Title: Plankton stoichiometry determines trophic transfer in aquatic food webs

Ecological stoichiometry integrates elemental fluxes, energy transfer efficiency, and prey selectivity into a comprehensive food web research framework. The central idea of ecological stoichiometry is that the mismatch between resource stoichiometry (elemental carbon:nitrogen:phosphorus ratio; C:N:P) and stoichiometric requirement of consumers hinders the carbon assimilation efficiency of consumers. Because high phytoplankton C:N and C:P ratios are disadvantageous to zooplankton growth, zooplankton would consume prey with preferred C:N:P ratio. In addition to stoichiometry, body size determines metabolic rates, and predator-prey mass ratio (PPMR, body size ratio of predator and its prey) determines food chain length in aquatic systems. Through lab-manipulated incubation experiments, stoichiometry and body size are found potential traits that influence trophic transfer efficiency and prey selection; however, evidence from *in situ* observations in natural aquatic food webs remains elusive. Furthermore, the interactions between body size and stoichiometry are rarely studied. Here, I examined (1) how prey stoichiometry (C:N:P ratio) influences zooplankton production, (2) how body size determines plankton stoichiometry, and (3) how nutrient and prey stoichiometry alter community PPMR in plankton grazing food webs, by *in situ* observations and theoretical modeling. I found that prey (phytoplankton) C:N and C:P ratios are indeed negatively correlated with zooplankton production in subtropical marine systems, indicating that N and P are essential to zooplankton. In both subtropical marine and freshwater grazing food webs, I found a unimodal C:N ratio pattern with respect to plankton body size: C:N ratio increases and reaches the maximum at 50 μm autotrophs, and then decreases with body size in heterotrophs. This pattern is explained by the accumulation of C through allometric resource affinity and respiratory C loss in my size-based food web model. The decreasing of C:N ratio with body size and heterotrophy suggests that predators prefer large prey and thus decrease PPMR when large size prey are sufficient; my field observations based on stable isotope analysis reveal that PPMR is smaller when nutrient supply is higher and supports more large prey. My research combining *in situ* observations and theoretical modeling point out that prey stoichiometry and size affect zooplankton production and modifies predation, indicating the important role of stoichiometry and allometry in trophic transfer efficiency in nature.