



Plant Invasions as a Major Aspect of Global Environmental Change: Gunnera tinctoria invasions Reduce not Increase Carbon Dioxide Emissions

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Invasions by alien plants are increasingly seen as a major aspect of global environmental change, altering soil attributes and plant communities and impacting on ecosystem processes, such as greenhouse gas emissions (GHG). However, there is little information on how or if plant invasions impact on GHG emissions although, given their increasing contribution to land cover change, this could have a significant impact on national GHG inventories. In general, it is often assumed that invasive plant species will lead to significantly enhanced GHG emissions due to their high biomass productivity. Although *Gunnera tinctoria* Molina (Mirb.) is an important N-fixing and highly productive invasive plant species that is associated with significant negative impacts on ecosystems in Ireland, investigations of its impacts on ecosystem processes are still quite limited. We conducted a field experiment on Achill Island, located off the west coast of Ireland, comparing invaded areas (GUN) with uninvaded semi-natural grasslands (GRASS). Whilst GUN showed a >5-fold higher biomass productivity than GRASS, invaded areas had a 61% reduction in total soil respiration ($20.92 \pm 3.06 \text{ Mg CO}_2 \text{ ha}^{-1} \text{ y}^{-1}$) in comparison to uninvaded grasslands ($53.76 \pm 7.90 \text{ Mg CO}_2 \text{ ha}^{-1} \text{ y}^{-1}$), mainly due to the lower root mass per unit area. Invasive stands had an annual litter input >10 Mg ha⁻¹ and a litter respiration rate much higher ($13.15 \pm 0.36 \text{ Mg CO}_2 \text{ ha}^{-1} \text{ y}^{-1}$) than GRASS ($2.63 \pm 0.41 \text{ Mg CO}_2 \text{ ha}^{-1} \text{ y}^{-1}$). Whilst nitrous oxide emissions of an order of magnitude higher than those in adjacent uninvaded grasslands were found at the end of the growing season in invaded areas, methane emissions were largely unaffected by invasion. However, these trace gases made little contribution to the Global Warming Potential (GWP), with N₂O and CH₄ emissions representing less than 5% and 1%, respectively. Based on estimates of the area covered, *G. tinctoria* invasions may be responsible for a reduction of >10% (or 6.231 Mt CO₂eq y⁻¹) of the national CO₂ emissions, with the potential to offset the amount emitted (6.047 Mt CO₂eq y⁻¹) by the residential sector in 2016. Whilst the generality of these results is unclear, this information argues for a more detailed appraisal of the effects of plant invasions on GHG budgets.