The Oceans Represent a Vast Reservoir of Unexplored Genetic Diversity

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The oceans are major drivers of global biogeochemical cycles. For example, the oceans produce and consume about half of the oxygen on the Earth. These biogeochemical processes are almost entirely driven by microbes. By weight, the unicellular micro-organisms comprise >95% of the living material in the ocean. If viruses are also included, then nearly all of the biomass in the ocean is microbial. Numerically, the abundance of unicellular microbes ranges from about 500,000 to 5 million organisms per mL, while viruses are typically about 10-fold more abundant. To give you a perspective on how abundant these organisms are, if the viruses in the ocean were aligned end-to-end they would stretch for ~10^7 light years, or far enough to stretch beyond the nearest 60 galaxies (Suttle 2005). Consequently, almost all of the genetic diversity and genetic resources in the ocean lie within the microbial components. Despite their overwhelming dominance of marine systems by microbes, they remain relative unknown in with respect to their genetic diversity. For example, the majority of genes in viruses isolated from the sea have no recognizable similarity to other genes that have been sequenced(Paul & Sullivan 2005). Similarly, the vast majority of putative genes in the marine virosphere have no recognizable similarity to other genetic sequences (Breitbart et al. 2002). Given that all of these putative genes likely code for proteins of unknown function, the potential genetic resources in the marine virome is enormous. Despite their enormous diversity, sequence analysis demonstrates that the distribution of virus genotypes varies among locations(Angly et al. 2006). Therefore the composition of a microbial community in one marine environment is likely to be very different from one found in another environment. Given the very poor understanding of the composition of microbial communities and the factors that control their distribution, there is no knowledge of their vulnerability to environmental changes, or their potential role in changing climate. Defining the genetic richness and potential of marine genetic resources will require a considerably enhanced research effort.

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