

Organic carbon in intertidal mangrove forests: sources and utilization by benthic invertebrates

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In contrast to the large number of studies on the trophic significance of mangrove primary production to the aquatic foodweb, there have been few attempts to provide an overview of the relative importance of different primary carbon sources to invertebrates in the intertidal mangrove habitats. Mangrove sediments from three different mangrove ecosystems (Coringa Wildlife Sanctuary in the Godavari Delta, Andhra Pradesh, India, and Galle and Pambala, Sri Lanka) were analysed for their organic carbon and total nitrogen content, elemental ratios (C:N) and carbon isotopic composition. Organic carbon content (0.64 – 31.67% dry weight), C/N ratios (7.0 – 27.3) and $\delta^{13}\text{C}$ (between -29.37 and -20.61‰) showed a wide range of values. Lower stocks of organic carbon coincided with low C/N (atom) ratios and less negative $\delta^{13}\text{C}$ values, indicating import of marine or estuarine particulate suspended matter. High organic carbon stocks coincided with high C/N ratios and $\delta^{13}\text{C}$ values close, but not equal, to those of the mangrove vegetation. While in some mangrove ecosystems or vegetation zones, organic carbon stocks can be very high and are almost entirely of mangrove origin, there also appear to be cases in which deposited estuarine or marine suspended matter is the dominant source of organic carbon and nitrogen in mangrove sediments. At one such site (Coringa Wildlife Sanctuary), 23 invertebrate species and different primary producers were collected and analysed for their carbon and nitrogen stable isotopic composition ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) in order to determine the contribution of mangrove leaf litter and other carbon sources to the invertebrate community. These invertebrates were found to display a wide range of $\delta^{13}\text{C}$ values, most being 3-11‰ enriched relative to the average mangrove leaf signal. Two invertebrate species displayed remarkable stable isotope signatures: the pulmonate gastropod *Onchidium* sp. had extremely low $\delta^{15}\text{N}$ values ($-5.58 \pm 0.86\text{‰}$) and *Polycladia* hosting endosymbiotic algae showed low $\delta^{13}\text{C}$ values ($-36.2 \pm 0.8\text{‰}$), but further work is needed to adequately explain these. A compilation of stable isotope data from various sources indicates that significant assimilation of mangrove-derived carbon is only detectable in a limited number of species, and stresses that local and imported algal sources can be a major source of carbon for benthic invertebrate communities in intertidal mangrove forests. These findings show a striking similarity with results from temperate salt marsh ecosystems where local plant production has often been found to contribute little to intertidal foodwebs, and thus provide new insights into carbon utilization patterns in vegetated intertidal ecosystems.