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Effects of Climate Change on Aquatic Invasive Species and Implications for Management and Research (PowerPoint presentation)

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Aquatic Nuisance Species Task Force Fall Meeting, November, 2007

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_2 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

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 %

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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