RI Ocean Special Area Management Plan

Overview of the Ocean SAMP Climate Change Chapter

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Stakeholder Workshop
April 6, 2010

Source: Providence Journal photos / Sandor Bodo
Methodology

1. Literature and data review
2. Workshops (Jan 5 and Feb 9)
3. Expert review and comments

Acknowledgments

– Dawn Kotowicz
– Leanna Heffner
– Pam Rubinoff
Major Findings

• The effects of global climate change are already being witnessed globally, regionally and in Rhode Island and are projected to intensify in years to come
• Climate change affects many uses of the SAMP area
• The effects of global climate change should be considered when evaluating proposed future uses
Findings: Climate Change Trends and Projections

- Air temperature
- Ocean temperature
- Sea level rise
- Storminess
- Precipitation
- Ocean acidification
Carbon Dioxide - CO₂ - Levels

Carbon Dioxide Levels Today are Higher than over the Past 650,000 Years

Industrial CO₂ Levels
Pre-industrial CO₂ Levels


New Antarctic ice core data extends the record back to 650,000 years before the present and shows that CO₂ levels were below 300 ppmv.
Observed Global Warming and Climate change projections

Le Quéré et al. 2009
Air Temperature

Annual Mean Temperature for Providence and TF Green Airport (1905-2006)

Projected mean increase by 2100
- Global: 3.6-12.6°F
- Northeast: 3-14°F

Air Temperature Trends
- 1961 to 2006 – Increase of 0.3°C (0.6°F) per decade

Source: Pilson 2008

Source: NOAA 2009
Rhode Island climate “migration”

By mid-century, summer in Rhode Island could feel like the typical summer in the Chesapeake Bay area (lower emissions scenario) or southern Virginia (higher emissions scenario)

Courtesy of the Union of Concerned Scientists
Ocean Temperature

Mean Surface Water Temperatures (Dec, Jan, Feb)
West Passage, Narragansett Bay

Sea surface temperatures in Narragansett Bay have risen 2.2°C (4°F) since the 1960s

Sea surface temperatures:
- Higher emissions scenario (A1FI): 6-8°F (3.3-4.4°C)
- Lower emissions scenario (B1): 4-5°F (2.2-2.8°C)

Bottom temperatures:
- Higher emissions scenario (A1FI): 5-7°F (2.8-3.9°C)
- Lower emissions scenario (B1): 2°F (1.1°C)

Source: Nixon et al. 2009

Frumhoff et al. 2007
Sea Level Rise

Sea level rise under accelerated ice melt

HISTORIC SEA-LEVEL RISE - Newport, RI

Rate of Rise
25.8 cm +/- 1.9 cm / 100 yr

Adapted from: http://tidesandcurrents.noaa.gov/sitrends/sitrends_station.shtml?stnid=8452660
Sea Level Rise

Simulation of 3 foot
Sea Level Rise
Providence, RI
Storminess

2002

2005

2007

2007
Increased Probability of Flooding

Woodworth, 2001
Changes in weather in the Northeast US

- Since 1900 precipitation has increased 5-10%, mostly falling as rain rather than snow
- More frequent extreme precipitation
- Fewer days with snow on ground
- Decreased snowfall
- Longer summers, shorter winters
Decadal Trends in 1 inch Precipitation Events 1948-2007

Red shows locations with increasing number of 1 inch precipitation events

Spierre et al., 2008
Ocean Acidification

- Globally averaged marine surface atmospheric CO2 has increased 13.2% since 1981. This has resulted in a reduction of surface ocean seawater pH levels by 0.1 pH units.
- The most recent IPCC report projects that by late century pH will drop 0.3 to 0.4 units from current levels.
- With the exception of rare events, a change of this magnitude has not occurred in the last 300 million years.
What does all this mean for the Ocean SAMP study area?

- Ecological impacts
  - Marine ecology
  - Fish and invertebrates
  - Seabirds, marine mammals, sea turtles
- Human use impacts
  - Marine transportation, navigation, and related infrastructure
  - Recreation and tourism
  - Renewable energy
  - Historical and cultural assets
  - Fisheries resources and uses
  - Future uses
Ecological Impacts

- Changes in the distribution of fish
- Warmer water temperatures can lead to the spread of disease organisms and invasive species that cause harm to the ecosystem
- Harmful Algal Blooms (HABs)?
- Hypoxia (very little oxygen in the water column)?
- Reduced survival rate of marine animals that have shells or skeletons made of calcium carbonate
Fish and invertebrates moving North

- Species at the southern extent of their range in the Ocean SAMP study area: American lobster, Atlantic cod, silver hake
- Species at the northern extent of their range in the Ocean SAMP: black sea bass, butterfish, scup, summer flounder
Ratio of pelagic to demersal fish species caught in Northeast Fishery Science Center, Autumn Bottom Trawl Surveys
Threats to Survival of Whales, Seabirds and Sea Turtles

- Changes in abundance, timing and distribution of prey
- Loss of beach and salt marsh nesting habitat due to sea level rise and coastal retreat
- Loss of low-lying islands outside the Ocean SAMP that seabirds rely on
Impacts on Marine Transportation, Navigation and Related Infrastructure

- Extended shipping season and less problems with icing on vessels and infrastructure
But,
- Greater damage from more intense storms
- Increased decay from increasingly acidic seas
- Higher risk of flooding with higher sea levels
- More exposure to intense storm events

Source: NOAA 2009
Source: LIN Television 2007
Source: NOAA 2009
Impacts on Recreation and Tourism

• Longer summer season
  – More opportunity for recreation activities
  
  But

• Warmer water may introduce more algae and jellies
• Increased rainfall and runoff increase nutrients and pollutants entering the sea
  – More beach closures, decreased water quality and red tide
• Barrier beaches, coastal lagoons and tidal salt flats vulnerable to increased erosion and loss of habitats

Ibis in Misquamicut
Source: Flickr 2007

Misquamicut beach
Source: Wikimedia Commons 2009
Climate Change
Recommended Policies and Standards

- Review policies, plans and regulations related to the activities within CRMC jurisdiction of the Ocean SAMP
- Promote data collection and monitoring programs
- Assess vulnerability of key infrastructure to climate change projections
- Develop design standards that account for projected wind, storms, and waves
- Support public awareness and interpretation programs to increase public understanding of climate change

Source: Lacoastpost 2009

Quonset Point

Source: General Dynamics Electric Boat 2010
Thank you!

For further information, see
http://seagrant.gso.uri.edu/oceansamp/

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