**ABSTRACT FORM** (for new projects only)

**Project Title: 901400 LRAUV – Coordinated Observations of Marine Organisms and Ocean Features**

| PI | Project Manager | Lead Scientist | Lead Engineer |
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*(Indicate individuals appropriate for your project. Not all projects need all four positions filled in.)*

**Project Description:**

This three year project will exploit and augment the LRAUV platforms to observe the evolution of defined concentrations of marine organisms or ocean features. As with prior LRAUV projects, these will be carried out in the context of the CANON program. Early in the project we will complete construction of the 3G ESP LRAUV for the Scholin laboratory. We expect to support the integration of the ESP system and field operations. A major focus will be cooperative operations, for example using the existing LRAUVs to map in the vicinity of the ESP vehicle. The resulting observational capability will provide MBARI an unparalleled capability to observe marine microbial communities as they evolve and interact with each other and their environment.

To realize the vision of an observational system capable of autonomously following and characterizing marine microbial communities or other ocean features, we will have to overcome a number of challenges. These include:

- Quantifying the performance of our ability to track organism aggregations (this is a problem for the entire CANON team, but LRAUV will play a key role).
- Developing cooperative strategies, where the vehicles interact with each other rather than being coordinated through a shore operator.
- Using the Wave Glider promises to both provide a communications/navigation gateway to submerged assets.
- Improving sensors for characterizing microbial communities and the organisms that consume them.
- Augmenting chemical sensors (e.g. adding pH).

This project builds on the 2011-2013 effort, "LR AUV: Transition to Operations." That effort promised to build a second Tethys platform and transition the vehicles to routine operations in the context of CANON science operations. While the initial two vehicle operations were extremely demanding, we have now accumulated more than 5000 hrs of cumulative operational time, and recently completed a 150 hr mission without any need for operator intervention. A brief selection of field accomplishments include:

- Several field programs used both LRAUVs for coordinated sampling (CANON, ECOHAB and NSF funded Benthic Mixing programs).
- Autonomous observations of the dynamics of upwelling fronts has been accomplished in both one and two dimensions.
- Extended observations circling around an offshore drifting ESP have been carried out to map the immediate vicinity of the drifter.
- Rendezvous with a surface platform (the first step towards docking) has been demonstrated using a Wave Glider as the target.

In addition, increasingly sophisticated payloads have been integrated on the vehicles. These include a turbulence packaged developed by collaborator Tim Stanton for the Benthic Mixing activity. The rendezvous activity was enabled by the integration of a USBL/Acoustic Communications system (funded by the DARPA Power Buoy project). Less visible, but equally essential for the long term success of the vehicle, are improvements that have been made to the operator interface and mission scripting routines that make it easier to run the vehicles.

In summary, the current project has positioned us well to carry the Lagrangian observation system postulated by the CANON program to the next level. We can now conduct multi-vehicle operations for up to three weeks continuous deployment. We have demonstrated coordinated operations. We have demonstrated the key sensing and communications capabilities to enable cooperative operations (e.g. where the vehicles coordinate with each other without being mediated by the shore operator). Our shore-side operational tools and increased vehicle reliability are reducing operator load and allowing more sophisticated missions such as frontal tracking. Experimentation using the Wave Glider to tow the LRAUV later this year may further extend LRAUV ability to operate offshore. Thus while the goals of the proposed effort are ambitious, we believe we are well positioned to deliver.

This effort addresses the Strategic Plan in that it constitutes an innovative technology for observing the ocean specifically tailored to address topics in the third theme (Ecosystem Dynamics). The scientific relevance of the LRAUV will initially be through the CANON initiative, which will use the LRAUV as a key adaptive observational element for quantitative biological process experiments.