UNIVERSITY OF CALIFORNIA, SAN DIEGO

Marine Sponges and Symbionts:
Chemical and Biological Studies

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in Oceanography

by

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1999

ABSTRACT OF THE DISSERTATION

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This thesis concerns two quite different types of research that are separated into distinct sections of the thesis, but which seek to answer the same question using diametrically opposite approaches. The first part (Chapters 1-8) covers research leading to novel, bioactive compounds in marine sponges, while the second (Chapters 9-10) involves molecular biological studies of symbiosis between microbes and sponges. Although these topics seem at first glance completely separate, they are in reality intimately tied together through marine natural products chemistry. In some sponges, potential pharmaceuticals or compounds with interesting structures are produced by microbial symbionts, so a more detailed understanding of sponge-microbe symbiosis will lead to new compounds or a better source for new drugs. Conversely, a knowledge of chemistry, particularly biosynthesis and the distribution of compounds, can help in the understanding of sponge-microbe symbioses, leading to information which could never otherwise be obtained on microorganisms that are nearly impossible to culture.

Chapter 1 outlines chemical research and provides a review of structure elucidation methods. Chapters 2-6 contain reprints of previously published material, describing the isolation and structure elucidation of novel secondary metabolites from marine sponges. Although the first compounds are achiral, most of the work in the remaining chapters pertains to the elucidation of the stereochemistry of new compounds.

The chemistry chapters progress logically into the introduction to biological studies, culminating in the structural solution of a peptide previously isolated directly from symbiotic bacteria of the sponge *Theonella swinhoei* (Chapter 8). With this chemical lead-in, current knowledge of sponge-microbe symbioses is briefly reviewed along with an introductory rationale to my biological studies (Chapter 9). Details of a molecular-biological study of sponge-microbe symbiosis in sponges of the order Lithistida are presented in Chapter 10. It is demonstrated that the symbiotic, peptide-containing bacterium of *T. swinhoei* are new species of δ-subdivision Proteobacteria. Sequences of similar strains from closely related sponges and media used to attempt to culture the symbionts are reported. In conclusion, chemistry and molecular biology are shown to supplement each other in the understanding of sponge-microbe symbiosis in the order Lithistida.

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Funding for the research described in this dissertation was provided by the National Science Foundation, the National Institutes of Health, and the California Sea Grant (National Oceanographic and Atmospheric Administration NOAA NA36RG0537). I thank the Whole Earth Society (SIO) for funding a portion of my research, and the Scripps Graduate Department for supporting my attendance at a marine natural products conference. (R/MP-60)

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