

# Effects of Climate Change on Aquatic Invasive Species and Implications for Management and Research

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Environmental Protection Agency

# Five Key Lessons from Report

- **Climate change will affect aquatic invasive species throughout the invasion pathway**
- Important research gaps exist in understanding climate change effects and interactions with other stressors
- Most AIS activities do not take climate change effects into account, potentially jeopardizing management goals
- Capacity exists to incorporate this information, although tools may not
- More information is needed on impacts and adaptation options for effective management

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# Climate Change Effects on Aquatic Ecosystems

- Changes in air temperature influence changes in ***water temperature***
- Changes in precipitation timing and amount affect ***water quantity*** and ***quality***, and ***timing of flows***
- Thermal expansion and polar melting cause ***sea level rise***
- Increasing atmospheric CO<sub>2</sub> decreases ***pH***

Effects ***vary regionally and seasonally***

Alterations have consequences throughout ecosystem



# Climate Change Effects on Aquatic Invasive Species may...

- Create additional opportunities for some
- Create unsuitable conditions for others
- Counteract each other (e.g., sea level rise vs. freshwater input from increased precipitation in coastal areas)
- Cause increase, decrease, or no change in ecological and economic impacts from AIS

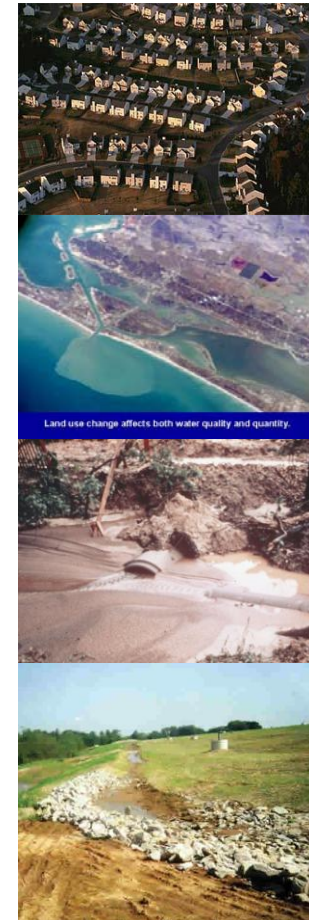




# Other stressors may...

**Exacerbate or ameliorate  
climate change effects on AIS,  
such as:**

- Land use changes
- Water quality changes
- Human-induced disturbances  
(e.g., fire, channelization, dams)



# Why focus on AIS?

- EPA implements Clean Water Act
- Various EPA offices involved with AIS issues
  - Ballast water & NPDES permits
  - TMDLs & impaired water listings
  - Biological indicators
  - Economic consequences
  - Pesticide usage for control



# This Report Includes

- Literature review on climate change & invasive species, esp. AIS
- Inventory of state-level AIS management activities
- Review of AIS management plans for their adaptive capacity
- Description of research needs and information gaps for AIS managers

# Report Process

- Two workshops in 2006
  - Identify needs and gaps
  - Synthesize research in Special Section in *Conservation Biology*
  - Analyze AIS management plans, state and regional



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# Climate Change & Invasion Pathway

- New and/or altered pathways
  - Tourism, commerce, or recreation opportunities
  - International transportation (e.g., Northwest Passage)
  - Extreme weather
- Longer or more favorable shipping season
  - Enhanced survivorship
  - Increased propagule pressure
- Assisted migration

# Climate Change & Interacting Stressors

Many research gaps exist:

- Relationship among climate change, other stressors, and invasibility
- Interactions and feedbacks among climate change, water quality, and AIS
- Interactions between climate change and land use change affecting distribution, spread, establishment and impacts of AIS
- Other factors facilitating establishment and spread of AIS under changing climate

# AIS Management Activities

- Climate change may jeopardize management goals
- Management activities currently do not take climate change into account



# State Managers' Reported Concerns

Many managers and decision makers aware of potential impacts of climate change on AIS and management goals

- AIS range expansion
- New AIS establishing under changing conditions
- Predicting and assessing conditions that may lead to invasion
- Overwintering capabilities
- Increasing propagule pressure and pathways
- Increasing growth rates (longer growing season)
- Unanticipated interactions between climate change & AIS
- Effects of climate change on control
- Effects on ecosystem services from increased invasions

# Capacity to Adapt to Climate Change

- Reviewed 23 ANS state management plans, 2 general invasive species plans
- Scored plans in 5 categories
  - Addressing potential climate change impacts
  - Demonstrating capacity to adapt to changing conditions
  - Describing monitoring strategies
  - Revising and updating plan
  - Describing funding sources/strategies

Although most plans do not mention climate change or changing conditions, states **do** have some capacity to adapt programs or activities

- Results show which aspects of programs could be modified
- Most adaptive capacity in
  - Revising and incorporating new information
  - Having sources of funding
  - Establishing monitoring strategies

# Accounting for Changing Conditions

<i>Plan chapter</i>	<i>Percent of plans</i>
Leadership and coordination	8 %
Prevention	16 %
EDRR	12 %
Control and management	4%
Restoration	0 %
Research	40 %
Information management	0 %
Education and public awareness	12 %

# Information & Research Needs

- More information on impacts and adaptation options needed for effective AIS management under changing climatic conditions
  - Scope of climate change problem, regionally
  - Modification of management activities
  - Tools to assess threats

# Research Recommendations

- More information and research needed on effects of climate change on
  - AIS management activities
  - Each step in invasion pathway
  - AIS impacts (ecological & economic)
  - Specific species and invaded ecosystems
  - Interacting stressors



# Possible Next Steps

Follow-on case studies and workshops to provide information on revising AIS management plans to account for climate change effects

# On-going Activities

- EPA STAR and USDA grants to be awarded on this topic
- Publication of Special Section in *Conservation Biology* (August 2008)







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