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Non-native mangroves support carbon storage, sediment carbon burial, and accretion of coastal ecosystems

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Abstract

Mangrove forests play an important role in climate change adaptation and mitigation by maintaining coastline elevations relative to sea level rise, protecting coastal infrastructure from storm damage, and storing substantial quantities of carbon (C) in live and detrital pools. Determining the efficacy of mangroves in achieving climate goals can be complicated by difficulty in quantifying C inputs (i.e., differentiating newer inputs from younger trees from older residual C pools), and mitigation assessments rarely consider potential offsets to CO_2 storage by methane (CH_4) production in mangrove sediments. The establishment of non-native *Rhizophora mangle* along Hawaiian coastlines over the last century offers an opportunity to examine the role mangroves play in climate mitigation and adaptation both globally and locally as novel ecosystems. We quantified total ecosystem C storage, sedimentation, accretion, sediment organic C burial and CH_4 emissions from ~70 year old *R. mangle* stands and adjacent uninvaded mudflats. Ecosystem C stocks of mangrove stands exceeded mudflats by 434 ± 33 Mg C/ha, and mangrove establishment increased average coastal accretion by 460%. Sediment organic C burial increased 10-fold (to 4.5 Mg C ha^{-1} $year^{-1}$), double the global mean for old growth mangrove forests, suggesting that C accumulation from younger trees may occur faster than previously thought, with implications for mangrove restoration. Simulations indicate that increased CH_4 emissions from sediments offset ecosystem CO_2 storage by only 2%–4%, equivalent to 30–60 Mg CO_2-eq/ha over mangrove lifetime (100 year sustained global warming potential). Results highlight the importance of mangroves as novel systems that can rapidly accumulate C, have a net positive atmospheric greenhouse gas removal effect, and support shoreline accretion rates that outpace current sea level rise. Sequestration potential of novel mangrove forests should be taken into account when considering their removal or management, especially in the context of climate mitigation goals.

KEYWORDS

^{210}Pb, methane, Moloka'i, non-native species, restoration, *Rhizophora mangle*, sediment

