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High levels of benthic biomass and primary production on an oligotrophic boundary current shelf and its implications for nitrogen budget

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A survey of benthic habitat type, biomass and primary production (PP) was made on the south-western Australian continental shelf and a model constructed to represent the distribution of organic carbon, total nitrogen and PP across the shelf and to calculate a nitrogen budget. Total animal and plant biomass was 51 tDW km-2, 16 tC km-2 and 1.2 tN km-2. Biomass was dominated by kelp (43%), other algae (33%) and filter feeders (20%). Kelp and other algae made up 97% of all biomass in the 0-20 m depth zone while filter feeders made up just 1.2%. On the other hand at depths >than 20 m, filter feeders accounted for 48% of all biomass. Sixty-one percent of all biomass occurred in the 0-20m depth zone which made up only 9% of the area modelled. 29% of the biomass was in the 20-50 m depth zone, while the deeper areas 50-200 m made up just 9% of biomass. Reef habitats accounted for 96% of all biomass. Water column biomass (phytoplankton and zooplankton) made up 30% of biomass in the 100-200m depth zone but only 1.4% of overall biomass. Incorporating C and N tied up in the top 2cm of marine sediments (not already accounted for above as microalgae) into the model contributed significantly to the total store of C (21 tC km-2) and N (2.3 tN km-2) on the shelf. Thus 25% of all organic carbon on the shelf is tied up in sediments and 34% is stored in the standing stock of the kelp Ecklonia radiata. The largest stores of nitrogen on the shelf occur within sediments (46.4%) with most of this in the 20-50 m depth zone (36.6%).Total PP was estimated to be 122.9 tC km-2 yr-1. Total pelagic PP was 80.0 tC km-2 yr-1 and benthic PP was 42.7 tC km-2 yr-1 which is more than three times previous estimates. The nitrogen budget showed a requirement for 18.52 gN m-2 yr-1 (12.1 gN m-2 yr-1 pelagic and 6.4 gN m-2 yr-1 benthic) and that 90% of nitrogen used for PP was recycled on the shelf. The nitrification rate at the benthos required to achieve this was calculated to be 9.53 gN m-2 yr-1 which is similar to other estimates of benthic nitrogen fluxes made in the same region. Resupply of nutrients as a result of nitrification by bacteria in sediments and sponges is thought to be the principal source of recycled nitrogen on the shelf.