Regents Professor Samuel D Fuhlendorf and his colleagues have been testing new ideas for conserving the world’s grasslands. Here, he reveals how lessons from the past might hold the key to solving some of today’s most pressing agricultural problems.

Could you begin by outlining the main focus of your research?

In general I have two primary areas of focus. The first lies in gaining an understanding of how grazing and fire interact (pyric herbivory) as disturbance processes on diverse landscapes of the world. This involves studying large landscapes and their fires and free-roaming herbivores – including grazing animals such as bison, elk, horses and cattle. Second, I want to use this understanding of pyric herbivory to develop management approaches that sustain agricultural productivity through rangeland management and simultaneously enhance or maintain biodiversity on lands grazed by domestic livestock.

What is pyric herbivory, and how is it beneficial?

Recent research has demonstrated that restoration of pyric herbivory – the spatial and temporal interaction of fire and grazing – can sustainably produce livestock and maintain biodiversity. Similarly, on large landscapes focused on conservation of native herbivores like bison, the reintroduction of these species without allowing them to interact with fire in space and time is not sufficient to conserve all components of these landscapes. Herbivores strongly prefer to graze on recently burned areas. Most continue to focus on burned areas until somewhere else is burned and they switch their focus to the new patches. Over subsequent years the previously burned portions of the landscape recover in biomass and are prone to fire again. Pyric herbivory simply argues that rather than treating them as two independent disturbances, grazing and fire should be coupled.

What is heterogeneity, and why is it necessary for biodiversity?

Heterogeneity is essentially variability and describes the amount and variety of conditions that occur across a landscape. Its connection to biodiversity is simply based on the assumption that different species require different conditions, so a variety of conditions are required for many species. Variable disturbance patterns like fire and grazing can create a special kind of heterogeneity, known as a shifting mosaic,
Many existing management recommendations are based on the conservation of a specific species; how effective is this approach in relation to heterogeneous environments?

This myopic approach is incapable of sustaining rangeland ecosystems for long-term production and conservation. A short-term focus on one type of habitat or objective leads to the simplification of a landscape and lowers its resilience to future perturbations, such as drought or invasive species. An effective alternative would be a heterogeneity-based approach that may not maximise a single objective, but does build resilience of the landscape. In some cases, this can be achieved simply by restoring the processes that created patterns across the landscape over thousands of years. In grasslands, for example, this means restoring diverse fauna and heterogeneous fire interactions in space and time.

From an agricultural perspective, the focus of rangeland management has been on minimising negative impacts to dominant forage species and reducing bare ground while maintaining uniform use of forage by grazers. This limits fire because it can create short-term bare ground, leading to an increase in woody plants and minimising habitat for species that require intense disturbance and undisturbed prairie. Also, a landscape with patches cause by fire may be less susceptible to large-scale fires that would burn hundreds of thousands of acres under extreme conditions.

In what way has the study and implementation of fire ecology changed over time?

Over the past 50 years, scientific publications related to fire have grown exponentially. This includes a focus on the importance of fire as an ecological disturbance in sustaining ecosystems throughout the world, as well as a cultural appreciation of the role of fire for indigenous people. In centuries past, people and fire were coupled and those who understood fire were cultural leaders. As we entered the industrial era, we developed the perspective that we were masters of our domain and fire was something destructive that should be controlled. Over the last 50 years, pioneers in fire ecology and the social sciences have developed an understanding of the importance of fire to various landscapes on our planet. There are specific scientific journals focused on fire ecology, as well as web-based tools that assist in planning in the use of fire. However, fire ecology and management is still on the periphery of disciplines like rangeland management and general ecology.

Supporting rangeland heterogeneity

For centuries, Native Americans used fire to control and manage prairie and rangeland grazed by herds of bison. Today, researchers at Oklahoma State University have found that this ancient technique could be key to conserving global grassland diversity. Regents Professor Samuel D Fuhlendorf and his colleagues at the Rangeland Ecology and Management Department of Oklahoma State University are making an exciting contribution to this debate. They are working to understand the complexities of rangeland ecology and are applying their findings to developing more sustainable rangeland management techniques. A key focus of their research has been the impact of fire on the flora and fauna of rangeland, and the potential of the so-called patch-burning approach to landscape management. Their research calls into question conventional ideas about livestock rearing and grazing management. In order to describe their findings about the complex relationship between fire and the diversity of rangeland ecosystems, they have coined the term pyric herbivory.

HOMOGENEITY VERSUS HETEROGENEITY

Fuhlendorf’s work aims to counter the current decline in rangeland diversity. Contemporary rangeland management has overseen an alarming drop in the populations of 29 bird species native to the North American prairies. This decline can largely be attributed to the agricultural technique of rotational grazing in addition to fire suppression and cultivation. This style of grazing management controls where and when livestock graze by rotating them quickly through different pastures. It has a homogenising effect on the landscape because each area is grazed in equal measure, so no patches of prairie are over or under grazed. The landscape thus becomes more uniform in terms of the types of plants that grow there and consequently the birds and animals it supports. This practice is not the most efficient in terms of agricultural output, argues Fuhlendorf: “Rotational grazing treats rangelands and prairies as more similar to agricultural fields than natural ecosystems, limiting the ability of rangelands to sustainably produce agricultural commodities and provide critical habitat for some of the most threatened species in the world,” he explains. It is a complete contrast to the method favoured for centuries by Native Americans. They used controlled fires to vary
ROLE OF HETEROGENEITY IN MANAGING RANGELANDS FOR MULTIPLE USES

OBJECTIVES

To evaluate the fire-grazing interaction on natural landscapes and develop rangeland management practices based on the interaction that can simultaneously enhance production and biodiversity.

KEY COLLABORATORS

David M Engle; Dwayne Elmore; Craig Davis; John Weir; Oklahoma State University

Bob Hamilton, The Nature Conservancy

Numerous graduate students and postdoctoral research associates

FUNDING

US Department of Agriculture (USDA)-NRI • USDA-AFR • The Nature Conservancy’s Tallgrass Prairie Preserve • Oklahoma Department of Wildlife Conservation • Nebraska Game and Parks • US Fish and Wildlife Service

CONTACT

Samuel D Fuhlendorf
Regents Professor
Rangeland Ecology and Management
Oklahoma State University
Natural Resource Ecology and Management
008C Agricultural Hall
Stillwater
Oklahoma 74078-6013
USA

T +1 405 744 9646
E sam.fuhlendorf@okstate.edu

SAMUEL FUHLENDORF is Regents Professor in Rangeland Ecology and Management at Oklahoma State University (OSU). He received the Outstanding Young Professional Award for the Society for Range Management in 2002, the James A Whately Award of Merit for Research from OSU in 2001, the Outstanding Achievement Award for Research from the Society for Range Management in 2010, the Regents Distinguished Research Award at OSU in 2012 and was awarded Fellow of the DaVinci Institute for Creativity in 2013. His current research is focused on conservation of grassland landscapes. Specific areas focus on: understanding the role of disturbance-driven heterogeneity in the structure and function of grasslands; integrating a landscape perspective into rangeland ecology; fire ecology; and, understanding how herbivores use landscapes. Fuhlendorf currently teaches Applied Ecology and Conservation, Applied Landscape Ecology and Ecology of Fire Dependent Ecosystems. He has published over 80 peer-reviewed articles in international journals.

INTELLIGENCE

ROLE OF HETEROGENEITY IN MANAGING RANGELANDS FOR MULTIPLE USES

OBJECTIVES

To evaluate the fire-grazing interaction on natural landscapes and develop rangeland management practices based on the interaction that can simultaneously enhance production and biodiversity.

KEY COLLABORATORS

David M Engle; Dwayne Elmore; Craig Davis; John Weir; Oklahoma State University

Bob Hamilton, The Nature Conservancy

Numerous graduate students and postdoctoral research associates

FUNDING

US Department of Agriculture (USDA)-NRI • USDA-AFR • The Nature Conservancy’s Tallgrass Prairie Preserve • Oklahoma Department of Wildlife Conservation • Nebraska Game and Parks • US Fish and Wildlife Service

CONTACT

Samuel D Fuhlendorf
Regents Professor
Rangeland Ecology and Management
Oklahoma State University
Natural Resource Ecology and Management
008C Agricultural Hall
Stillwater
Oklahoma 74078-6013
USA

T +1 405 744 9646
E sam.fuhlendorf@okstate.edu

SAMUEL FUHLENDORF is Regents Professor in Rangeland Ecology and Management at Oklahoma State University (OSU). He received the Outstanding Young Professional Award for the Society for Range Management in 2002, the James A Whately Award of Merit for Research from OSU in 2001, the Outstanding Achievement Award for Research from the Society for Range Management in 2010, the Regents Distinguished Research Award at OSU in 2012 and was awarded Fellow of the DaVinci Institute for Creativity in 2013. His current research is focused on conservation of grassland landscapes. Specific areas focus on: understanding the role of disturbance-driven heterogeneity in the structure and function of grasslands; integrating a landscape perspective into rangeland ecology; fire ecology; and, understanding how herbivores use landscapes. Fuhlendorf currently teaches Applied Ecology and Conservation, Applied Landscape Ecology and Ecology of Fire Dependent Ecosystems. He has published over 80 peer-reviewed articles in international journals.

INTELLIGENCE

ROLE OF HETEROGENEITY IN MANAGING RANGELANDS FOR MULTIPLE USES

OBJECTIVES

To evaluate the fire-grazing interaction on natural landscapes and develop rangeland management practices based on the interaction that can simultaneously enhance production and biodiversity.

KEY COLLABORATORS

David M Engle; Dwayne Elmore; Craig Davis; John Weir; Oklahoma State University

Bob Hamilton, The Nature Conservancy

Numerous graduate students and postdoctoral research associates

FUNDING

US Department of Agriculture (USDA)-NRI • USDA-AFR • The Nature Conservancy’s Tallgrass Prairie Preserve • Oklahoma Department of Wildlife Conservation • Nebraska Game and Parks • US Fish and Wildlife Service

CONTACT

Samuel D Fuhlendorf
Regents Professor
Rangeland Ecology and Management
Oklahoma State University
Natural Resource Ecology and Management
008C Agricultural Hall
Stillwater
Oklahoma 74078-6013
USA

T +1 405 744 9646
E sam.fuhlendorf@okstate.edu

SAMUEL FUHLENDORF is Regents Professor in Rangeland Ecology and Management at Oklahoma State University (OSU). He received the Outstanding Young Professional Award for the Society for Range Management in 2002, the James A Whately Award of Merit for Research from OSU in 2001, the Outstanding Achievement Award for Research from the Society for Range Management in 2010, the Regents Distinguished Research Award at OSU in 2012 and was awarded Fellow of the DaVinci Institute for Creativity in 2013. His current research is focused on conservation of grassland landscapes. Specific areas focus on: understanding the role of disturbance-driven heterogeneity in the structure and function of grasslands; integrating a landscape perspective into rangeland ecology; fire ecology; and, understanding how herbivores use landscapes. Fuhlendorf currently teaches Applied Ecology and Conservation, Applied Landscape Ecology and Ecology of Fire Dependent Ecosystems. He has published over 80 peer-reviewed articles in international journals.

INTELLIGENCE

ROLE OF HETEROGENEITY IN MANAGING RANGELANDS FOR MULTIPLE USES

OBJECTIVES

To evaluate the fire-grazing interaction on natural landscapes and develop rangeland management practices based on the interaction that can simultaneously enhance production and biodiversity.

KEY COLLABORATORS

David M Engle; Dwayne Elmore; Craig Davis; John Weir; Oklahoma State University

Bob Hamilton, The Nature Conservancy

Numerous graduate students and postdoctoral research associates

FUNDING

US Department of Agriculture (USDA)-NRI • USDA-AFR • The Nature Conservancy’s Tallgrass Prairie Preserve • Oklahoma Department of Wildlife Conservation • Nebraska Game and Parks • US Fish and Wildlife Service

CONTACT

Samuel D Fuhlendorf
Regents Professor
Rangeland Ecology and Management
Oklahoma State University
Natural Resource Ecology and Management
008C Agricultural Hall
Stillwater
Oklahoma 74078-6013
USA

T +1 405 744 9646
E sam.fuhlendorf@okstate.edu

SAMUEL FUHLENDORF is Regents Professor in Rangeland Ecology and Management at Oklahoma State University (OSU). He received the Outstanding Young Professional Award for the Society for Range Management in 2002, the James A Whately Award of Merit for Research from OSU in 2001, the Outstanding Achievement Award for Research from the Society for Range Management in 2010, the Regents Distinguished Research Award at OSU in 2012 and was awarded Fellow of the DaVinci Institute for Creativity in 2013. His current research is focused on conservation of grassland landscapes. Specific areas focus on: understanding the role of disturbance-driven heterogeneity in the structure and function of grasslands; integrating a landscape perspective into rangeland ecology; fire ecology; and, understanding how herbivores use landscapes. Fuhlendorf currently teaches Applied Ecology and Conservation, Applied Landscape Ecology and Ecology of Fire Dependent Ecosystems. He has published over 80 peer-reviewed articles in international journals.

INTELLIGENCE

ROLE OF HETEROGENEITY IN MANAGING RANGELANDS FOR MULTIPLE USES

OBJECTIVES

To evaluate the fire-grazing interaction on natural landscapes and develop rangeland management practices based on the interaction that can simultaneously enhance production and biodiversity.

KEY COLLABORATORS

David M Engle; Dwayne Elmore; Craig Davis; John Weir; Oklahoma State University

Bob Hamilton, The Nature Conservancy

Numerous graduate students and postdoctoral research associates

FUNDING

US Department of Agriculture (USDA)-NRI • USDA-AFR • The Nature Conservancy’s Tallgrass Prairie Preserve • Oklahoma Department of Wildlife Conservation • Nebraska Game and Parks • US Fish and Wildlife Service

CONTACT

Samuel D Fuhlendorf
Regents Professor
Rangeland Ecology and Management
Oklahoma State University
Natural Resource Ecology and Management
008C Agricultural Hall
Stillwater
Oklahoma 74078-6013
USA

T +1 405 744 9646
E sam.fuhlendorf@okstate.edu

SAMUEL FUHLENDORF is Regents Professor in Rangeland Ecology and Management at Oklahoma State University (OSU). He received the Outstanding Young Professional Award for the Society for Range Management in 2002, the James A Whately Award of Merit for Research from OSU in 2001, the Outstanding Achievement Award for Research from the Society for Range Management in 2010, the Regents Distinguished Research Award at OSU in 2012 and was awarded Fellow of the DaVinci Institute for Creativity in 2013. His current research is focused on conservation of grassland landscapes. Specific areas focus on: understanding the role of disturbance-driven heterogeneity in the structure and function of grasslands; integrating a landscape perspective into rangeland ecology; fire ecology; and, understanding how herbivores use landscapes. Fuhlendorf currently teaches Applied Ecology and Conservation, Applied Landscape Ecology and Ecology of Fire Dependent Ecosystems. He has published over 80 peer-reviewed articles in international journals.