THE ROLE OF EPIFAUNAL CRUSTACEANS ON *SARGASSUM* SPP. AT MAGNETIC ISLAND, GREAT BARRIER REEF, AUSTRALIA.

Thesis submitted by
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in January 1994

for the degree of Doctor of Philosophy in
the Department of Marine Biology at
James Cook University of North Queensland.

"Ecology is the science that seeks to understand the distribution and abundance of life on earth. It is both an environmental and an evolutionary science, since it works to discover the ways in which environmental resources are divided among individuals of different species. In this process species are forged and kept distinct, males are separated from females and numbers are so regulated that the common stay common and the rare stay rare." Paul A. Colinvaux,

"To see a World in a Grain of Sand,
And a Heaven in a Wild Flower,
Hold Infinity in the palm of your hand,
And Eternity in an hour."
Auguries of Innocence, William Blake

Frontispiece. An insect of the sea? A juvenile *Cymodoce* forages on a *Sargassum* frond.

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ABSTRACT

Generalisations about the community ecology of invertebrates associated with plant surfaces have been developed largely from studies on terrestrial insect-plant systems and by limited studies on temperate marine macroalgal systems. This study was designed to quantify the seasonal variation in populations of a tropical macroalga and its associated epifauna, to investigate the causal factors producing the phenological patterns and to relate these findings to the general area of plant-arthropod relationships. The system investigated was four sympatric species of the brown alga *Sargassum* and their mobile epifauna, living at Magnetic Island, Queensland, Australia (19°10'S, 146°50'E).

Over two annual cycles all species of *Sargassum* showed pronounced seasonality in size and reproduction but not in density; three of four species grew annual laterals from perennial axes in spring, reached maximum size in summer, reproduced and subsequently senesced, while the fourth species showed the opposite phenology. Epiphytic algae on the surface of *Sargassum* were primarily absent during the spring and summer periods of *Sargassum* growth but attained high abundance during the winter on the residual portions. Epifauna was diverse and abundant on all species of *Sargassum*, being dominated numerically by gammarid amphipods, sphaeromatid isopods, tanaids, errant polychaetes and gastropods. There were few significant differences between abundance of epifauna on different species of *Sargassum* and few or no representatives of the reef cryptofauna: this suggested that the epifauna was a distinct algal-associated community. All epifaunal taxa also showed distinct, repeated seasonal changes in abundance. Gammarid amphipods, sphaeromatid isopods, tanaids and polychaetes – together with many of the less abundant taxa – had abundance maxima in winter and minima in summer. Conversely, only one dominant taxon, gastropods, and two less abundant taxa had summer maxima and winter minima. At finer temporal scales, epifaunal abundance was consistent over a time scale of hours and days, and moderately variable over a scale of weeks. There were few significant day-night variations in abundance of epifauna.

Manipulative experiments were run to test hypotheses about factors influencing the abundance of epifauna. Recolonisation experiments showed that the populations of epifauna were extremely dynamic in space and time, equilibrial communities being re-established on defaunated plants in approximately two weeks. The influence of predation by fishes was examined with an eight-week exclusion experiment: no effect

of predation was detected although cage artifacts may have obscured abundance changes of small magnitude. The influence of habitat complexity and heterogeneity was examined using artificial plants with and without epiphytic algae: a very significant positive correlation was found between the abundance of epiphytic algae and the abundance of many taxa of epifauna. Analysis of the results at the community level revealed that communities became increasingly similar over the eight weeks of the experiment, as epiphytes accumulated on the originally epiphyte-free artificial plants. It is suggested, therefore, that the seasonal patterns of abundance of epifauna, both at the community and taxon level, are driven primarily by fluctuations in the abundance of epiphytic algae.

A detailed study of the sphaeromatid isopods was conducted to determine whether the above results and hypotheses were applicable at the species level, as opposed to the family or community level. Resolution of the seasonal pattern of abundance for the sphaeromatid family revealed that each of three common genera had distinct, unimodal phenologies: *Cerceis* and *Cymodoce* showed autumn maxima while *Neonaesa* had a winter maximum. Size-frequency distributions of all genera suggested that reproduction occurred continuously over extended periods of time and that adults emigrated from *Sargassum* upon reaching a certain size. For these isopods the *Sargassum* and epiphytes acted as a nursery habitat for juveniles, providing habitable space and a potential food source. A series of laboratory and field experiments with artificial substrata revealed that various aspects of habitat structure (size and colour) and habitat architecture (number, size and arrangement of habitable spaces) were important determinants of colonisation by *Cymodoce*. It is suggested that the observed patterns of abundance for sphaeromatid isopods on *Sargassum* were produced by the selective colonisation of epiphytes by juveniles in response to a complex set of habitat criteria.

Although complicated at a local scale, broad scale patterns in the *Sargassum*-epifauna system are similar to those in temperate macroalgal-epifauna interactions. *Sargassum* and its associated epifauna, in common with these other systems, appears to be a 'passive' system, wherein associations are facultative and unspecialised. This contrasts strongly with 'active' terrestrial systems where plants and arthropods commonly have highly specialised, often obligate relationships. Thus, paradigms developed from terrestrial systems about the role of factors such as habitat structure or secondary compounds will need to be revised before they can be applied to marine plant-arthropod interactions.

ACKNOWLEDGEMENTS

First and foremost my sincere apologies for anybody who I've forgotten: this work has benefited enormously from the input of so many people, I'm bound to leave somebody out. I will start by thanking all of the people who have generously donated time (and occasionally suffered seasickness) as volunteer field assistants at Magnetic Island – Lynda Axe, Steve Blake, Tim Cooper, Allen Chen, Jocelyn Davies, Phil Davies, Maria Eriksson, James Gilmour, Alison Green, Jo Goudie, Emma Hutchison, Micaela Hellström, Geoff Jones, Ester Koh, Anne Lee, Tim Lynch, Natalie Moltschaniwskyj, Jo Pitt, Guy Smith, Ben and Sarah Stobart, Ilona Stobutzki, Jeremy Taylor, Glenn Wilson and Julia Yeatman. For technical assistance at various stages thanks to Phil Osmond, Jon Morrison, Don Ross, Dr. Martin Jones at the GBRMPA Aquarium, Dr. Peter Arnold at the Museum of Tropical Queensland and Dr. Niel Bruce at the Queensland Museum. Thanks very much to Gnat for the statistical advice and Ali for the fish IDs (even if the world's greatest labrid expert isn't always right). Financial assistance was provided by a CFSP scholarship and a GBRMPA Augmentative Grant.

The ideas and publications from this work have been sharpened by the input of the Coral Discussion Group at James Cook University, especially the slicing red pen of Dr. Terry Hughes. I would especially like to thank my supervisors, Dr. Geoff Jones and Prof. Howard Choat for their immense support, creative input and financial assistance in completing this thesis.

To Phil, thanks for the cups of tea, ideas and abuse; the nursing building crowd for the fun times (and coffee grounds!) - you know who you are (but a special hi to Vicki and Ali); Ben, Allen, Karen, Craig, Jo and Kate for making the lab. (and "tea-room") the place to be. To the other PhDs of the "class of '94", good luck, we are the future (scary thought!). Thanks also to the support from my flatmates and

I owe an enormous debt of gratitude to Ben who has provided ideas, helped with field work, brought in pastries to the lab. and even kept me up all night counting coral larvae – go forth and vanquish the nibble-pibblies!!

To my parents and thanks for being there; I love you very much.

Finally, to who taught me about the important things in life: friendship always.

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DECLARATION

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Infromation derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

K.M. Martin-Smith

This day: 27·1·94