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Management of hydrology and waterfowl grazing impacts wetland methane flux

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Hydrologically managed wetlands provide critical habitat for North American migratory waterfowl. Such 'waterfowl impoundment' systems are hosting increasingly dense aggregations of birds as populations have increased and natural wetlands have been lost over the past century. Because of the intense grazing pressure they receive and a prescribed hydrologic regime, these waterfowl wetlands represent ideal settings for unravelling effects and interactions of plants, herbivores and hydrology on dynamics of methane (CH4) emissions at field scale. Yet, despite the ubiquity of waterfowl impoundment systems, they have been almost completely ignored by studies of wetland greenhouse gas biogeochemistry. To test for grazing effects on methane, we implemented a 2-year herbivore exclosure experiment in a waterfowl impoundment at a wildlife refuge in North Carolina, USA. We found that exclusion of waterfowl led to a dramatic increase in the density of the emergent Eleocharis quadrangulata and reduced mean cumulative CH4 flux by 29 to 84 percent, presumably because of radial oxygen loss from plant roots into wetland sediments as indicated by soil pore water chemistry. In addition the arrival of a new refuge manager in the second year of our study allowed us to test the impact of a change in the timing of prescribed impoundment dewatering. We found that hydrologic management leading to exposed wetland surface soils a month earlier in the second year's growing season led to a major decrease in CH4 emissions (roughly 70%). These results suggest that relatively minor adjustments to waterfowl impoundment management protocols can lead to significant abatement in seasonal CH4 flux, and may represent a promising avenue for greenhouse gas mitigation given the inventory of 1.5 million hectares of federally-owned waterfowl production areas in the United States.