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Invasions and Extinctions as a Consequence of Climate Change

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Symposium 4
Invasions and Extinctions as a Consequence of Climate Change

Panel
Mace Hack, *Director, The Nature Conservancy in Nebraska*
Rick Kearney, *Wildlife Program Coordinator, USGS*
Chad Smith, *Director of Natural Resources, Headwaters Corporation*
Scott Taylor, *Nebraska Game and Parks Commission*

Moderator
Craig Allen, *Leader, Nebraska Cooperative Fish and Wildlife Research Unit, USGS/UNL*

Invasions and extinctions are occurring at a rate that is unprecedented in historical time. These phenomena are a kind of biological extreme at each end of the spectrum, and both are responses related to landscape and environmental conditions, which also link to climate change. Research shows that species change their ranges in response to climate change and to general predictable trends, but individual responses seem to be idiosyncratic, said moderator Craig Allen. Because of this, there is a need to explicitly anticipate and think about ecological surprises and the unanticipated consequences of global change. Ecological systems often exhibit nonlinear threshold responses, so systems can change suddenly in response to a slow force such as climate change.

From left: Scott Taylor, Craig Allen, Chad Smith

The Platte River Basin can provide a focal point for the study of invasion and extinction and other effects on species related to changes in climate. The Platte River provides critical habitat for many species, including four threatened and endangered wildlife species: the least tern, piping plover, whooping crane and pallid sturgeon. The shallow riverine wetlands along a narrow 100-mile stretch of the central Platte River provide a crucial stop-over for whooping cranes and more than 500,000 sandhill cranes each spring during their northward migration. Approximately 300,000 shorebirds comprising more than 30 species migrate through the North American Migratory Flyway that transects Nebraska. At the other biological extreme, low water levels in the Platte induced by drought have led to invasive species problems. For example, the common reed *Phragmites australis* is choking the river channels and hindering habitat restoration efforts.

The panelists represented a range of organizations and agencies with interest in the effects of climate change on wildlife species and included a representative of the state agency charged with wildlife management, a director on a $300 million

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Platte River project, state director for the largest conservation organization in the U.S. and the wildlife coordinator for a federal agency. Their discussion ranged over three broad areas: the potential effects of climate change and challenges they present; research strategies and programs addressing these challenges; and the tools and information needed for decision-making.

Effects of climate change

"The effects of climate change include increased average global temperatures and variability in temperatures over time, longer growing seasons and an increase in the frequency and duration of droughts," said Rick Kearney, USGS wildlife coordinator. For each of these physical changes in climate there will be consequential ecological effects. Plants that are adapted to particular temperature and moisture conditions will change their range, shifting northward or upslope if they are in the mountains, Kearney said. Wildfires will increase as a result of droughts. All of these factors will cause a fragmentation of habitats – species that were overlapping or in proximity will be pulled apart.

"We're going to see an increased frequency of what I call ecological disconnects," Kearney said. "In this situation, plant, animal and pest species that are more generalist can take advantage of changing circumstances and become invasive species."

A prime example is *Phragmites australis*, the common reed, which is choking the Platte River from Kingsley Dam to below Grand Island, Neb. Low water flows in the Platte caused by seven years of drought and below-normal snowpack in the Rocky Mountains, gave *Phragmites* the advantage it needed. *Phragmites* has so completely changed the landscape, including changes in sediment transport and the way sandbars and islands are built, that the problem must be dealt with before recovery plans for the river can proceed, said Chad Smith of the Headwaters Corporation.

Phragmites australis

These same disconnects can cause plant and animal diseases to increase. As new opportunities emerge, especially as winters become milder and the pathogens or the insects that transmit pathogens survive the winter, plant and animal diseases will increase, Kearney said.

Mace Hack of the Nature Conservancy cited another threat related to climate change – land diversion driven by high crop prices and the conversion of non-crop land to crops. "We're worrying a lot right now about temperature and how it's going to affect species, but the biggest threat to species right now is really land diversion," Hack said. This land diversion isn't happening just in the Amazon; it is occurring in the High Plains where Conservation Reserve Program land is being plowed and planted with corn in response to high prices and the demand for corn as an ethanol feedstock.

The Nebraska Game and Parks Commission is developing a comprehensive wildlife conservation strategy incorporating climate change planning, in response

to requirements of a federally funded program for conservation of at-risk species, said Scott Taylor of the Nebraska Game and Parks Commission.

Tools and information needed for decision-making

All of the panelists stressed the need for monitoring. Only through extensive monitoring can the basic information about plants and animals in the ecological communities be gathered, and that data are needed to populate ecological models.

"I think the tool we most need to try to address these future challenges is a really accurate crystal ball at the right level of resolution, at a scale that will be useful for designing resilient systems and habitats that will protect the biological diversity represented on the ecoregional scale," Hack said. "How are we ever going to get the data at the scale we need if we don't have a good monitoring network and the people to do the work?" Taylor agreed, saying there is a critical need for more biologists and botanists to do the monitoring. Kearney said long-term monitoring also is needed to understand what is going on in the environment and to understand the effectiveness of our management actions.

"We need to develop adaptive management techniques, management techniques which will change over time based on what we learn and not on some historic reference point. That is what we have been doing for many years now – trying to restore what was."

The ability to downscale models to an area as localized as a basin was cited as a need by all of the panelists. Climate models that are appropriate for managers at the regional and local scale are needed so they can be linked to ecological models. "In the Northwest they are starting to get those climate models down to the point where you can see what's going on with salmon and other cold-water fisheries. We're going to have to do the same thing for this part of the world," Smith said.

Research strategies and programs to manage resources

The panelists represent organizations with research programs addressing the issues of extinction, invasion and changes in range, habitat and diversity affected by climate change. An innovative approach for addressing these issues is adaptive management. Adaptive management provides a robust framework for making decisions in the face of uncertainty and for assessing the appropriateness of decisions when social, economic and ecological conditions and scientific data all are changing. Data from experimentation and sustained monitoring of ecological conditions is used to adjust strategies and inform policy choices to achieve sustainable solutions to complex social-ecological problems, such as management of limited water resources.

"Adaptive management is perhaps the preferred and best method to help understand the effects of climate change and to do so with experiments where it's okay to fail, where we reduce uncertainties and try to understand the key uncertainties that are present," said moderator Craig Allen, leader of the USGS/UNL Nebraska Cooperative Fish and Wildlife Research Unit. "I'm happy to say that at UNL, with USGS and other partners, we are creating a node of expertise in adaptive management. In my opinion, our key focus should be on maintaining the resilience and adaptive potential of systems, of people and nature."

Kearney agreed. "We need to develop adaptive management techniques, management techniques which will change over time based on what we learn and not on some historic reference point. That is what we have been doing for many years now – trying to restore what was."

Adaptive management also is being used to structure the Platte River Recovery Implementation Program, a long-term $300 million project funded through

the federal government and the state governments of Nebraska, Colorado and Wyoming. Major goals of the program are to protect habitats for four endangered and threatened species, increase flows in the Platte River and provide scientific monitoring and research to evaluate benefits of the program.

"The heart of the program is the adaptive management plan," said Smith, director of natural resources for the Headwaters Corporation, which manages the program. "Sensitivity to climate is already having an impact on how we put this adaptive management plan on the ground." The chief strategy being tested with the adaptive management plan for the Platte River program is using water flows in combination with sediment and with some mechanical means to build sandbars and nesting islands in the river and get the endangered species to use them. This plan already is facing challenges from extended drought and reduced water flow in the Platte.

"When the plan was being written in 1997, Lake McConaughy on May 1 before irrigation had a million and a half acre-feet of water to use," Smith said. "In 2007, we had about 600,000 acre-feet to use. So we already don't have as much water as we thought we were going to have, and that's going to force us to adapt our adaptive management plan."

The Nature Conservancy's mission is to preserve the plants and animals and natural communities that make up the diversity of life on the planet by protecting the lands and the waters they need to survive. The Conservancy's focus is on natural communities, rather than species. The organization has attributes that position it to study climate change effectively, Hack said. The research is science-based and community-based and always begins with an ecoregional approach, so scientists are working at a scale that is amenable to ecological changes likely to occur. They work at multiple scales, from 100- to 200-acre preserves, in multiple ecoregions and even globally. "We're going to need to work at multiple scales if we're going to address climate change in an effective manner on this planet," Hack said.

The Conservancy also has a strong ethic of being a single organization, although it has separate organizations statewide, nationally and globally, including in 38 countries. "The political boundaries of states and regions don't constrain collaboration, and I think that's a natural framework for the type of collaboration that you all are building here today," Hack said.

Rick Kearney

USGS is developing a national global warming and wildlife science center in partnership with federal agencies, state agencies, the academic community, industry and the public. Kearney said this initiative was developed by several nongovernmental organizations to urge the federal government to examine and do more to manage the impacts of climate change on fish and wildlife populations. Planning has just begun on a USGS workshop that will bring together all the groups working with fish and wildlife with the goal of identifying priorities for the center. "This is exciting for all of us to come together because

this is bigger than all of us combined. But through cooperation, through collaboration, we can take the first steps toward addressing these issues," Kearney said.

Recommended research needs

- Increased and more extensive monitoring networks to gather needed data on the plants and animals in ecological communities
- Develop sophisticated ecological models based on these data
- Develop climate models at the regional and local scale that can be linked to ecological models
- Develop ability to downscale models to an area as localized as a basin
- Develop adaptive management techniques
- Conduct research at multiple scales in multiple regions
- Train more biologists and botanists to monitor ecological communities
- Emphasize collaborative research