

QUANTIFYING DISSOLVED ORGANIC CARBON RELEASE BY CANOPY-FORMING KELPS

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Study Description

Kelp forests fix tremendous quantities of carbon, yet little is known about the process whereby kelps release fixed carbon as dissolved organic carbon (DOC). We used ^{13}C stable isotope incubations to quantify DOC release by kelp blades in relation to carbon fixation, nutrient uptake, tissue nitrogen content, and light availability. The annual kelp *Nereocystis luetkeana* released an average of 16% of fixed carbon into the seawater as DOC. Carbon isotopes revealed that carbon is rapidly fixed and released, within hours, but DOC release was decoupled from recent photosynthesis and was partly correlated with nitrogen availability.

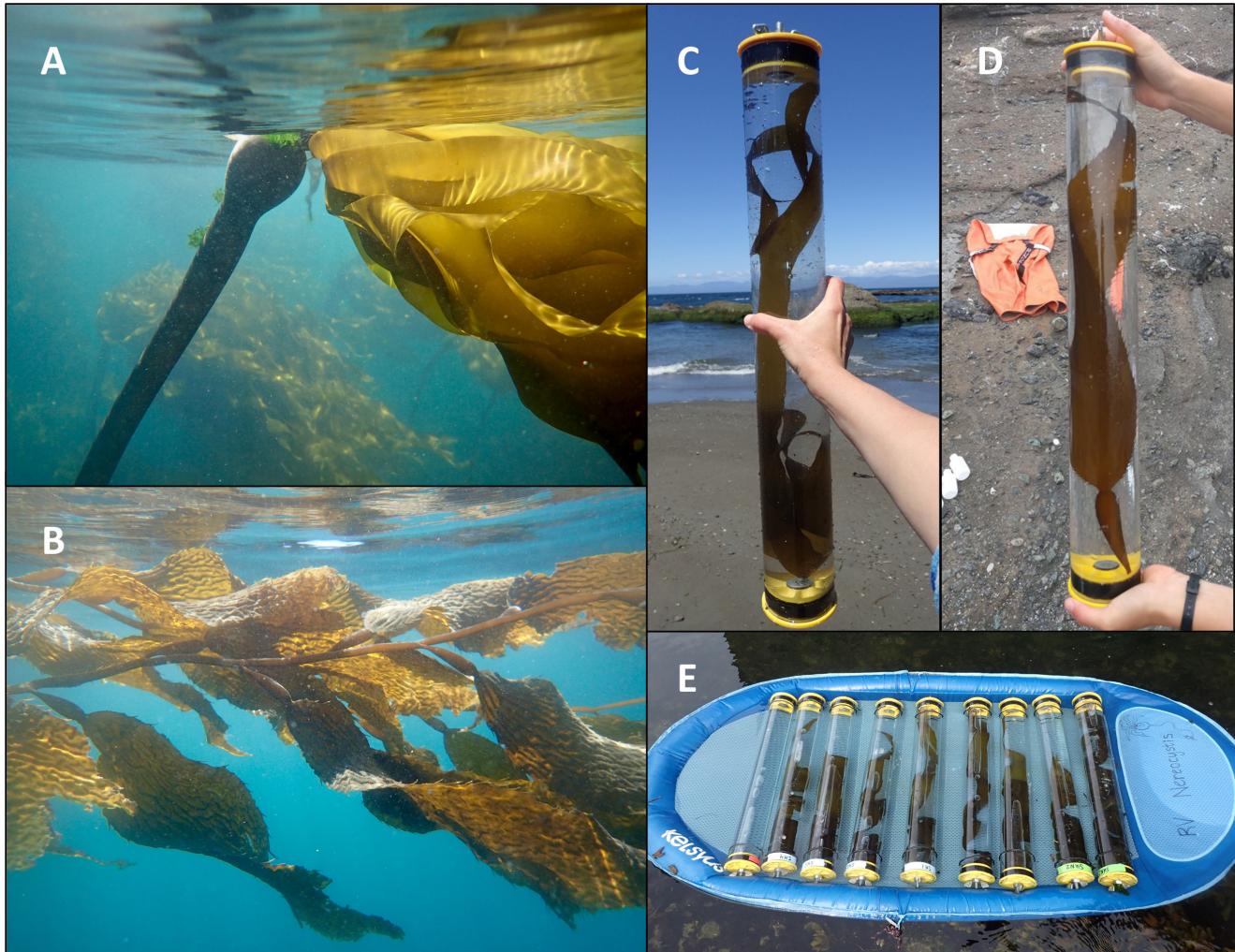


Photo 1: Carbon fixation and DOC release were quantified for two different canopy-forming kelp species: (A) *Nereocystis luetkeana* and (B) *Macrocystis pyrifera*. Most experiments focused on *N. luetkeana*, but one comparative experiment included both species. To quantify DOC release over time, single blades of (C) *N. luetkeana* or (D) *M. pyrifera* were incubated in chambers filled with seawater. (E) Chambers containing replicate kelp blades were incubated horizontally in a recreational float, keeping them immersed in the cold seawater and permitting wave movement and natural sunlight. Photo credit: Brooke Weigel (A-C, E) and Olivia Cattau (D).



Photo 2: The kelp forest of *N. luetkeana* on Tatoosh Island, Washington, USA, viewed from below the seawater surface and above. Carbon fixation measurements for *N. luetkeana* were scaled up from carbon fixation per gram dry mass per hour from chamber experiments. Using estimates of biomass at this site, we found that carbon fixation by the annual kelp *N. luetkeana* is as high as $2.35 \text{ kg C} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$. Thanks to the Makah Tribe for permission to work on Tatoosh Island. Photo credit: Brooke Weigel.

These photographs illustrate the article “The dynamics and stoichiometry of dissolved organic carbon release by kelp” by Brooke L. Weigel, Catherine A. Pfister published in *Ecology*. <https://doi.org/10.1002/ecy.3221>