Currently, the two principal methods for responding to a maritime oil spill are the use of floating barrier booms to encircle and contract the spill, so that it may be removed by mechanical skimming or in-situ burning, and the aerial spraying of surfactants onto the spill to cause the oil slick to emulsify into small droplets that are carried away from the site or are broken down by microbes. Taken together they are an inadequate toolbox: Booms are difficult to deploy, and dispersants do not really remove the oil from the marine biota, and the effect of currently utilized dispersants on marine life is under dispute.

The object of this proposal is to develop eco-friendly chemical herders for removing maritime oil spills. In this method, surfactant is aerially sprayed around the spill, to lower the large surface tension of the air/sea surface uncontaminated by the oil. The reduction in the surface tension causes the floating oil layer to retract and thicken to the point where it can be ignited, and the spill burned away. The most effective surfactant herders that have emerged from laboratory and field testing are siloxane polymers, which do not easily or rapidly degrade in the marine environment and are ineffective in rough seas where wave action can disintegrate the herding monolayer.

The overall goal of this proposal is to develop a new class of effective surfactant herders which are molecularly designed to be eco-friendly and to be effective even on rough sea surfaces. Our central idea is to design the herder as a mixture consisting of two surfactant components: The first is a glycolipid/oligosaccharide surfactant, which, because of its sugar moiety can complex with polysaccharides in the sea surface to form a monolayer with high surface dilatational viscosity. High surface viscosities dampen surface waves. The second is a surfactant with isoprenoid (i.e. branched) aliphatic chains (e.g. phytanic acid) which intercalate into surfactant monolayers through their branched structure to achieve the significant tension reduction necessary for herding.

We report measurements of the surface pressure isotherms and dilatational viscosities of monolayers of a glycolipid (MGDG), phytanic acid and their mixtures on the surface of pure water and artificial seawater with natural polysaccharides. In addition AFM images of Langmuir-Blodgett films of the monolayers are obtained to understand the molecular structure. From these results we identify mixtures suitable for effectively herding maritime oil spills in rough seas.