

Catalyst Grant Final Project Report

Project title

Providing solutions to address the risk and impact of biological invasion under climate change

Project team

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Summary

One of the challenges regions around the globe are currently facing is the introduction of harmful, invasive species. This is major issue because invasive species can disrupt ecosystem services provided by natural ecosystems, e.g., water provision and purification, climate amelioration, economic resources. Furthermore, the onset of global warming will likely affect the risk and impact of invasive species, and concrete predictions of how biological invasions will take place and affect a particular system will be imperative for the development of efficient management and conservation plans under climate change. Our work was focused on developing the tools that would allow scientific knowledge to be translated into the kinds of outputs and forecasts useful for management and conservation of systems threatened by biological invasions. Our objective is to forecast invasion risk and impacts for species of concern in ways that can directly inform management and conservation. The main outputs of this Catalyst project were: i) the associated scientific knowledge necessary to address and inform

managerial needs posted by natural resources practitioners; ii) the formation of a multidisciplinary working group of researchers and practitioners ready to develop a working framework that provides specific solutions to the issues brought up by our practitioner collaborators. Outcomes from this work are now being used by the scientific team to develop the basis for working projects aimed at providing specific solutions, assessment of our methods, and identification of research gaps to be addressed by the scientific community.

Project background and approach

One of the challenges most regions around the globe are currently facing is the introduction of harmful, invasive species^{1,2}. This is major issue because invasive species can disrupt ecosystem services provided by natural systems. For example, biological invasions in the southwest USA are altering the water table and water resources available to native ecosystems and human populations³. In the Midwest, accidental and intentional introductions of several organisms had profoundly affected aquatic communities and fisheries in Great Lakes⁴. As a result, there has been an extensive body of research focusing on understanding the mechanisms underlying invasions and on forecasting the impacts of these introductions^{5,6,7}. Still, the research community has not been able to fully communicate its findings into formats useful for land managers and conservation practitioners. Basic research strives for generality and broad forecasts, while management requires targeted predictions and system-specific prescriptions. Furthermore, the onset of global warming will likely affect the risk and impact of invasive species^{8,9,10}, and concrete predictions of how biological invasions will take place and affect a particular system will be imperative for the development of efficient management and conservation plans under climate change. Thus, we are in dire need of the tools that would allow scientific knowledge to be translated into the kinds of outputs and forecasts useful for management and conservation of systems threatened by biological invasions. The main objective of our work was to address this translational gap by developing a framework to predict synergistic interactions between biological invasions and climate change across ecosystems.

The scientific team included experts (14 participants) from different institutions on a wide set of disciplines related to biological invasions and climate change, invasive plants ecology, forest pests, invasive vertebrates, aquatic invasive organisms, invasions in marine ecosystems, invasive species distribution modeling, climate modeling, satellite remote sensing, phenology and population demographic modeling, human adaptation to environmental change, natural resource sociology, and a working group coordination. Practitioners and collaborators included land management and conservation institutions and research institutes. The Northeast RISCC Management partnership includes state agencies (NY Invasive Species Research Institute; MA Dept. Environmental Protection), NGOs (TNC; Mass Audubon), and Federal agencies (USFS; USFWS).

We organized a workshop in July 2018 where we identified information/prescriptive priorities from our practitioner collaborators and local stakeholders. Through the workshop we also formed a multidisciplinary team of researchers and practitioners who

approach global change impacts from a diversity of perspectives in order to develop a conceptual working framework and modeling approaches that integrates available scientific knowledge and the needs of land managers and conservation practitioners. The scientific team evaluated the risks to natural and managed systems due to interactions between invasive species and climate change with the goal of meeting the information needs of managers on the topic. Over the course of the meeting, we 1) solicited informational and research needs from invasive species managers, 2) reviewed and synthesized existing research on invasive species and climate change, and 3) developed synthesis projects to better understand invasion risk under climate change.

Researchers meet for three days, and on the fourth day scientists and practitioners met at a Symposium. The objective of the meeting was to bring together natural resource managers and scientists to discuss how climate change might affect invasion risk in the northeastern region and identify ways to translate research into management action. Nearly 120 people representing more than 50 organization from 16 states attended either in person or online. The symposium consisted of 12 presentations with a combination of international, national, and regional foci coming from both research and management perspectives, as well as two facilitated discussions. The first discussion session focused on the Interaction of Climate Change and Invasive Species. The second discussion focused on “Policy and Regulations Related to Climate Change and Invasive Species”. The event received local media coverage and presentations were recorded and are available on the RISCC website at (people.umass.edu/riscc).

Findings*

*From the RISCC 2018 Symposium Summary Report

Attendees listed the following words and phrases in response to “What invasive impacts are most relevant to you?” Top responses:

- 1) Biodiversity.
- 2) Agriculture/agricultural.
- 3) Competition.
- 4) Economic/economic costs/economic impacts.
- 5) Ecosystem services.
- 6) Human health.

Attendees described the following as being complications related to the effects of climate change on the impacts of invasive species (in order of frequency of response, top responses):

- 1) Impacts get worse.
- 2) New Invasions.
- 3) Negative impacts on rare species and unique/high risk habitats, vulnerable communities, and biodiversity.

Attendees recommended that policies should be adjusted given the current and impending effects of climate change in the following ways (starting with the most commonly recommended):

- 1) Be more proactive. For example, "preparing for what is happening in other regions to come here" and "more aggressive treatment on range edges."
- 2) Another suggestion was to replace black lists with white lists, where species would be opted-in instead of opted-out.
- 3) Identify new threats. "Lists will need to be updated for potential invasive species." "Forecasting models need to be promoted by researchers and accepted by regulators to enact positive change."
- 4) Better coordination, including outreach to nursery professionals. As one respondent put it, we need "greater international collaboration - we know what plants are aggressive in each of our own native habitats that could be invasive elsewhere."
- 5) Better accountability, with increased enforcement, follow-up monitoring, and clean construction certification.
- 6) Be more adaptable/flexible. For example, they recommended more frequent adjustments to regulatory lists," and that "we will need to be more nimble to respond to disturbance."
- 7) Think holistically, plan strategically. Use adaptive management, focus on solutions and goals, ultimately "need council with staff in each state and authority to draft regulations and policies."
- 8) Better outreach and education with nursery professionals as well as the public, including evaluating messaging regarding not moving firewood.

Additional questions and challenges identified were:

- 1) Incorporating management priorities into impact assessment protocols.
- 2) Can we predict and prevent invasions – or should we just focus on increasing native system resilience?
- 3) Coordinating and funding efforts for IAS (invasive alien species) research and management
- 4) How to get the word out to the public and affect behavior.
- 5) Time and funding for proactive measures: early detection and rapid response.
- 6) Thinking ahead about restoration strategies post-IAS control.
- 7) Funding and coordinating management across geo-political and public/private boundaries.
- 8) Identifying “sleeper species” that are present at low abundance but could undergo population booms under climate change.
- 9) To what degree should we incorporate assisted colonization into restoration (e.g., replanting with southern species or genotypes).

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