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## Invasive Species and Climate Change

### Issue

We recognize the Administration's commitment to deal proactively with climate change. NISAW particularly applauds the Department of Interior's establishment of a Climate Change Response Council to synthesize data and coordinate appropriate management of our nation's lands and waters. We also acknowledge the United States Department of Agriculture's recent, detailed presentation of the impact of climate change in its publication *The Effects of Climate Change on U.S. Ecosystems*.<sup>1</sup>

Climate change and biological invasions are dynamic, interconnected, and interdependent phenomena that alter ecosystem services. Ecosystem goods and services, in turn, impact agriculture and food security, water supplies, natural resources, wildlife, recreation, and public health and safety nationwide.

The change in climate patterns and the speed of these changes directly influence biological systems including the ability of invasive species to become established and thrive when introduced into new ecosystems. In turn, the speed of ecosystem change, both physically and biologically, can be dramatically increased by the introduction of invasive species.<sup>2</sup> At the very least this means a dramatic reshuffling of agricultural services and resources such as food, fuel, feed, fiber, flower and forests along with quickly changing land use decisions.

The interrelationship between climatic change, the biology of invasive species, and ecosystem resources requires that all levels of government integrate invasive species considerations into climate change policies.

### Decisive Action is Required

This briefing paper, prepared for 2010 National Invasive Species Awareness Week (NISAW)<sup>3</sup>, provides:

- a) Background information on the linkages between invasive species and climate change, and;
- b) Recommendations for action by the Federal government to capitalize on the opportunities to integrate invasive species mitigation in climate change policy and reduce the risks of invasive species to the economy, environment, and human health.

<sup>1</sup> <http://www.usda.gov/img/content/EffectsofClimateChangeonUSEcosystem.pdf>.

<sup>2</sup> Beck, K. G., and K. Zimmerman, J. D. (2006). *Invasive Species Definition Clarification and Guidance White Paper*. Invasive Species Advisory Committee, Washington, DC. <http://www.invasivespeciesinfo.gov/docs/council/isacdef.pdf>.

<sup>3</sup> This paper was drafted by John Peter Thompson (<http://ipetrus.blogspot.com/>) and reviewed by a wide range of stakeholders with expertise in invasive species issues.

## Background

Natural resource managers are beginning to plan for adaptation to changing climate. Federal, state, and local agencies, tribes, NGOs, and private landowners all play essential roles in addressing invasive species and ecosystem issues. Collaborative programs that link universities, farmers, ranchers, fishermen, conservation organizations, recreational interests, trade and transportation interests, and government agencies are necessary to effectively address the issues. It is critically important to develop practices that strengthen environmental monitoring and management of invasive species to minimize impacts on ecosystem resources as climatic conditions change.

## Ecological Impacts

Climate change shifts the range of suitable habitat for plants, aquatic organisms, wildlife, insects, and diseases. For example, the distributions of Japanese honeysuckle and kudzu are limited by low winter temperatures. Warmer temperatures could extend their northern limits by several hundred miles. On the other hand, relatively benign plants that spread northward in warmer temperatures may become invasive pests if their expansion outpaces their natural enemies.<sup>4</sup> In aquatic environments, increasing water temperatures may enable invasions of new species such as mussels.<sup>5</sup> The negative impacts of invasive species on the environment, economy, human and animal health, and quality of life may increase, decrease, or remain the same and are likely to vary regionally.<sup>6</sup>

Invasive species can alter the plant composition of ecosystems and change their structure and function over large areas. Climate change and associated vegetation change interacting with invasive species are increasingly leading to large wildfires that can facilitate the establishment of additional invasive plant species.<sup>7</sup> Further, invasive species such as perennial pepperweed and purple loosestrife change the amount and composition of wetland vegetation in western North America and may alter regional methane emission.<sup>8</sup>

Climate change may alter the effectiveness of management strategies for invasive species due to changes in temperature, precipitation, sea level, and carbon dioxide and other atmospheric gases.<sup>9</sup> Many plant species (particularly invasive weeds) respond more positively to increasing CO<sub>2</sub> than most cash crops. Further, glyphosate, the most widely used herbicide in the United States, loses its efficacy on weeds grown at increased CO<sub>2</sub> levels.<sup>10</sup>

Invasive plants can alter biogeochemical and hydrological cycles, as well as affect disturbance regimes. For example, cheatgrass (*Bromus tectorum*) changes the cycling of water, carbon, and nitrogen, and alters fire regimes at landscape scales. Cheatgrass changes the reflectivity of the landscape, which affects

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<sup>4</sup> University of Florida. 2008. *Climate Change Opens New Avenue For Spread Of Invasive Plants*. ScienceDaily. <http://www.sciencedaily.com/releases/2008/11/081119161125.htm>.

<sup>5</sup> US EPA. 2008. *Predicting Future Introductions of Nonindigenous Species to the Great Lakes*. National Center for Environmental Assessment. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=190305>

<sup>6</sup> US EPA. 2008. *Effects of climate change for aquatic invasive species and implications for management and research*. Center for Environmental Assessment, Washington, DC. EPA/600/R-08/014. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=188305>

<sup>7</sup> Tausch, R.J. 2008. *Invasive Plants and Climate Change*. U.S. Department of Agriculture, Forest Service, Climate Change Resource Center. <http://www.fs.fed.us/ccrc/topics/invasive-plants.shtml>.

<sup>8</sup> Dukes, J.S. and H.A. Mooney. 2004. *Disruption of ecosystem processes in western North America*. *Revista Chilena de Historia Natural* 77: 411-437. <http://dgc.stanford.edu/DGE/Dukes/Dukes&Mooney2004.pdf>

<sup>9</sup> Hellmann, J.J., J. E. Byers, B.G. Bierwagen, and J.S. Dukes. 2008. Five potential consequences of climate change for invasive species. *Conserv. Biol.* 22(3): 534-543.

<sup>10</sup> Hauser, R., S. Archer, P. Backlund, J. Hatfield, A. Janetos, D. Lettenmaier, M.G. Ryan, D. Schimel, and M. Walsh. 2008. *The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the U.S.* US Global Change Research Program. <http://www.climatechange.gov/Library/sap/sap4-3/final-report/default.htm>.

energy budgets and climate.<sup>11</sup> Invasive plants can also alter the composition of the soil microbial community, further affecting biogeochemical cycling.<sup>12</sup>

Integral to any policy or practice is the ability to acquire long-term data on climate and invasive species relationships to improve forecast models and resource management. Climate changes confound predictive biological models and, more importantly, the policy decisions based on the models. As climate conditions change, novel ecosystems may be filled with a new mix of native and non-native species.<sup>13</sup> The assisted migration of endangered species may unintentionally create new challenges related to biological invasion.<sup>14</sup> A current assessment of the distribution and environmental requirements of invasive species across North America with respect to climate trends is necessary to determine effective ecosystem management policies. Management strategies must be flexible to respond to emerging insights from scientific research and society.

## New Pathways for Introductions

Human activities provide pathways for the introduction and spread of opportunistic invasive species.<sup>15</sup> Given the exponential increase in international trade and travel, the risk of introducing new species into ecosystems has never been higher. In addition, climate change will alter the routes of planes and ships, especially as new sea routes open up.<sup>16</sup> An ice-free Northwest Passage portends an increase in inter-ocean shipping activity across the Arctic and thus an increase in the movement of species in the ballast water and on the hulls of ships. Arctic development (e.g., oil and gas development and its associated on- and offshore infrastructure) increases the likelihood of invasion from the movement of bio-fouled drilling rigs and other equipment.<sup>17</sup> The federal government plays a critical role in preventing the introduction of invasive species through international trade and transport. Ballast water exchange, hull-fouling mitigation, sensible plant and animal import screening, and thorough cargo inspections can help reduce introductions of invasive species.

## Policy and Legal Responsibilities

Executive Order 13112 requires Federal agencies to address invasive species and establishes the National Invasive Species Council to coordinate planning and response. The International Plant Protection Convention requires analyses of pest risk. Agencies can integrate climate change considerations into existing risk-assessment protocols and procedures. Environmental laws such as the Endangered Species Act and the National Environmental Protection Act (NEPA) can be used more powerfully to address invasive species under emerging climate change scenarios.

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<sup>11</sup> Schnase, J.L. 2008. Science/Cheatgrass. US Geological Survey. <http://invasivespecies.gsfc.nasa.gov/cheatgrass.html>.

<sup>12</sup> Kourtev, P.S., J.G. Ehrenfeld, M. Haggblom. 2002. Exotic plant species alter the microbial community structure and function in the soil. *Ecol.* 83(11): 3152-3166.

<sup>13</sup> Fox, D. 2007. Back to the No-Analog Future? *Science* 316: 823-825.

<sup>14</sup> Ricciardi, A., and D. Simberloff. 2008. Assisted colonization is not a viable conservation strategy. *Trends in Ecol. and Evol.* 24(5): 248-253.

<sup>15</sup> Wittenberg, R. and M. J.W. Cock. 2001. *How to Address One of the Greatest Threats to Biodiversity: A Toolkit of Best Prevention and Management Practices*. Global Invasive Species Programme, CAB International, Wallingford, Oxon, UK.

<sup>16</sup> Pyke, CR, Thomas RT, Porter RD, Hellmann JJ, Dukes JS, Lodge DM, Chavarria G. 2008. Current practices and future opportunities for policy on climate change and invasive species. *Conserv. Biol.* 22(3): 585-592.

<sup>17</sup> US Fish & Wildlife Service. 2007. Alaska Region Invasive Species News [http://alaska.fws.gov/fisheries/invasive/pdf/news\\_1007.pdf](http://alaska.fws.gov/fisheries/invasive/pdf/news_1007.pdf).

## Recommendations

Strategic effectiveness requires that we employ sound science to operate from a position of knowledge. Robust monitoring, improved interagency coordination, and expanded research will help us respond quickly, manage efficiently, and take advantage of restoration opportunities that arise. We call on the member Departments and Agencies of the National Invasive Species Council (NISC) and potential partners to:

- Formalize the commitment to address invasive species by codifying the National Invasive Species Council in legislation and the EO13112 definition of invasive species. Codification will require the Federal response to invasive species in a time of climate change to be coordinated, empowered, and appropriately funded.
- Streamline agency programs to address invasive species effectively and efficiently by establishing: 1) strategic plans that anticipate invasives issues in a time of climate change, 2) forward-looking environmental compliance documents (e.g., NEPA, nationwide EIS on invasives prevention, management, and restoration), and 3) awareness programs to anticipate and manage potential ecosystem changes.
- Assess new invasion pathways and strengthen prevention programs to address invasives in ballast water, hull-fouling, interstate and international movement of materials and equipment (e.g., energy development, wildfire response, national defense), and screening of plant and animal imports.
- Support monitoring and adaptive management programs for invasive species at the regional scale so that natural resource managers can identify new threats and respond quickly and appropriately to invasive species in changing climatic conditions. Monitoring protocols and databases must be integrated across agencies.
- Use the Global Change Research Act of 1990 (GCRA)<sup>18</sup> (PL 101-606) to aggregate information about the implications of a changing climate for invasive species so scientific data may be synthesized through existing authorities to inform policy-makers.
- Foster networks of existing organizations to address the broad geographic nature and altered management of invasive species issues in a time of climate change. This will allow the national response to be coordinated, efficient, and capitalize on current capacities using a synergistic approach.
- Increase research and development targeted at climate change and invasive species by supporting and expanding the USDA-ARS Climate Change program, as well as competitive research programs such as USDA's Agricultural and Food Research Initiative (AFRI), USDA-ERS's PREISM program, EPA's Project Grants, and NOAA's Sea Grant program. Better understanding of the interaction of climate change and invasive species will result in more relevant prioritization and management on the ground.

We call on Congress to:

- Build incentives into climate change legislation that require the use of non-invasive plant species for activities such as carbon sequestration, biofuels, post-wildfire land rehabilitation, land and water adaptation, and wildlife habitat security so new legislation supports long-term ecosystem health.

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<sup>18</sup> GCRA mandates periodic national scientific assessments to analyze the effects of global change on the natural environment, biological diversity, and other systems. The Act established an interagency Earth and Environmental Sciences Committee to implement actions. That group is now the Committee on Environment and Natural Resources (CENR) under the President's National Science and Technology Council.