Summary Title Page

Project title: ECOHAB - Interannual variability of PSP toxicity in eastern Maine: testing the leaky gyre hypothesis and improving regional forecasts and management

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Requested funding amounts:

Woods Hole Oceanographic Institution

Year	With ship funding	Without ship funding
1 (9/1/15-8/31/16)	$181,243	$181,243
2 (9/1/16-8/31/17)	$430,462	$304,112
3 (9/1/17-8/31/18)	$120,112	$120,112
Total	$731,817	$605,467

North Carolina State University

Year	With ship funding	Without ship funding
1 (9/1/15-8/31/16)	$44,046	$44,046
2 (9/1/16-8/31/17)	$46,011	$46,011
3 (9/1/17-8/31/18)	$48,004	$48,004
Total	$138,061	$138,061

University of Maine

Year	With ship funding	Without ship funding
1 (9/1/15-8/31/16)	$9,902	$9,902
2 (9/1/16-8/31/17)	$10,272	$10,272
3 (9/1/17-8/31/18)	$9,946	$9,946
Total	$30,120	$30,120

Total

Year	With ship funding	Without ship funding
1 (9/1/15-8/31/16)	$235,191	$235,191
2 (9/1/16-8/31/17)	$486,745	$360,395
3 (9/1/17-8/31/18)	$178,062	$178,062
Total	$899,998	$773,648

Project Summary

The Gulf of Maine (GOM) is a large continental shelf sea with extensive shellfish resources that are annually impacted by *Alexandrium fundyense* blooms and outbreaks of paralytic shellfish poisoning (PSP), leading to significant social and economic impacts every year, often totaling tens of millions of dollars in losses and sometimes more. Toxicity occurs in three main regions of the Gulf (the eastern and western Gulf of Maine (EGOM and WGOM), and Georges Bank) that are interconnected, but that can also behave independently due to largescale oceanographic forcings. These areas have been the subject of past NOAA-funded investigations that have been highly productive in terms of scientific advances, publications, and management tools, but EGOM toxicity remains poorly understood, despite the serious nature of the PSP problem in that region and its hydrographic connections to the west. One major development from prior research programs is an *A. fundyense* population dynamics model that has been used to produce near-real-time weekly nowcasts and forecasts, and seasonal forecasts. That model is being transitioned for operational use by NOAA. Model skill is strongest in the WGOM where *A. fundyense* cyst abundance in a "seedbed" or accumulation zone off mid-coast Maine has proven to be a primary driver of interannual PSP variability. Skill is weakest in the EGOM because the mechanisms responsible for interannual variability are not thought to relate to cyst abundances in that subregion, which are very low, but instead to the advection of established vegetative *A. fundyense* populations that originate in the Bay of Fundy (BOF) where there is a major cyst seedbed and a gyre that can be retentive for *A. fundyense* cells. We hypothesize that interannual variations in EGOM toxicity are controlled by these upstream populations, for which there are two key sources of variability: (1) growing conditions, and (2) hydrodynamic leakiness of the BOF gyre. Neither of these aspects is adequately represented in existing models. We therefore propose to investigate linkages between BOF *A. fundyense* populations and PSP toxicity in the nearshore and offshore waters of the EGOM, to characterize the physical mechanisms that control that export, and to use this

information to improve regional HAB management, modeling, and forecasting. Recognizing that high-frequency *in situ* observations of *A. fundyense* concentrations in the two exit pathways from the BOF (either side of Grand Manan Island) are needed to capture the episodic nature of the export process, we will utilize a network of novel biosensors called Environmental Sample Processors (ESPs) to obtain data that would not be feasible with ship-based surveys. Daily autonomous measurements at multiple locations will be augmented by satellite-tracked surface drifters released within the gyre, and by three targeted survey cruises to provide spatial context for the ESP observations. Measurements of nutrients and water column structure from NERACOOS ocean-observing buoys will also be obtained. All of this information will be incorporated into our existing regional *Alexandrium* model and hindcast simulations run to identify mechanisms underlying patterns in EGOM shellfish toxicity. The project team has extensive experience in all aspects of the proposed work, and has strong ties to managers and other stakeholders in the region. Furthermore, the project leverages a huge amount of ongoing activities and equipment –ESPs, mooring hardware, and contextual sensors that are owned by the PI, ship time, deployment and operational costs for a full field season, as well as ship of opportunity survey cruises and nearly a dozen soon-to-be-deployed nutrient sensors supported by the IOOS program – all at no cost to the program. This proposal is an important and timely opportunity to advance novel HAB biosensor technology while addressing a critical scientific question underlying regional toxicity in a highly productive and important shellfishing region. This effort is also directly responsive to the priorities of the ECOHAB program and of the NOAA Next Generation Strategic Plan.