Impact of Grazing on Soil N_2O Emissions from an Alpine Grassland in China

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Background:

- Animal grazing can affect grassland N_2O emissions through its influences on soil environment and the abundance of soil N_2O-producing functional genes.
- Alpine grassland on Kunlun Mountain of NW China plays an important role in livestock production, whereas overgrazing causes severe degradation.
- Field studies were conducted to investigate how grazing intensity affected N_2O emissions and their environmental and biological drivers.

Methods:

- The long-term grazing study site was established in 2007 by fencing three paddocks with areas of 20, 40, and 2 ha, producing three stocking densities of 1.0 sheep ha^{-1} (light), 3.0 sheep ha^{-1} (heavy), and non-grazed control, respectively.
- Soil N_2O flux was measured using the static vented chamber over 2017 and 2018.
- The abundance of N_2O-producing and reducing genes including archaeal *amoA* and bacterial *amoA*, *Nitrobacterlike nxrA*, *narG*, *nirK*, *nirS*, and *nosZ* gene were assessed by qPCR).
- Soil nitrate/ammonium, moisture, temperature, pH, DOC, plant biomass, and weather data were measured.

N_2O gas sampling

Soil sensors installation

qPCR analysis

Results and Discussion:

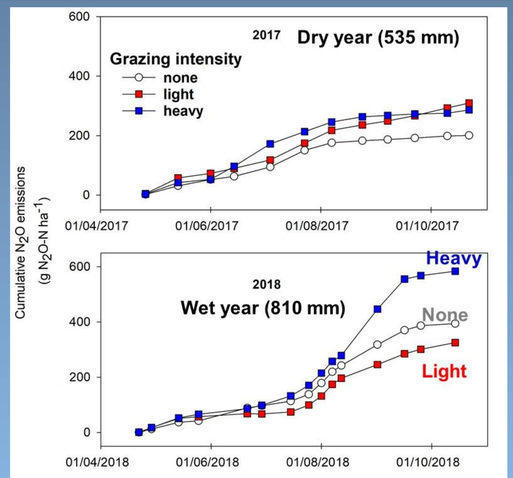
- The aboveground biomass followed the order of Non-grazed > light grazing > heavy grazing, indicating that a reduced grazing intensity can potentially prevent grassland degradation.

Aboveground Biomass (kg/ha)

2017	**2,059 a**	**439 b**	**217 c**
2018	**1,730 a**	**508 b**	**269 c**

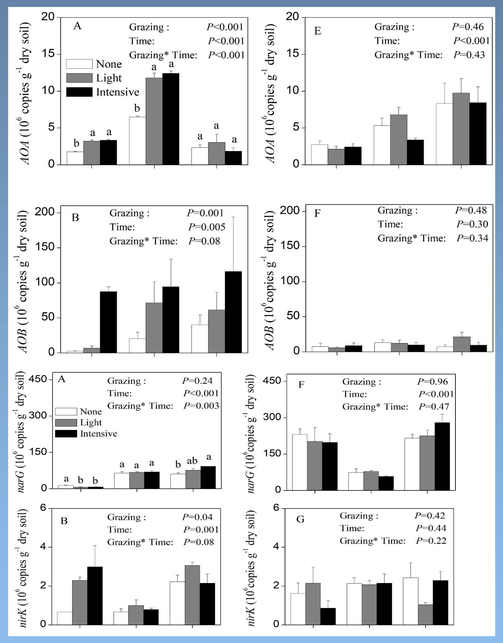
Results and Discussion:

- Reducing grazing intensity from heavy to light effectively reduced 2-yr N_2O emissions by 27%.
- The abundance of functional genes varied with sampling time but showed little response to varying grazing intensities.
- N_2O flux rate correlates with soil temp, moisture, and DOC, and not with gene abundance.



2-yr Total N_2O (kg N/ha)

None:	**0.60 b**
Light:	**0.67 b**
Heavy:	**0.90 a**



	Soil Temp.	WFPS	DOC	AOA	AOB	*narG*	*nirS*	*nirK*	*nosZ*
N_2O flux	0.31*	0.42**	0.27**	0.01	0.01	-0.30	-0.01	0.05	-0.17

Implications:

1) A proper grazing intensity is important in reducing N_2O emissions while maintaining sustainable production.
2) Soil physiochemical characteristics, rather than the abundances of the functional genes determined soil N_2O emissions.

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