

OCEANS AND HUMAN HEALTH, AND HUMANS AND OCEAN HEALTH - RISKS AND REMEDIES FROM THE SEA

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Life on earth is fundamentally and inextricably linked to the oceans. Oceanic processes affect climate and determine the food and material resource upon which we depend. How we use the sea can influence those processes to our benefit or detriment. The demands of populations, especially in coastal regions worldwide, may aggravate human influences on the oceans, and increase risks to public health. Understanding the processes and predicting or mitigating the risks, as well as identifying new resources and benefits, requires an integrated approach combining disciplines as disparate as physical oceanography, chemistry, genomics, and epidemiology.

The need for such understanding, prediction and resource discovery as described above led to focused research programs in the US including the novel joint effort between the US National Science Foundation (NSF) and the National Institute of Environmental Health Sciences (NIEHS), which established four Centers for Oceans and Human Health (COHH), and a complementary Oceans and Human Health Initiative (OHHI) by the National Oceanic and Atmospheric Administration. These programs are addressing fundamental biological questions of harmful algal blooms (HAB) and pathogenic organisms in coastal waters, genomic and biological factors determining their abundance, toxicity and pathogenicity, and the hydrodynamic influences on abundance and distribution. The programs have had great success, for example in applying biological advances to forecast blooms of *Alexandrium* red tides, identifying new *Vibrio* pathogens, achieving deep sequencing of microbial communities, establishing sources of pathogens in recreational waters and beaches, development of remote sensing, assessing economic consequences of HAB and pathogen events, and public health benefits deriving from coastal regions. OHH programs also established human pathogen prevalence in marine biota, identified novel therapeutic agents from marine microbes, and are focusing new efforts to understand the significance of cyanobacterial toxins. The Centers established a new Gordon Conference supporting the development of this new integrative field.

The concerns in OHH will not diminish, and meeting the growing challenges will require progress in interconnected areas. Addressing major issues and meeting the growing challenges will depend on: advances in identifying pathogens and other harmful agents (more accurate sensing); advances in technology for sensors (more accurate detection and timely warning); advances in knowledge of chemical toxicant action and dose-response in humans, and identifying the vectors and pathways of microbes and chemicals to humans; advances in epidemiological studies in OHH; advances in screening for novel biologically active agents; advances in policies and practices that encourage health benefits from the sea; advances in applying understanding and technology to address problems in less developed regions, where sometimes problems are much more severe. Based on current indications, frequent communication and collaboration among the leadership and investigators of different Centers will be a significant driver of progress. The ultimate goal of wise use of the oceans, protecting and properly exploiting resources, and serving the public health, requires cooperation, among scientists, agencies, and governments. (Support by: US NIEHS P50 ES012742 and NSF OCE-043072).