**To:** Manti-La Sal NF Forest Plan Revision Team

**Re:** Annotated bibliography of some new information relevant to assessment of MLSNF for the forest plan revision surrounding carbon stocks and greenhouse gas emissions

**Submitted by**: Mary O’Brien & Kristina Young, Grand Canyon Trust

**Date:** July 20, 2017

*Note*: Each of the following documents can be downloaded by clicking on the link.

[Bowker, M.A., Miller, M.E., and Belote, R.T., 2012, Assessment of rangeland ecosystem conditions, Salt Creek watershed and Dugout Ranch, southeastern Utah: U.S. Geological Survey Open-File Report 2012-1061, 56](https://pubs.usgs.gov/of/2012/1061/)

**Topic:** Research: comparison of multiple ecosystem functions in grazed and ungrazed watershed in Southeast Utah

In 2012, when comparing the actively grazed watershed in Dugout Ranch outside of Canyonlands National Park and ungrazed watersheds in Canyonlands National Park that has been ungrazed since 1975, the authors found clearly high levels of forage production, dust retention, and C storage attained in the ungrazed watershed. The differences were strongest when examining dust retention and C storage.

**Implications for forest plan assessment:**  Grazing was found to increase carbon storage and increase dust emissions in lands near to the Manti-La Sal NF. The EIS and Assessment need to address how grazing on the Manti-La Sal influences carbon storage.

[BRADLEY, B. A., HOUGHTON, R. A., MUSTARD, J. F. and HAMBURG, S. P. 2006. Invasive grass reduces aboveground carbon stocks in shrublands of the Western US. Global Change Biology, 12: 1815–1822. doi:10.1111/j.1365-2486.2006.01232.x](http://www.greatoldbroads.org/wp-content/uploads/formidable/44/BRADLEY_et_al-2006-Global_Change_Biology.pdf)

**Topic:** **Research: expansion of cheatgrass has changed portions of western US from a carbon sink to carbon source**

Field research in north central Nevada compared carbon storage in adjacent plots of invasive grassland and native shrubland in 2004. The researchers scaled-up the impact of this ecosystem shift using regional maps of the current invasion and of the risk of future invasion. The expansion of cheatgrass within the Great Basin has released an estimated 8 +/- 3 Tg C to the atmosphere,and will likely release another 50 +/- 20 Tg C in the coming decades. This ecosystem conversion has changed portions of the western US from a carbon sink to a source,making previous estimates of a western carbon sink almost certainly spurious. The growing importance of invasive species in driving land cover changes may substantially change future estimates of US terrestrial carbon storage.

**Implications for forest plan assessment:** The assessment and EIS should assess the baseline carbon stocks in shrublands and account for change to those stocks as cheatgrass continues to expand

[Briske, D.D., Bestelmeyer, B.T., Brown, J.R., Fuhlendorf, S.D., Polley, H.W., 2013. The Savory Method can not green deserts or reverse climate change. Rangelands 35, 72–74.](http://www.greatoldbroads.org/wp-content/uploads/formidable/44/Briske_EtAl_2013_Savory_Rangelands.pdf)

**Topic:** Review: refuting the Savory Method of grazing and pointing out the lack of science behind it

Allan Savory’s grazing regime, specifically concentrated, intense grazing followed by rest, which he claims is capable of greening the desert and resisting climate change is not based on any science according to this review. At best rangelands are weak sinks for atmospheric carbon.

The authors find all of Savory’s claims unfounded. In fact the authors suggest that Mr. Savory’s method to reverse rangeland degradation and/or climate change might actually accelerate these processes.

**Implications for forest plan assessment:**  Grazed lands are not significant sources of carbon sequestration and claims for benefits of grazing management must be based in evidence.

[Canadell, J. G., D. E. Pataki, R. Gifford, R. A. Houghton, Y. Luo, M. R. Raupach, P. Smith, and W. Steffen (2007), Saturation of the terrestrial carbon sink, in](http://www.globalcarbonproject.org/global/pdf/Canadell.2007.SinkSaturation.Springer.pdf)*[Terrestrial Ecosystems in a Changing World](http://www.globalcarbonproject.org/global/pdf/Canadell.2007.SinkSaturation.Springer.pdf)*[, edited by J. G. Canadell, D. E. Pataki, and L. F. Pitelka, pp. 59–78, Springer, Berlin, Germany.](http://www.globalcarbonproject.org/global/pdf/Canadell.2007.SinkSaturation.Springer.pdf)

**Topic:** Book chapter: the potential for the saturation of the terrestrial carbon sink

This book chapter look at the terrestrial carbon sink and the potential for the sink to become saturated as CO2 levels continue to increase. The reviewed literature suggests most of the biological sinks will eventually level off and subsequently decline to zero whereby no further C will be removed from the atmosphere. Coupled with this sink decline, global warming and deforestation have the potential to destabilize large biospheric C pools which would add CO2 to the atmosphere. This C source component will further diminish the net gains of C sinks and could even diminish the sink strength beyond zero, thereby moving from being a C sink to a source during this century. Such an eventuality would put further pressure on society to select higher targets of CO2 emission reductions from fossil fuel burning.

**Implications for forest plan assessment:**  Nearly all of the MLNF is grazed, which can reduce carbon pools. These predicted reductions in carbon storage need to be assessed in the Assessment and EIS.

[Carter J., Jones A., O’Brien M., Ratner J., Wuerthner G. 2014. “Holistic Management: Misinformation on the Science of Grazed Ecosystems,” International Journal of Biodiversity. 2014:163431](https://www.hindawi.com/journals/ijbd/2014/163431/)

**Topic:** [Review: reviewing the literature on grazing management and showing wrong information in the holistic management system](https://www.hindawi.com/journals/ijbd/2014/163431/)

Review of grazing literature found no peer-reviewed study showing that the grazing method of holistic management was superior to conventional grazing systems in outcomes. The authors find holistic management is just as detrimental to plants, soils, water storage, and plant productivity as conventional grazing.

**Implications for forest plan assessment:**  Any claims for benefits of particular grazing systems need to be based in evidence, in comparison with other grazing systems and not grazing.. The EIS and Assessment need to assess how the grazing systems used on the Manti-La Sal influence carbon storage using scientific evidence.

[Frankenberg, C. et al. 2016. Airborne methane remote measurements reveal heavy-tail flux distribution in Four Corners region. PNAS. 113 (35) 9734-9739](http://www.greatoldbroads.org/wp-content/uploads/formidable/44/Frankenberg-et-al.-2016.pdf)

**Topic:** **Research: methane plumes over the Four Corners due to gas processing facilities, storage tanks, pipeline leaks, well pads, and coal mine venting shafts**

Methane (CH4) impacts climate as the second strongest anthropogenic greenhouse gas and air quality by influencing tropospheric ozone levels. Space-based observations have identified the Four Corners region in the Southwest United States as an area of large CH4 enhancements. The remote sensing technique detected more than 250 individual methane plumes from fossil fuel harvesting, processing, and distributing infrastructures, spanning an emission range from the detection limit ∼∼ 2 kg/h to 5 kg/h through ∼∼ 5,000 kg/h in 2015. Observed sources include gas processing facilities, storage tanks, pipeline leaks, and well pads, as well as a coal mine venting shaft.

**Implications for forest plan assessment:**  The MLNF is on the Colorado Plateau and has active natural gas extraction. The estimated release of methane from these natural gas wells needs to be assessed in the Assessment and EIS.

[Lassey, K.R., 2007. Livestock methane emissions: from the individual grazing animal through national inventories to the global methane cycle. Agricultural and Forest Meteorology 142, 120-132](http://www.greatoldbroads.org/wp-content/uploads/formidable/44/Lassey-AFM2007.pdf)

**Topic:** **Research: methane emissions from grazing animals from the national scale to the global scale**

Methane is a potent greenhouse gas whose atmospheric abundance has grown 2.5-fold over three centuries, due in large part to agricultural expansion. The farming of ruminant livestock, which generate and emit methane during digestion is a leading contributor to this growth. This modeling study concludes livestock are possibly one of the largest emitters of methane in the world.

**Implications for forest plan assessment:**  Most of the MLNF is actively grazed by livestock.. Those livestock are releasing methane into the air. This needs to be assessed in the Assessment and EIS.

[McGlade, C., Ekins, P. 2015. The geographical distribution of fossil fuels unused when limiting global warming to 2 degrees C. Nature. 517(7533):187-90](http://www.greatoldbroads.org/wp-content/uploads/formidable/44/McGlad-et-al.-2015.pdf)

**Topic:** **Research: modeling showing that to keep global warming below 2 degrees C coal needs to be left in the ground**

This modeling research shows that to keep global warming below the target goal of 2 degrees C, 1/3 of global oil reserves, half of gas reserves, and over 80% of coal reserves should remain unused from 2010 to 2050.

**Implications for forest plan assessment:**  The MLNF has active coal mines which are removing sequestered carbon from under the ground. These reductions in carbon storage needs to be assessed in the Assessment and EIS.

[Warmuzinski, K. 2008. Harnessing methane emissions from coal mining. Process Safety & Environmental Protection: Transactions of the Institution of Chemical Engineers Part B. 86:5, **315**-320.](http://www.greatoldbroads.org/wp-content/uploads/formidable/44/Warmuzinsky-et-al.-2008.pdf)

**Topic:** **Research: examining the amount of methane emitted during coal mining**

Considerable amounts of methane are released into the atmosphere with coal-mine ventilation air. A single ventilation shaft may discharge several hundred thousand cubic metres of ventilated air that includes methane per hour. As a greenhouse gas, methane is 20 times more effective in trapping heat in the atmosphere than carbon dioxide over a 100-year period

**Implications for forest plan assessment:**  The MLNF has active coal mines which are releasing methane, a greenhouse gas. These emissions need to be assessed in the Assessment and EIS.