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The influence of saltmarsh restoration on sediment dynamics and the potential impact on carbon sequestration

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Coastal wetland ecosystems can act as large-capacity carbon sinks, providing a valuable climate change mitigation function. Globally, saltmarshes are estimated to accumulate an average of 244.7g C m-2 yr-1 (Ouyang & Lee 2014). Saltmarsh areas have experienced rapid loss in the recent past of approximately 1-2% per year (Duarte et al. 2008). Efforts to restore these areas could result in additional carbon storage due to extended vegetation cover and altered burial due to changing sediment dynamics.

The influence of restoration through transplantation on sediment dynamics within a small estuary on the east coast of Scotland was assessed. Restoration efforts have been implemented since the early 2000s providing examples of old established sites ("old", >10years), young recently planted sites ("young", <5years), and 'business-as-usual' mudflats and natural marsh areas. In each of these area types seasonal data of sediment deposition and settlement were collected and sediment accretion rates measured.

Deposition and settlement samples were taken four times a season, provided total sediment weight and organic content information. Elevation changes were measured once per season, quantifying sediment accretion rates. All data were collected between summer 2015 and spring 2016.

Data suggest a positive correlation between sediment settlement and deposition quantities (dry weight) across the estuary ($r2=0.64$), with restored areas displaying a slightly stronger relationship (old $r2=0.67$, young $r2=0.68$) compared to natural marsh and mudflats ($r2=0.54$ and 0.59 respectively). Suggesting restored areas which are developing or expanding are retaining more from the potential sediment load in the water column. However average amounts of actual deposited material are significantly greater in mudflat and young areas with old and natural areas significantly lower; potentially as a result of those being of a lower elevation. Nevertheless, percentage organic matter content of deposited material is significantly lower in mudflat and young areas ($3.78 \pm 0.59\%$ and $3.66 \pm 0.79\%$ respectively) versus those of natural and old areas ($12.08 \pm 2.27\%$ and $6.70 \pm 1.30\%$ respectively). This relationship suggests that older restored areas are potentially offering the most potential benefit in terms of carbon sequestration, due to higher rates of deposition from the potential load and higher percentage organic content of those deposits. Furthermore, measurements of sediment accretion rates over the same period show natural and old areas to be the most effective at retaining sediment, with average elevation changes of 6.99 ± 1.64mm and 6.56 ± 0.94mm respectively, in comparison to young areas, 4.44 ± 1.58mm, and mudflats, 1.51 ± 1.23mm.

Factors influencing these differences could be attributed to type and density of vegetation present and elevation of each area (or immersion period). However, the data suggests restoration could play an important role, which once established, appears to facilitate efficient sediment deposition from potential sediment load and crucially the effective accumulation of organic rich material through sediment accretion, possibly leading to increased carbon sequestration and climate change mitigation services.