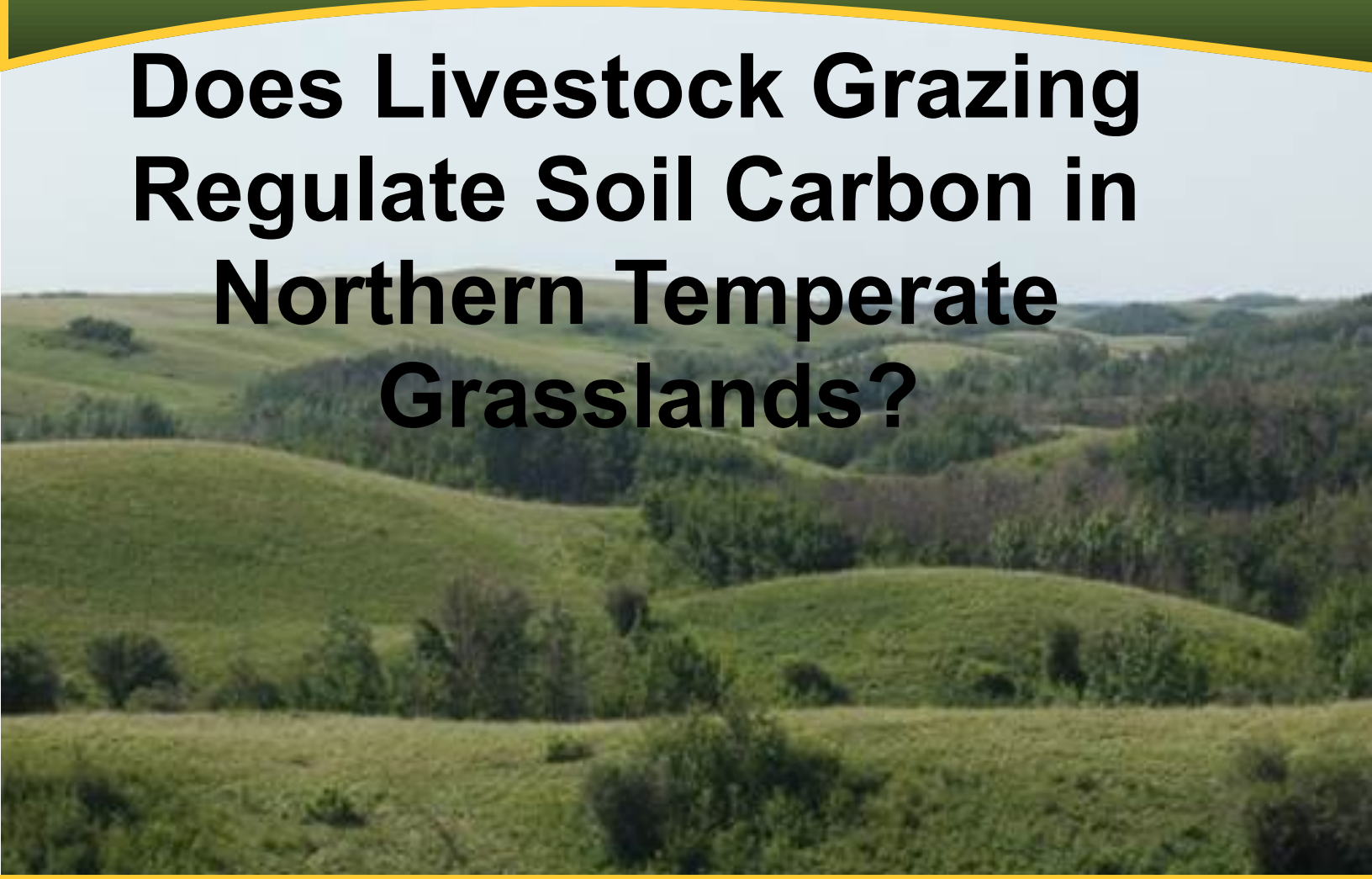
Saskatchewan
Prairie Conservation Action Plan

Prairie's Got the Goods Week!

Does Livestock Grazing Regulate Soil Carbon in Northern Temperate Grasslands?



Friday March 22nd, 2019 at 12:00pm MST

Presenter: Edward W. Bork, Professor & Mattheis Chair, Rangeland Ecology and Management, Dept. of Agricultural, Food and Nutritional Science, University of Alberta

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Does Livestock Grazing Regulate Soil Carbon in Northern Temperate Grasslands?

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Presentation Summary:
Grasslands store large amounts of carbon (C) and significant interest exists in understanding how grasslands may be managed to conserve or increase this C, thereby offsetting rising atmospheric CO2 levels. While grassland conversion to annual cropping is widely known to reduce soil C and soil health, the effects of cattle grazing are less clear. Past studies from western Canada indicate a high degree of inconsistency in the impact of grazing on soil C, ranging from increases, to decreases or no change. Many of these studies however, rely on limited data sets (e.g., a single or handful of locations), and fail to capture the broad range of environments under which grazing occurs. Additionally, few studies have addressed the mechanisms responsible for how grazing alters soil C, leading to uncertainty in how/why (and therefore where and when) soil C changes under grazing. Our research has 1) quantified the size and distribution of grassland C stores, 2) examined the impacts of grazing on grassland C, and 3) explored the mechanism (s) explaining when and where C changes with different grazing treatments, including stocking rates and grazing systems. Here I review some of those findings and provide a framework that may explain how grazing could alter grassland C. In our early work, we quantified the C mass associated with grasslands distributed across more than 100 study sites in Alberta, covering 6 natural subregions with divergent vegetation, soil and climatic conditions. Total C mass varied from ~75 t/ha in the mixedgrass prairie, to ~180 t/ha in the most mesic grasslands, most of which (~85%) was soil C. A sizeable (and likely under-reported) pool of C in these grasslands was found in the surface mulch, which contained 4.5-34 t/ha of C. Additionally, we contrasted C concentrations in the top 30 cm of mineral soil between long-term grazed and non-grazed grasslands, finding an increase in surface soil C concentration (0-15 cm) of 12% under grazing. Notably, this pattern of C increase under grazing coincided with differences in vegetation composition, including a reduction in shrub encroachment under grazing, and an increase in grazing-tolerant (mostly introduced) plant species. Increases in the latter were positively associated with vegetation biomass and soil C concentration, regardless of grazing history. To better understand the mechanisms regulating grazing-induced vegetation change on soil C, we conducted litter decomposition studies with various dominant grasses possessing divergent responses to grazing, and assessed extracellular enzyme activities (EEAs) responsible for C and nutrient cycling. While most native grasses had slow to moderate rates of litter decay, the introduced forage Kentucky bluegrass (KBG), a widespread species known to increase under grazing, had high litter mass loss, and coincided with elevated EEA responsible for C cycling. High decay of KBG could contribute to C accumulation in grasslands under grazing. In yet another investigation using data from mixed prairie grassland sites in Saskatchewan, we related soil organic and inorganic C mass to long-term cattle stocking rate data. Total C mass, and in particular organic C, was positively related to cattle stocking, even after adjustment for growing conditions (rainfall). Surprisingly, this pattern coincided with a decline in range 'condition', largely due to the invasion of KBG. Of note is that inorganic soil C comprised ~1/3 of soil C mass to 60 cm depth, and also increased with stocking rates. Collectively, these findings indicate optimal livestock stocking may lead to changes in vegetation composition that favor soil C increases, possibly through changes in vegetation composition.

About Dr. Bork:
Dr. Edward Bork has been at the University of Alberta since 1997, where he is currently the Mattheis Chair in Rangeland Ecology and Management, and also serves as the Director of the Rangeland Research Institute. He has been teaching and conducting research since 1991 on a wide variety of basic and applied topics such as integrated weed control in pasture, grazing systems, fire ecology, forage and legume production dynamics, landscape and disturbance ecology, and more recently, on the importance of grasslands in providing environmental goods and services such as carbon storage and the maintenance of biodiversity. Dr. Bork's work has had a primary focus on addressing practical problems of high relevance to practitioners, including livestock producers and managers of private and public rangelands. His work has involved extensive collaboration with other researchers and agencies. He and his graduate students have given numerous extension talks on their work.