Concept Clearance

Branch: Genes Environment and Health Branch

Council Period: 201605

Concept Title: Centers for Oceans and Human Health 3: Climate Change Impacts (COHH3)

Introduction

Human populations have been and will continue to be extremely dependent on the ocean and other water bodies for work, food, travel and recreation. Many aspects of health maintenance are associated with proximity to oceans/water bodies. Oceans occupy greater than 70% of the planet's surface and 60 % of the human population lives within 75 miles of coastal waterways or ocean coasts. Thirteen out of 15 of the world's largest cities lay on or near coasts. The largest source of protein in the world is fish and more fish are harvested throughout the world than cattle, sheep, poultry or eggs. Billions of dollars are turned over annually from fishing and other commercial ventures, which include travel and recreational use of coastal waterways.

The proximity of many human activities to oceans and water bodies, together with the prevalent use of marine and freshwater-derived foods and other products, creates widespread human exposure to several point and non-point sources of chemical pollutants and toxicants draining into the oceans and coastal waterways daily. Over 2.8 billion tons of industrial waste are being released into the oceans annually by the US alone. This marine pollution causes significant damage to marine ecology and has multiple potential negative impacts on human health. For example, the known beneficial effects of fish consumption are reduced when fish are contaminated with heavy metals from industrial pollution.

There is growing recognition that the oceans are a sustaining, re-invigorating resource that demands proper stewardship because our well-being and health outcomes are at risk. Increasing marine and lacustrine temperatures associated with global climate change introduce additional variables that may further escalate human health risks associated with water bodies. These risks may be associated with: changes in the seasonal windows of growth and the habitat range for freshwater and marine toxin-producing algae; increases in the frequency and intensity of severe weather events; rises in sea level and increased flooding in proximity to rivers and lakes; alterations in the patterns or magnitude of chemical contamination of seafood; the failure of water infrastructure; and altered winds and currents.

Lacustrine systems are equally affected by human activities. The Great Lakes, for example, form the largest surface freshwater system on Earth and over 30,000,000 people live in the Great Lakes Basin. Shared with Canada and spanning more than 750 miles (1,200 kilometers) from west to east, these vast inland freshwater seas provide water for consumption, transportation, power, recreation and a host of other uses. Excessive nutrient loading, agricultural and stormwater runoff, industrial pollution, and wildlife waste all degrade water quality. Bacteria and other pathogens can threaten both human health and the integrity of the Great Lakes ecosystem. Climate change is adding additional levels of stress to the Great Lakes system. Included in the consequences of climate change are increased surface and subsurface water temperatures, declining water volumes due to decreased winter ice cover allowing more evaporation, and increased frequency of intense storm events (altering the timing of inflows). Warmer water temperatures may be conducive to changing internal water cycling in the Great Lakes with longer summer stratification potentially leading to larger dead zones (lacking in oxygen). Other potential consequences include reduction in habitats for coldwater fish, more suitable temperatures for hazardous algal blooms, with increased mobilization of contaminated sediments as well as nutrients and toxic chemicals from urban and agricultural runoff.

As previously noted, the existing environmental exposure health risks associated with marine and freshwater aquatic environments are being exacerbated in ways that are currently under-investigated. Additionally, there are segments of these populations that will be even more vulnerable to the current and emerging aquatic environmental health risks amplified and intensified by the increasing temperatures associated with climate change. The most vulnerable populations will include those people with the least capacity to withstand these environmental stressors and include the elderly, children, women of childbearing age, and people in low SES income brackets with existing health disparities. Populations at highest risk would also include people who have occupational exposures (i.e., subsistence fishermen) and those who have cultural practices that are dependent on oceans/Great Lakes such as Native Americans. Community engagement cores or research projects will be encouraged to focus on addressing relevant aspects of the center's science in an inclusive manner to address the segments of the population deemed most vulnerable. This aspect of community engagement in the COHH3 program is consistent with other multi-component programs supported by NIEHS as well as being compatible with the NSF's Broader Impacts. Broader Impacts refers to benefits above and beyond the achievement of the actual scientific research objectives themselves; educational impacts and outreach to the public and commercial/industrial sectors fall in here.

The NIEHS has successfully collaborated with the National Science Foundation, (NSF) for more than a decade beginning with

the 2002 release of the initial Funding Opportunity Announcement (FOA) soliciting applications for Centers for Oceans and Human Health, ES-03-003. This collaboration for the first time brought together multiple investigators from a broad array of diverse disciplines, amalgamating the expertise/skills of basic and clinical biomedical scientists with physical, chemical, and biological oceanographic scientists. The program has been extremely productive, producing close to 500 publications in that time, while developing a new field of science with this unique meld.

Research Goals and Scope

The NIEHS and NSF are pursuing support for an additional round of collaborative funding of Oceans and Human Health through the Centers for Oceans and Human Health 3 (COHH3). The purpose of the COHH3 program is to provide linkages between marine scientists and biomedical investigators in order to support interdisciplinary research in areas where improved understanding of marine/lacustrine processes and systems has potential to reduce public health risks and enhance existing biomedical capabilities. A new focus of this multi-disciplinary research program would be on how climate change is projected to increase risk to human health as a consequence of: rising sea levels; ocean acidification; increasing frequency and intensity of severe weather events; failed or compromised infrastructure; changing hydrology; warmer ocean temperatures, decreased water volume in the Great Lakes Basin; increased duration of toxic bloom events, leading to longer windows of opportunity for exposures to HAB toxins, as well as altered patterns of sediment distribution.

Each Center will support at least three meritorious research projects with a conceptual theme focusing on oceans or the Great Lakes basin and human health. Research projects must be interdisciplinary and address one or more of the identified special emphasis areas including but not limited to: HABs; point-non/point pollution; sediment distribution; various aspects of seafood safety; and/or statistics/bioinformatics; and must be done in the context of climate change. Research needs pertaining to climate change include: evaluating and monitoring exposures and health risks of chemical contaminants likely to be increasingly released and mobilized due to climate change; improving understanding of harmful algal blooms including their initiation, development, and termination, as well as the exact nature of the toxins associated with them; understanding how toxins, pathogens, and chemicals in land-based runoff and water overflow interact synergistically and with marine species, especially those important for human consumption, and the potential health risks of changing water quality and the disproportionate impact on the most vulnerable segments of the population. Moreover, Centers that are collaboratively supported by the NSF and the NIEHS will require a stakeholder engagement component which may include the active participation by members of affected communities, local and state public health agencies and or caregivers.

COHH3 programs are expected to create an environment conducive to interdisciplinary and reciprocally beneficial collaborations among: biomedical scientists (e.g., epidemiologists, pharmacologists, toxicologists, microbiologists, cell and molecular biologists); marine/lacustrine scientists (e.g., biological and physical oceanographers, limnologists, hydrologists, geochemists, and ecologists); investigators with documented expertise in climate change (e.g., climate scientist); and population health (e.g. social scientists, communication researchers, health care providers) with the common goal of improving our knowledge of the impacts of the oceans and Great Lakes on human health.

Mechanism and Justification

The COHH3 program represents the continuation of a productive partnership to support multi-disciplinary research and projects with an evolving format and research scope developed to address emerging marine and lacustrine environmental health risks and challenges. The program will require emphasis on consideration of how climate change may increase and exacerbate marine and lacustrine environmental health challenges. The COHH3 will also require a component that incorporates community engagement approaches, either in the form of a research project or a community engagement Core.

Meeting the objectives of the COHH3 Program will require a mechanism that utilizes an integrated, coordinated thematic multi-project format, that can also support an administrative core and other cores as necessary. A Program Project Grant (P01) is an assistance award for the support of a broadly based multidisciplinary research program that has a well-defined central research focus or objective. It may also include support for common supporting resources (cores) required for the conduct of the component research projects. Thus, the P01 mechanism is well suited to support the goals of COHH3. NIEHS intends to commit $3m per year and the NSF expects to commit $4m per year to support 4-6 Program Projects (P01). The maximum allowable direct costs for each COHH3 P01 award may not exceed $1m per year and can be funded for up to five years.

The COHH3 is only one component of the NIEHS portfolio of research related to the general study of marine/Great Lakes processes and human health. Independent of the collaboration with the NSF, our current portfolio includes studies of the health effects of toxins derived from harmful algal blooms (HABs) and contaminated seafood consumption.

NIEHS recognizes that multi-component program project (P01) approaches are not always requisite to address some of the issues related to climate change and its impacts on marine and lacustrine processes that will adversely impact human health outcomes. Fittingly, this concept clearance also advocates for a separate Program Announcement with a special Review (PAR) to solicit R01 research activities that are relevant to the OHH and Great Lakes Program. The PAR will have similar research objectives but will not require the same multi-disciplinary approaches or community engagement component as the FOA soliciting P01 applications. The use of an ongoing PAR will help grow the community of investigators addressing OHH issues and ensure use of a diversity of approaches. To help build awareness and identify potential future collaborations, NIEHS investigators who receive support through the OHH PAR and whose research aligns with COHH3 studies can be invited to participate in COHH3 grantee meetings.

COHH3 Committee: NIEHS DERT (Fred Tyson, Caroline Dilworth, Symma Finn) NSF(Don Rice, Heather Edmonds, Eric Itsweire, Michael Sieracki)