John Pringle, Stanford University, USA

Title: A Model System for Studies of Dinoflagellate-Cnidarian Symbiosis

Abstract: The enormous importance of coral reefs is widely recognized, as is the unfortunate fact that corals throughout the world are greatly threatened by a variety of anthropogenic stresses. These stresses can lead to a loss of the intracellular algal symbionts whose photosynthesis provides the bulk of the corals' nutrition, resulting in subsequent coral death. Thus, there has been much recent attention to corals and their problems from marine and conservation biologists. Missing, however, has been a commensurate attention to the molecular and cellular mechanisms that underlie coral growth and the interactions between the animal hosts and their symbiotic algae (dinoflagellate genus Symbiodinium). The lack of such basic information is a serious impediment to understanding and addressing the ecological and conservation issues.

Major obstacles to improved understanding of basic coral molecular and cell biology have been the intrinsic difficulties of studies under field conditions and the intractability for laboratory investigation of organisms that form large colonies (although individual polyps are typically small) and are encased in rock, slow-growing, picky about their environment, genetically heterogeneous (to an unknown extent), and incapable of surviving long without their symbionts. Most of the enormous progress of the past 50 years in elucidating the basic mechanisms of eukaryotic molecular and cell biology has come from intensive studies of a small number of "model organisms" that were chosen not for any particular ecological or economic importance but because they have properties that facilitate laboratory investigation. It seems certain that this will also be true for corals, Symbiodinium, and their interactions.

The small sea anemone Aiptasia sp. offers an outstanding opportunity to develop the needed model system. Aiptasia contains Symbiodinium types similar or identical to those found in corals, has a convenient range of polyp sizes (~1.5-40 mm), is noncalcifying (and thus easily observed microscopically, squashed, or homogenized), grows rapidly (mass-doubling times of 1-2 weeks), is tolerant of widely varying environmental conditions, reproduces asexually by "pedal laceration", and can survive indefinitely in the absence of Symbiodinium. We are engaged in a systematic effort to develop this model system. For example, we have generated large clonal populations of Aiptasia and clonal, axenic strains of both compatible and incompatible Symbiodinium; improved methods for precise counting of algal numbers; completed a transcriptome assembly for aposymbiotic animals and begun such analyses for both cultured Symbiodinium and symbiotic Aiptasia; begun analysis of the Aiptasia genome sequence; and taken a major step toward developing Aiptasia genetics by identifying conditions that induce spawning and larva production in the laboratory.

I will summarize these efforts in model-system development and some of the specific biological questions that we are investigating using this system.