UNIVERSITY OF ALASKA FAIRBANKS

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To the EVOS Trustee Council Members,

I am a physical oceanographer and a faculty member of the University of Alaska's School of Fisheries and Ocean Sciences. My oceanographic research career spans nearly 30 years. Most of my research has been in the Gulf of Alaska and the Bering, Chukchi, Beaufort seas. My work has focused on understanding the causes of variations in the physical environment (currents, temperature and salinity distributions) and how this variability affects these marine ecosystems. As such my research entails collaborations with other marine scientists, including fisheries and marine mammal biologists. Throughout my career I have provided information relevant to state and federal resource management agencies as well as industrial, commercial, and subsistence users of the marine environment. Based upon my background I advocate using the remaining restoration funds to support long-term monitoring of the Gulf of Alaska marine ecosystems for the following reasons.

I begin by noting that the broad scale circulation over the Gulf of Alaska continental shelf and slope flows northward from the mid-latitude North Pacific Ocean and the shelves of the Pacific Northwest. This flow transports heat, dissolved and suspended materials, including nutrients and organisms, into the Gulf of Alaska. While in transit, these waters are enormously modified by both physical and biogeochemical processes. The aggregate effects of the transport and the modification processes establish the marine ecological habitats and control biological production on this shelf and slope and its adjacent bays. Moreover, Gulf waters eventually enter the Bering Sea to significantly influence this marine ecosystem and they ultimately flow northward into the Chukchi Sea and the Arctic Ocean through Bering Strait. I thus view Alaska's marine ecosystems as a continuum whereby the general circulation provides the linkage between subsystems. Individually, these ecosystems serve Alaskans in diverse and important ways; hence it is critical to understand how conditions in each vary and how these variations are transmitted along this continuum. Long-term monitoring provides the framework for this understanding.

Second, ecosystem-based resource management relies on three inter-related elements: research, modeling, and monitoring. Long-term monitoring provides the data sets essential for guiding model development and evaluations and these data sets can suggest new research directions and/or provide the background information essential for shorter-term, process-oriented research.

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Third, marine ecosystem processes are complex, poorly understood, and highly-variable. Patterns and connections among ecosystem components can only emerge through patient, dedicated, and high-quality sampling.

Fourth, a considerable body of information and understanding has been obtained for this region within the past 15 years. These measurements include physical and nutrient data sets, information on the space-time distribution, abundance, production of phytoplankton and zooplankton communities, as well as several fish, marine mammal, and seabird communities. Some data sets from the northern Gulf are 40 years in length and thus provide a long-term perspective for understanding and quantifying change. All of these data sets are shared and thus continue to be used by various scientists and students in ecosystem studies.

Fifth, the long-term data are leading to new insights on how this ecosystem operates and how it may be altered due to natural or anthropogenic changes. These insights include a better understanding of the causes of ocean temperature variability over the *entire* water column, the unique role that coastal freshwater discharge plays in affecting ocean temperatures and biological production through changes in stratification and the delivery and dispersal of key phytoplankton nutrients such as nitrate and iron, a developing relationship between zooplankton abundance and community composition and juvenile salmon recruitment, and new insights on sea lion behavior, energetics, and reproductive potential. I emphasize that these findings were possible only because long-term data were available.

Sixth, the infrastructure for monitoring is largely in place. Hence the funds can be efficiently applied to maintaining and expanding the existing suite of measurements, rather than constructing anew the considerable infrastructure needed to begin such an effort.

Seventh, there are new concerns on the horizon. These include ocean acidification, which may directly affect the exoskeletons of a variety of plankton that are either prey for, or larval components of, the fish community. Moreover, recent findings indicate that the iron-mediated uptake of nitrate by phytoplankton may be inhibited by acidification, which could alter production at the bottom of the food chain. Finally, climate-warming scenarios for the future suggest that the hydrologic cycle in the Gulf will change thus altering the phasing and volume of coastal freshwater discharge. This in turn will affect the timing of phytoplankton blooms, the thermal structure of the water column, and the availability of nutrients. Such changes are likely to propagate up the food chain and may lead to changes in the abundance, composition, and economic value of fish stocks.

I conclude by noting that EVOSTC support was critical in developing some of the insights obtained on the functioning of the Gulf of Alaska ecosystem. Long-term monitoring provides the framework upon which changes can be quantified, understood, and ultimately predicted. It can thus provide a tool for making economic and resource management decisions. A wise and lasting legacy of the

Council would be to create an endowment with the remaining funds so that long-term ecosystem monitoring on this shelf can continue.

Sincerely,

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