Climate Change Impacts on Future Carbon Stores and Management of Warm Deserts of the United States

Author(s): Michell L. Thomey, Paulette L. Ford, Matthew C. Reeves, Deborah M. Finch, Marcy E. Litvak, and Scott L. Collins
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On the Ground

- Reducing atmospheric CO_2 through enhanced terrestrial carbon storage may help slow or reverse the rate of global climate change. However, information on how climate change in the Southwest might affect the balance between CO_2 uptake and loss on semiarid rangelands is not easily accessible to land managers.
- We summarize studies that focus on key components of carbon exchange across the warm deserts of North America to determine if common trends exist that can be used in management.
- Management strategies that increase carbon sequestration or decrease carbon loss are especially important. Thus managers will need to know what management practices are likely to promote carbon storage or minimize losses during critical time periods.

Keywords: global climate change, carbon dioxide (CO_2), carbon sequestration in arid–semiarid ecosystems, Mojave Desert, Sonoran Desert, Chihuahuan Desert, land management to increase carbon storage.

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Reducing concentrations of greenhouse gases (GHG) is a pressing environmental issue that has increased the necessity to quantify the exchange of GHG between terrestrial ecosystems and the atmosphere. Carbon dioxide (CO_2) is one of the primary anthropogenic greenhouse gases. Reductions in atmospheric CO_2 concentration through enhanced terrestrial carbon storage may help slow or reverse the rate of global climate change.[1] As a result, federal land management agencies, for example the Forest Service and Bureau of Land Management, are now beginning to implement management policies to increase carbon storage.

Throughout the southwestern United States, climate models consistently project increased aridity and seasonal shifts in precipitation, along with more extreme precipitation events. Moreover, recent warming in the Southwest is among the most rapid in the nation. Information regarding how these elements of climate change might affect the balance between CO_2 uptake and loss (i.e. flux) is especially lacking in forms available to land managers on semiarid rangelands. Here, we present a brief overview of the wide variety of topics to consider related to the key components of carbon flux, including leaf-level photosynthesis, soil respiration, and plant community productivity across the warm deserts of North America (Fig. 1).[2] We also provide a discussion of links between management practices and carbon sequestration, as well as the current goals and unique challenges of management in this region. Since desertification is projected to increase in the future, management strategies that increase carbon sequestration or decrease carbon loss will be especially important.

The Terrestrial Carbon Cycle

Prior to understanding how management actions can alter carbon stores, a baseline assessment is needed to estimate the current amount of carbon being stored in an area. In the terrestrial carbon cycle (Supplemental Material; available online at http://dx.doi.org/10.2111/RANGELANDS-D-13-00045.s1), plants take up CO_2 from the atmosphere through photosynthesis, and CO_2 is released back to the atmosphere as the by-product of autotrophic (plant) and heterotrophic (e.g., microbial) respiration or what is collectively referred to as ecosystem respiration. The rate at which photosynthesis and ecosystem respiration occurs is largely affected