Zooplankton Biodiversity Is Enhanced by eDNA

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Abstract

The microscopic plankton community is an understudied, yet vital component of pelagic food webs. Much of the summertime zooplankton community consists of indirect developing larvae that feed on other plankton and are dispersed by currents. When the zooplankton community is included in biodiversity estimates of marine invertebrates through direct sequencing of unique larval morphotypes, biodiversity and species richness is greatly increased. However, direct sequencing and identification of individual zooplankton is a time-consuming and labor-intensive process. This is unsustainable if we want to understand Earth's biodiversity before climate change fully alters ecosystems. We used a new tool for biodiversity sampling, environmental DNA (eDNA) with metabarcoding, in comparison with manually picking and direct sequencing unique zooplankton morphotypes. We sampled the zooplankton community at midday and at night just after midsummer in front of Friday Harbor Laboratories (FHL). Half our samples were sorted by a class of invertebrate zoologists for unique morphotypes, imaged and then directly sequenced for Cytochrome oxidase subunit one (COI). The other half of our samples (eDNA) were submitted for next generation sequencing of COI and metabarcode analysis. We found that metabarcoding is superior to traditional hand-picked, directly sequenced morphotypes, recovering 70% more OTUs than direct sequencing and a higher Shannon-Wiener index value. However, traditional methods also found 25 additional morphospecies not recovered by metabarcoding. Both methods are useful and important for accurate biodiversity documentation. eDNA metabarcoding is also useful monitoring changes in zooplankton; for example, we recovered 46 different species of annelids, only 21 of which we were able to assign to a scientific name, including two species of invasive polychaetes from Peter the Great Bay and the Sea of Japan. As databases of COI barcode sequences are added metabarcoding will be increasingly useful for monitoring zooplankton communities during climate change and for the detection of invasive species.