UNIVERSITY OF CALIFORNIA, SAN DIEGO

Planktonic Patterns and Processes in the Giant Kelp *Macrocystis pyrifera*

A dissertation submitted in partial satisfaction for the degree

Doctor of Philosophy in Oceanography

by

Michael Hall Graham

Committee in charge:

Paul K. Dayton, Chair
Nicholas D. Holland
Lisa A. Levin
B. Greg Mitchell
Brad Werner
Chris Wills
Richard K. Zimmer

2000

ABSTRACT OF THE DISSERTATION

Planktonic Patterns and Processes in the Giant Kelp *Macrocystis pyrifera*

by

Michael H. Graham

Doctor of Philosophy in Oceanography

University of California, San Diego, 2000

Professor Paul K. Dayton, Chair

Propagule supply is fundamental in regulating the strength of demographic and genetic interactions in natural populations. In marine systems, recent studies focusing on benthic fish and invertebrate species with long planktonic durations have found that propagule production and supply are de-coupled by physical transport processes. Most benthic marine populations therefore have been considered demographically open, whereby recruitment is driven by remote propagule production. Few studies have focused on species with shorter planktonic durations (e. g. seaweeds). I developed techniques for *in situ* sampling and identification of kelp zoospores and used them to study coupling between giant kelp (*Macrocystis pyrifera)* zoospore production and supply in the Point Loma kelp forest during 1999. The techniques were based on

instrumentation for (1) concentrating and isolating planktonic particles from sea water and (2) obtaining absorption spectra from individual kelp zoospores. Absorption spectra were found to be species-specific and useful for classifying individual zoospores among southern California kelp taxa. As such, giant kelp zoospores were quantified from sea water collected in the forest interior at intervals spanning minutes to months. Temporal variability in zoospore concentration was random and relatively constant at intervals < 24 hr, but highly structured at longer time scales with large fluctuations reflecting changes in adult reproductive condition. Reproductive biomass, fertility, and size-structure of adults found within 100 m^2 of the zoospore sampling location explained greater than 75% of temporal variability in zoospore supply. The tight coupling between zoospore production and supply was due to a lack of strong currents in the forest interior; drag of adult plants dampened flow keeping zoospores close to their release sites. Coupling was validated at two additional interior sites. Lower plant densities along the forest edges, however, resulted in rapid uni-directional flows likely transporting zoospores far from adults. Here, sampling indicated that zoospore supply was de-coupled from local zoospore production. These results therefore suggest that kelp populations are not simply open or closed, but that the extent of reproductive coupling likely exists along a continuum, due to the scale-dependent contribution of local versus remote propagule supply.

ACKNOWLEDGMENTS

Final technique development and all field research were funded entirely by a generous grant from the National Sea Grant College Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, under grant number NA66RG0477, project number R/CZ-141 through the California Sea Grant College System, and in part by the California State Resources Agency.