ORD Invasive Species Research

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Management efforts directed at invasive species are typically reactive, occurring *after* a species has become established in an area. This scenario results in management that perpetually lags behind the most recent invasion and makes eradication or control much more difficult, if not impossible. Anticipatory efforts are critical to effective non-native invasive species (NIS) management, and there is a clear need for tools that the Agency and its stakeholders can use to anticipate species invasions and focus prevention and management strategies. To meet these needs, ORD has directed its NIS research towards three areas:

Prevention

NIS management efforts are most effective at the early stages of the invasion process, before a species has an opportunity to become established or spread. Preventing the transport and introduction of NIS is a critical management strategy.

Key efforts:

- DNA-based ballast water screening methods
- Performance verification of ballast water treatment technologies

Products:

- Invasion genetics of a saltmarsh grass (Sloop et al. 2005. *Conservation Genetics*; Blum et al. 2004. *Molecular Ecology Notes*)
- Technology verification partnerships with U.S. Coast Guard, Singapore Institute of Environmental Science and Engineering

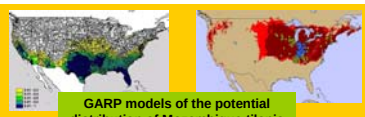
Impacts & Future Directions:

- DNA-based ballast water screening will be able to inform compliance monitoring and NIS management strategies.
- Molecular techniques to characterize species assemblages regularly transported in ballast water.
- Screening techniques to determine frequency of introduction and population size of incoming cohorts of NIS.
- Verification of this technology will be an important consideration when discussing international ballast water standards.

Forecasting and Monitoring

Predicting the identity of future invasive species and determining geographic areas of actual or potential invasion are key elements of proactive NIS management.

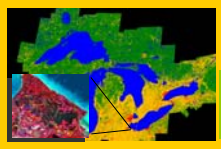
Predictive Modeling: Genetic Algorithm for Rule-set Prediction (GARP) (ORD/KU/USGS)



GARP models of the potential distribution of Mozambique tilapia (left) and rusty crayfish (right)

Key efforts:

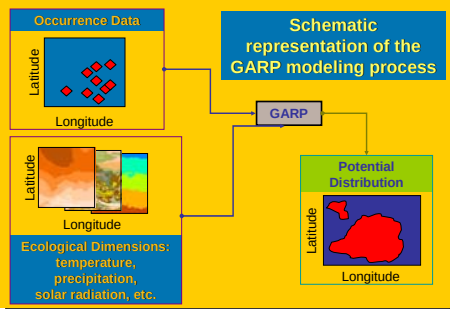
- Remote sensing of invasive plants (ORD/Eastern Michigan University)
- Predicting future invasive species (ORD/Kansas University/USGS)
- Great Lakes Invasive Species Research Initiative



'Hot-Spot' mapping of dense live wetland plant species within the context of the landscape surrounding each wetland (ORD/ Eastern Michigan University)

Products:

- Remote sensing of plants in freshwater coastal wetlands (Lopez et al. 2004. *Remote Sensing and GIS Accuracy Assessment)*
- Predicting geographic distributions of NIS (Peterson et al. 2003. *Weed Science; Vector Borne and Zoonotic Diseases*; Kluza & McNyset. 2005. *Aquatic Invaders*)
- Predicting the Identity, Spread, and Impact of Future NIS in the Great Lakes (Grant to D. Lodge, University of Notre Dame)



Impacts & Future Directions:

- Customers using remote sensing information and applications include The Great Lakes Commission, International Joint Commission, State of the Lakes Ecosystem Conference, US Army Corps of Engineers (Detroit District).
- Since 2002, >20 journal articles have been published based on the Genetic Algorithm for Rule-set Prediction (GARP), an NCEA-supported software application for predicting species occurrence that is predominantly used for NIS.
- NCER-sponsored research will contribute to improvement of monitoring and research strategies and provide tools for identifying future NIS.

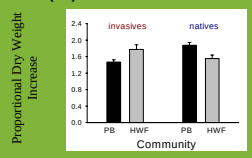
Vulnerability

Assessing ecosystem characteristics and conditions that influence susceptibility to invasion will help to improve NIS forecasting, monitoring, and management prioritization.

Key efforts:

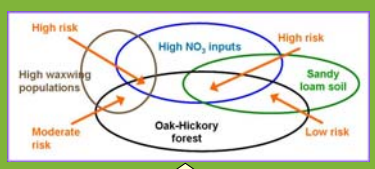
- Invasion dynamics of red shiner in Southeastern rivers
- Quantifying and modeling the risk of disturbance to ecosystems caused by invasive species (ORD/USGS/OSU)
- Regional assessment of macrobenthos in small West Coast estuaries (ORD/USGS)
- Distributions of invasive plants in riparian ecosystems of the Western US
- Several ORD STAR research grants investigating various aspects of ecosystem susceptibility to invasion. Examples:
  - An Experimental Study of Biological Invasions in Forests of the Eastern United States (Grant to J. Gurevitch, State University of New York, Stony Brook)
  - Predicting the Distribution and Dominance of Exotic Species Across Landscapes of Southern Appalachia (Grant to Michael Huston, Interdisciplinary Solutions for Environmental Sustainability, Inc.)
- Ecological risk analysis of the proposed introduction of Asian oyster into Chesapeake Bay (ORD/NOAA/USFWS/USACE)

2000: Invasives did better in hardwood forests (HWF); Natives did better in pine barrens (PB)



Preliminary results of surveys conducted at 44 heavily-invaded to uninvaded forest sites:

- Native and invasive species diversity and richness are positively correlated
- Pine barren sites were not invaded, but hardwood sites could be invaded or uninvaded.
- Invasives responded more to available light than enhanced nutrients; therefore, light may be more important than nutrients in facilitating invasion.
- Gaps created in the hardwood forests (not pine barrens) are likely to facilitate invasions.



Conceptual model of invasion risk from eastern redcedar. Field studies of soil characteristics and plant diversity have provided insights towards the mechanisms of redcedar invasion and characteristics of vulnerable ecosystems.

(ORD/USGS/Oklahoma State University)

Impacts & Future Directions:

- Forecasting potential NIS water quality and socioeconomic impacts.
- Develop predictive models of invasion probability based on empirical data.
- Develop tools to enable decision makers to address important assessment questions such as:
  - *What are the current and projected conditions of the region?*
  - *What is the greatest regional threat in the future?*
  - *Where are the biggest threats posed by NIS?*

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