 reports received between September 2013 and August 2014
Project participants
South Carolina

View Large Map
• Ground conditions are very dry. Grasses are dying once cut by lawn equipment and this is causing excessive dust and dirt and clippings to be scattered about once lifted by either the wind or lawn equipment. Red Leaf Maple leaves are prematurely falling and Dogwood leaves are starting to prematurely turn from green to red. A false autumn.
SC CoCoRaHS Reports included in the national Drought Impacts Reporter for the last year

http://droughtreporter.unl.edu/
Types of information provided by participants, by Drought Impact Reporter categories

- Agriculture: 440
- Business & Industry: 21
- Energy: 5
- Fire: 26
- General Awareness: 27
- Plants & Wildlife: 374
- Relief, Response & Restrictions: 14
- Society & Public Health: 26
- Tourism & Recreation: 38
- Water Supply & Quality: 256

1227 total impacts identified/551 reports
Other information included in reports

- Temperature Data: 173
- Precipitation Data: 447
- Other Weather Obs: 157
- Drying or Drought: 210
- Soil Moisture: 263
- Actions Taken (Or Not): 413
Next steps: evaluating the information provided by citizen scientists

- Effectiveness of CoCoRaHS-citizen science as a tool to improve understanding of drought impacts

- Usefulness of information for drought decision makers and resource managers

- Effectiveness of CoCoRaHS-citizen science as a tool to inform other drought monitoring efforts
Atlas of Hydroclimate Extremes for the Carolinas
  - CISA Team

Forecasting blue crab distributions using an individual-based population model (IBM)
  - Links freshwater discharge data with an IBM to forecast blue crab abundance and landings
  - Michael Childress (Clemson University)

Real-time salinity drought index (SDI)
  - Based on USGS salinity and streamflow data
  - Paul Conrads (USGS SC Water Science Center)

Indicators and indices of drought in southeastern coastal ecosystems
  - Work with refuge managers to characterize ecological drought
  - Relate ecosystem impacts of drought to the SDI, develop triggers and thresholds
  - Dan Tufford (CISA), David Chalcraft (East Carolina Univ.)

Assessment of drought indicators for coastal zone fire risk
  - Which drought index is the best indicator of fire risk in coastal organic soils?
  - Ryan Boyles (NC State Climate Office)
For more information, visit:

http://www.drought.gov/drought/regional-programs/coastalcarolinas/coastal-carolinas-projects

http://www.cisa.sc.edu/coping.html

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