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Shifting baselines: How coastal settings shape Blue Nitrogen benefits in wetlands

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Nitrogen (N) pollution persists as a global threat to aquatic ecosystem health. While mangroves are recognized as efficient filters of reactive N, how N-removal service differs between estuarine and open-coast mangrove ecosystems remains poorly understood. To address this, we quantified rates of denitrification, anaerobic ammonium oxidation (anammox), and dissimilatory nitrate reduction to ammonium (DNRA) in mangrove-flat habitats across estuarine and open-coast ecosystems. We found that actual N removal (denitrification and anammox) was 18-fold higher in the estuarine ecosystem. Here, high external nitrate (NO_3^-), muddy and organic-rich sediments, together with compressed oxygen penetration depth (OPD, <0.5 mm) drove the anaerobic N loss through denitrification. In contrast, the open-coast ecosystem was dominated by DNRA (63% of total NO_3^- reduction), fueled by high dissolved organic carbon (DOC) to sediment NO_3^- ratios. Mangrove colonization restructured N cycling pathways differently in these different coastal ecosystems. By comparing with adjacent bare flats, we could observe that the presence of mangrove trees suppressed DNRA even more in the estuarine ecosystem, while it increased N-removal potential by elevating DOC and reducing OPD in the more sandy open-coast ecosystem. Our findings highlight that the coastal setting creates distinct baselines in N cycling, yet mangroves enhance ecosystem resilience by providing a critical buffer against eutrophication.