**Invasion of a semi-arid shrubland by annual grasses increases autotrophic and heterotrophic soil respiration rates due to altered soil moisture and temperature patterns.**

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Shrub <-> grassland conversions are a globally occurring phenomenon altering habitat structure, quality and nutrient cycling. Grasses and shrubs differ in their above and belowground biomass allocation, root architecture, phenology, litter quality and quantity. Conversion affects soil microbial communities, soil moisture and temperature and carbon (C) allocation patterns. However, the effect of conversion on C storage is regionally variable and there is no consistent direction of change. In Southern California invasion by annual grasses is a major threat to native shrub communities and it has been proposed that grass invasion increases NPP and ecosystem C storage (Wolkovich et al, 2009). In order to better understand how this shrub <-> grassland conversion changes ecosystem C storage it is important to understand the partitioning of soil respiration into autotrophic and heterotrophic components.

Respiration was measured in plots under shrubs and grasses from February when it was cold and wet to July when it was hot and dry, capturing seasonal transitions in temperature and water availability. Roots were excluded under shrubs and grasses with root exclusion cores to quantify heterotrophic respiration. Using total soil respiration (Rt) = autotrophic respiration (root) (Ra)+ heterotrophic respiration (microbial) (Rh) the components contributing to total soil respiration can be evaluated. Respiration, soil moisture and temperature were measured daily at four hour intervals using Licor 8100 automated chamber measurements.

Throughout the measurement period, Rt under grasses exceeded Rt under shrubs. Higher Rt levels under grasses were mainly due to higher Ra in grasses rather than changes in Rh. On average grass Ra was almost double shrub Ra. Higher grass respiration levels are partially explained by differences in soil moisture and temperature between shrubs and grasses.

Respiration rates responded similarly to seasonal transitions regardless of treatment although Rt had a much stronger seasonal response. Across all months changes in respiration rates are explained by changes in soil moisture. However, within wet periods respiration rates increase with temperature. From February to April the soil was wet and respiration levels gradually increased as day time soil temperatures increased. From April onwards absence of precipitation events and rising soil temperatures caused the soils to rapidly dry out. As a result Rt rates declined and gradually converged with Rh levels. As soils dried, grass Rt declined more gradually than shrub Rt. This was contrary to our expectation that shrub roots would respire longer into the dry season because they have deeper roots and can access water. The high late-season levels of respiration observed in the grass community are possibly due to the presence of invasive forbs which have deep tap roots and continue to grow after the grasses have senesced.

Conversion from native shrubs to annual invasive grasses increased both Rt and Rh which indicates changes in plant C allocation and decomposition rates of soil C. The continued encroachment of grasses on shrubland has important implications for the future of C storage in this system.