The relative importance of microbial and classical food webs in a highly productive coastal upwelling area

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ABSTRACT: We present an analysis of seasonal variations in the trophic pathways of carbon in a highly productive coastal upwelling region in the Humboldt current system off Chile. Seasonal changes in phytoplankton, protozooplankton, and bacteria biomass, along with rates of primary production (PP), bacterial growth, secondary production, vertical particle fluxes, and feeding b protozooplankton, omnivorous mesozooplankton, and carnivorous gelatinous zooplankton were determined from July 2004 to June 2005. Phytoplankton biomass and PP were maximal during spring/summer months, associated with upwelling episodes. Heterotrophic nanoflagellates (HNF) were the principal consumers of bacteria, removing >100% of their biomass daily. During autumn/winter, the protozooplankton grazed down a large fraction of HNF production (56% to 9 d⁻¹). The mesozooplankton consumed 1-6% of the PP d⁻¹; the different size fractions of copepods were omnivorous mostly during autumn/winter months, and ctenophores preyed most strongly c small copepods (0.5% to 5% d⁻¹). A large part of the PP was channeled through the microbial fooc web, and only a small part directly to copepods via the herbivore food chain. The microbial fooc web transfers bacterial or small algal carbon to protozooplankton, and then to mesozooplankton and a large percentage of this carbon is also available for the gelatinous predators. Because zooplankton are not able to feed on dissolved organic matter and cyanobacteria, the combined feeding activity of zooplankton either by direct (phytoplankton) or indirect (microbial) pathways increases the yield of PP reaching the zooplankton and, eventually, the upper trophic levels. Ou findings suggest that the carrying capacity for larger omnivorous and carnivorous metazoans, anc even for commercially exploitable pelagic fishes, might be considerably larger than that expecte from a simple herbivore-dominated food chain in coastal upwelling areas.