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Bierwagen, Britta; Thomas, Roxanne; Mengerink, Kathryn; and Kane, Austin, "Effects of Climate Change on Aquatic Invasive Species and Implications for Management and Research (PowerPoint presentation)" (2007). U.S. Environmental Protection Agency Papers. 52. https://digitalcommons.unl.edu/usepapapers/52

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

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Aquatic Nuisance Species Task Force Fall Meeting, November, 2007

The views expressed in this presentation do not necessarily reflect policies of the US Environmental Protection Agency

- 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

RESEARCH & DEVELOPMENT

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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 CO₂ decreases *pH* Effects *vary regionally and seasonally*

Alterations have consequences throughout ecosystem



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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

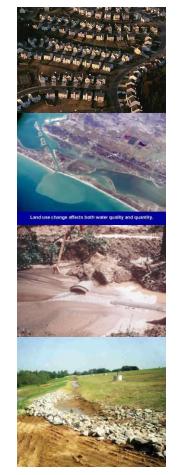


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Other stressors may...

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

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



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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



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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

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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



RESEARCH & DEVELOPMENT

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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

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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

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AIS Management Activities

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

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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

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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

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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

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Accounting for Changing Conditions

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

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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

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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



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Possible Next Steps

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

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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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